Evidence Review: Prevention of the Adverse Health Effects of the Health Care System

Population and Public Health
BC Ministry of Healthy Living and Sport
This paper is a review of the scientific evidence for this core program. Core program evidence reviews may draw from a number of sources, including scientific studies circulated in the academic literature, and observational or anecdotal reports recorded in community-based publications. By bringing together multiple forms of evidence, these reviews aim to provide a proven context through which public health workers can focus their local and provincial objectives. This document should be seen as a guide to understanding the scientific and community-based research, rather than as a formula for achieving success. The evidence presented for a core program will inform the health authorities in developing their priorities, but these priorities will be tailored by local context.

This Evidence Review should be read in conjunction with the accompanying Model Core Program Paper.

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Evidence Review accepted by:
Population and Public Health, Ministry of Healthy Living and Sport (February 2010)
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EXECUTIVE SUMMARY

Organizational/Management Strategies

A range of organizational and management best practices provide a foundation for enhancing patient safety and the quality of care. Experts highlight the importance of establishing a “culture of safety” founded on a model of proactive leadership and commitment to beliefs and values that continuously seek to minimize patient harm through adoption of well-established policies and procedures.

In addition, an organization-wide surveillance, risk assessment/risk management and quality improvement structure is necessary to seamlessly integrate information from multiple sources in order to drive system changes that reduce risks and enhance the quality of care.

- Data gathering is a key function: incident reporting systems have been well developed in many health facilities to identify and address errors and near-misses. Since research has shown that these systems significantly under-report incidents, a variety of information sources are required for effective risk identification (e.g., interviews with health professionals, medical record reviews, external audits, studies of claims and complaints, patient satisfaction surveys, etc.).

- Investigations of adverse events after they have occurred, as well as ongoing assessments to identify, prevent and/or mitigate potential risks, are key components in enhancing patient safety. A number of frameworks and processes have been developed by health organizations for this purpose. They include:
  - Identification of potential risks and latent faults.
  - Epidemiologic analysis.
  - Prioritization (considering the frequency and severity of harm or potential harm).
  - Identification of evidence-based strategies to reduce risks.
  - Testing strategies to determine effectiveness.
  - Implementation.
  - Monitoring and assessment of outcomes.

Additional management strategies that enhance patient and staff safety and quality improvement include accreditation and the use of standards and guidelines. These provide helpful tools and resources to address specific issues, renew the commitment of an organization, and integrate quality measures on an ongoing basis. Collaborative initiatives between health care managers and clinical leaders are an important catalyst to organizational change. Similarly, teamwork has been shown to have a profound impact on safety. A wide range of health promotion initiatives also support the development of safety across health care organizations.
Patient Safety Issues and Medical Errors:

Health Care Associated Infections

Nosocomial, or health care associated infections (also called hospital-acquired infections, or HAI s) are estimated to affect 1 in 9 hospital patients in Canada (CIHI, 2004). There has been an increase in the number and frequency of infections resistant to common antibiotics and this in turn has increased the complexity of managing and controlling the infections. Prevention and control requires long-term plans that include management commitment, clinical leadership, staff that are trained in infection control practices, evidence-based protocols, standards and practices, an environment that is designed and maintained for a high level of hygiene, as well as education, information and communication for both staff and patients.

Surveillance and monitoring systems that are linked to operational improvement processes are important for early identification of infections including reporting in a timely way to infection teams, and in the case of surgical site infections, to individual surgeons. A surveillance system that encompasses interpretation of results, identification of best practices and development of recommendations is an essential element in ensuring improvements.

Hand hygiene practices are a primary prevention measure to reduce infections; however, surveys show that compliance rates among health care staff are, on average, below 50%. Multi-component strategies are necessary and are most effective when they involve consistent and sustained initiatives. Factors which support compliance over time include: strong institutional commitment and support for hand-washing campaigns, involvement of health care workers in campaigns, and excellent communication between staff at all levels. Strategies were successful when alcohol-based hand hygiene products were located close to patients and were supported by education, staff feedback, reminders, promotional campaigns, positive opinion leaders and supportive policies. Educational initiatives that included written information, reminders and continuous feedback on performance were more effective than other forms of education.

Other key preventive practices shown to be essential in reducing transmission of infections include the use of personal protective equipment (i.e., gloves, gowns and facemasks), effective facility cleaning and disinfection, isolation of infected patients, and clear protocols for the reuse of medical devices. Sufficient infection control practitioners, staff education and training, and adequate staffing levels generally, are also associated with reduced outbreak levels.

Prevention of Medication Errors

An estimated 1 in 10 adults with a health problem report have received the wrong medication or dose. Research reveals that most of the medication errors in hospitals occur at the points of prescribing/transcribing or administering the medication. Contributing factors frequently relate to a lack of full information about the drug or the patient’s history, a heavy workload, long hours and insufficient staff, distractions, inappropriate procedures/protocols and inexperienced staff.

Strategies to prevent prescribing and transcribing errors in hospitals include the expanded use of clinical pharmacy consultation services. For example, when pharmacists participated in medical rounds in hospital, drug errors fell by as much as 78% (CIHI (2004). Researchers note that involvement of clinical pharmacists can be most effective in environments most prone to error, or where error is more likely to result in serious injury (e.g., ICU, paediatrics, neonatal ICUs,
oncology units, transplant units, geriatric units). Computerized Provider Order Entry (CPOE) systems have been found to be effective in reducing medication errors and preventing adverse drug events (ADEs), particularly when combined with computer-based Clinical Decision Support Systems (CDSS). Studies indicate that they may prevent anywhere from 28% to 95% of ADEs. The development and use of electronic medical records is an important element that supports effective CDSS.

Drug dispensing strategies to reduce error includes unit-dosing and the use of automatic dispensing devices. Prevention during the administration of drugs requires a range of initiatives including: clear procedures for all settings, double checking of medicines, bedside identity checking, and discussion with the patient. The use of Barcode-enabled Point of Care (BPOC) automated systems are also being increasingly utilized and it is reported that they have a major impact on reducing medication errors: one study found errors were reduced by 87% (Cambridge Consultants, 2005).

To overcome the risk of errors during transitions in care (46% of medication errors are estimated to occur during moves to other services, sectors, or when discharged), medication reconciliation is a key process that ensures an accurate, comprehensive current list of medications is available. Pharmacist involvement in this process and in the provision of “seamless care” is highlighted as an effective strategy.

Recommended strategies for reducing medication errors in residential care include: interdisciplinary case management, medication therapy management, practice feedback combined with benchmarking, educational outreach and academic detailing.

**Prevention of Falls**

Both the incidence of falls and severity of fall-related complications rise steadily after the age of 60; approximately 35% to 40% of community-dwelling, generally healthy older persons fall annually. Institutionalized elderly persons fall three times more often than elderly persons living in the community. In long-term care facilities, the incidence rate is 1.6 falls per bed annually; 10% to 25% of these falls result in serious injuries that require medical treatment.

The most important risk factors for falls include muscle weakness, a prior history of falls, difficulties with gait and balance, visual impairment, arthritis, functional limitations, depression and the use of psychotropic medications. Multiple risk factors dramatically increase the risk of falling.

The causes, issues and associated prevention strategies for falls are discussed in relation to three settings: acute care hospitals, residential care facilities, and home and community care. There is overall consensus among researchers that client/patient risk screening and risk assessment, combined with an individualized multifactorial falls prevention intervention strategy, is the most effective approach to reducing the number of falls in all settings. A range of interventions that have been studied (primarily for community-dwelling elderly people and long-term care services) have been found to be promising, or effective components for multifactorial prevention plans. These include:

- Medication review and modification especially for psychotropic medications, and particularly for clients/patients taking more than four medications.
Exercise focused on improving balance, strength, flexibility and endurance, especially in residential care and home care where programs are specific, progressive and sustained: they can be effective either alone or part of a multifactorial program.

Vitamin D and calcium supplementation to enhance bone and muscle strength (effective in some studies, although not all, among residents in long-term care homes).

Assessment and treatment of visual impairment.

Appropriate use of assistive walking devices.

Hip protectors to reduce the risk of hip fractures (they reduce hip fractures but do not reduce falls or injuries to other parts of the body) for clients/patients in residential care and acute care settings.

Environmental modifications such as: increased stability of furniture, non-slip flooring, improved lighting, reduced clutter, hold bars in bathrooms, etc., for all settings.

Staff training to support falls prevention initiatives in all settings.

Although few high quality research studies have been conducted on acute care hospital settings, additional components that have been used in hospitals where the number of falls has been reduced include: detection and treatment of medical conditions associated with falls such as delirium, cardiovascular illness, osteoporosis, and incontinence; physiotherapy and access to walking aides; special attention to toileting needs for patients with incontinence or urgency; and special measures to address altered mental states such as reorienting confused patients to their environment.

Additional home care interventions shown to be effective, or promising, include: home hazard assessment and modification; client education on fall factors; and the involvement of municipal governments in the design and maintenance of safe public environments.

Prevention of Pressure Ulcers

Pressure ulcers create significant physical and psychological burdens for patients, families and health care providers. Once established, they are expensive and difficult to treat. It is estimated that prevalence of pressure ulcers among patients in Canadian health care facilities is about 26% (average for all health care institutions). Risk factors are highest among those who are malnourished, debilitated, immobile, and those with severe acute illness or neurological deficits. Approximately 70% of all pressure ulcers occur in elders. The cost in Canada is estimated to be an average of about $25,000 per patient for three months of treatment in a long-term care facility.

Prevention of pressure ulcers is shared by physicians, nurses, enterostomal therapy nurses, physical and occupational therapists, nutritionists, pharmacists, as well as patients and their families. Key prevention strategies include:

- Organization-wide coordination based on an interdisciplinary team representing key departments and specialties.
- Patient risk assessment and individualized risk management care plans.
- Specialized pressure-reducing mattresses.
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- Training for staff members and family members on effective prevention and treatment.
- The use of information management and reporting systems to guide both individual and organizational planning and quality improvement.

Workplace Health and Safety
Organizational Strategies for Healthy Health Care Workplaces

Occupational injuries in the health care workplace create a considerable burden of illness and cost, including the costs of morbidity and disability, as well as increased pressure on remaining staff members. BC injury rates (reported to Worksafe BC) were 4.1 injuries per 100 FTEs in acute care in 2005, and 10 injuries per 100 FTEs in long-term care. Estimated rates specifically for direct care staff are: 37 per 100 care aides in long-term care (the highest injury rate per occupational group), 30.5 per 100 licensed practical nurses in acute care, and by 21.9 per 100 Registered Nurses in acute care. The most common injuries are: 49% musculoskeletal injuries; 14% slips and trips; and 9% resulting from violence.

Researchers suggest that changing work environments in health care have influenced the rate of occupational injuries, including factors such as increased job complexity, increases in the number and acuity of chronic patients combined with a trend towards cost containment and downsizing. These developments have often resulted in increased workload, longer working hours, higher patient-staff ratios, and changes in workplace structures.

There is growing recognition of the need to develop a more comprehensive approach that moves beyond individual workers’ health outcomes to examine the underlying workplace determinants. Many workplace health researchers and practitioners now use the term “health and productivity management” to integrate changes to work processes and work environments as well as the adoption of health promotion strategies into all corporate functions. Organizational strategies that support healthy health care workplaces include: developing an organizational culture and climate that is committed to quality care; demonstrating trust and respect for staff members; using a participative team approach; encouraging job autonomy and decision input; open communication; and supporting work-life balance. Healthy workplaces are strongly correlated to quality health services and reduced staff injuries and illness.

Musculoskeletal Injuries in the Workplace

Musculoskeletal injuries (MSIs) are a major source of acute injury and disability for health care workers. These injuries also present a major financial burden to employers as a result of lost person days and disability claims.

The prevalence and incidence of MSIs has been significantly reduced in the past decade as a result of a range of initiatives. Key interventions have been an increased emphasis on “no lifting” policies and practices combined with the introduction of automated lifting devices. Related initiatives have also proven to be effective: BC regulations requiring employers to engage in a number of risk management and risk control practices; staff education and training; consultation and collaboration with staff members; and evaluation of program outcomes.
Research has clearly indicated that a multi-component prevention strategy encompassing “no-lift” patient handling policies, introduction of lifting equipment, and staff training (on equipment usage and patient handling) has a positive effect on musculoskeletal health, and that continued and strengthened implementation of these strategies can be expected to further reduce the number of MSIs in BC health care facilities.

Prevention of Occupational Injuries from Infectious, Toxic and Hazardous Agents

Exposure to a wide range of infectious, toxic and hazardous agents has the potential for serious occupational health impacts. Hazards include exposure to: infectious diseases such as hepatitis B and C, HIV virus, Severe Acute Respiratory Syndrome and other pathogens; chemicals used for cleaning, sterilization and disinfection; anaesthetic gases used during surgery and childbirth; hazardous drug therapies; and exposure to radiation.

Researchers suggest that a program to prevent occupational injuries from hazardous diseases/agents can only be effective when it is part of a larger occupational health and safety policy for the workplace. Major recurring themes identified in the literature highlight the need for, and effectiveness of, the following initiatives:

- A committed management team and the involvement of occupational health and safety committees in developing and implementing the program.
- Risk management analysis and planning.
- Personal protective equipment and engineering controls.
- Active administrative support in emphasizing safety.
- Staff education that focuses on barriers to compliance identified within their specific institution.

Compliance with safe work practices is strongly associated with cleanliness and orderliness of the work site. As well, employees who perceived strong senior management support for safety and who received high levels of safety-related feedback and training experienced half the number of exposure incidents than other employees.

Analysis of risks combined with implementation of evidence-based interventions can also successfully reduce injuries. For example, engineering controls that have been effective include: the use of needleless intravenous systems and suture needles that retract, sheathe or blunt immediately after use, significantly reduces needlestick injuries; use of alternative cleaning substances reduces exposure to toxic chemicals; improved exhaust and ventilation systems limit air-borne infections, toxic drug and disinfectant particulates in the air, gases from leaking anaesthetic equipment, and so on.

Prevention of Occupational Injuries Caused by Violence

Violence is the second highest cause of occupational injury in health care settings. The highest number of aggressive incidents arises from patients who have psychiatric or dementia illness, those with learning disabilities, and those in emergency departments. Staff who are injured, or at risk of being injured, are frequently under considerable stress, which may have a cumulative effect and cause anxiety, depression, exhaustion and burnout.
Research has shown that organization-wide policies and strategies are most effective in preventing occupational violence. For example:

- Interventions that use multiple components are more likely to be successful than are single measure efforts.

- Off-the-shelf solutions are not appropriate as site-specific strategies have far greater preventive effectiveness.

- Collaboration of the employer and workers is necessary to develop an effective prevention plan. Measures to “design-out” violence systematically across an organization have proven to be particularly effective, including:
  
  o A risk assessment of past violent events, work environment layout, work organization, and job-specific exposures.

  o Proactive preventive measures to improve or re-design the work environment and work processes, often through elimination of hazards (e.g., isolation of workers by installing barriers), and other environmental and administrative controls.

  o Strategies to enhance communication and interpersonal support systems in the workplace.

- Prevention must also include provision of information to staff, education and training, and monitoring to assess the effectiveness of action taken.

Risk assessment and risk management is important in all health care settings (acute care, residential care and home care). The issues are particularly critical for staff working alone or in isolation, where the risks can be heightened. In such cases, risk assessment and safety protection plans should be established prior to the provision of care.

**Prevention of Occupational Stress/Burnout**

Mental disorders (73% of which are depression) represent the fastest growing segment of long-term disability (LTD) claims in the BC health care sector. In 2003, claims for depression accounted for 13.8% of all active LTD claims (a rise from 10.6% in 1999). Key stressors reported by health workers are work overload, a lack of control over work or a lack of participation in decision-making, poor social support, unsupportive leadership or lack of communication/feedback, staff shortages, scheduling issues, and work-family demands.

Lower nurse-to-patient ratios are associated with higher rates of nonfatal adverse outcomes including higher levels of patient complaints, unplanned hospital readmission, increased length of stay, nosocomial infections, and pressure ulcers.

Multi-component comprehensive prevention programs are increasingly recognized as effective strategies in enhancing employee health and well-being, as well as in strengthening organizational performance. This approach requires a collaborative approach between employer and employee representatives to identify needs and risk factors and to determine the measures that are most appropriate for their organization.
It includes:

- A culture characterized by mutual trust, respect, fairness and commitment to quality care, in which supportive relationships exist between peers, physicians and management.
- Increased autonomous clinical practices in which nurses are involved in decision-making, and are valued by administrators and by physicians.
- Redesign of work environments and work processes by teams that enable learning and professional development, access to information, adequate support and resources, and control over decisions affecting care delivery.
- Open communication among employees combined with active participation in analysis, monitoring, evaluation and revision of prevention programs as necessary.

Specific prevention plans to reduce occupational stress and burnout integrate:

- Primary prevention including strategies aimed at both organizational factors (e.g., healthy workplace strategies, supportive leadership) and individual factors (e.g., mental health promotion, stress management/resiliency training and work-life balance).
- Early or secondary interventions such as assessment/referral, employee satisfaction surveys, an employee assistance program, acute and chronic stress case management, and an Early-Return-to-Work program.
- Tertiary prevention including case management, practice guidelines, assessment, task/job modification, vocational rehabilitation, and relapse prevention.

Health Care Design and Environmental Issues

Design of Health Care Facilities and Workflow

Improvements to the design of health care facilities including the design of appropriate work spaces, work processes and workflow have been shown to improve the quality of care, enhance patient outcomes, and support the health and safety of staff members.

Strategies to address a wide variety of environmental factors that influence health include the following:

- Work spaces and layouts can be designed to increase staff time for care. For example, rather than conventional floor layouts for patient-care units, researchers suggest localized charting stations with viewing windows to facilitate good visual access to patients, enabling nurses to provide assistance quickly. There is good evidence that well-designed patient-care units with single rooms and decentralized charting and observation do not require higher nurse staffing levels than conventional multi-bed units.
- Ergonomic interventions combined with careful consideration of air quality, noise and light, were shown to result in reduced levels of stress among staff members, a significant positive impact on staff health, and improved nurse productivity.
A reduction in noise has been shown to result in reduced patient stress and to positively impact the rate of elevated blood pressure, rate of wound healing, and re-hospitalization rates. Architectural design solutions include:

- Provision of single-patient rooms.
- Private areas in admitting and care units for private treatment and conferences with families and staff.
- Use of high-performance sound-absorbing acoustical ceiling tiles to reduce sound propagation, improve speech intelligibility and privacy.
- Removal or reduction of the sources of loud noise and the use of music to mask or counteract noise that cannot be eliminated.

Light has also been shown to influence patient health and staff job performance. Research on light levels indicates:

- Visual task performance improves with increased light levels (e.g., higher lighting levels are associated with fewer medication-dispensing errors in hospital pharmacies.
- Exposure to daylight is associated with reduced depression among patients with seasonal affective disorder and bipolar depression, and decreased length of stay in hospitals (e.g., bipolar patients assigned to rooms with more sunlight had a mean 3.67-day shorter hospital stay than patients with the same diagnosis in rooms with little or no sunlight).
- Lower agitation among dementia patients.
- Easing of pain.
- Improved adjustment to night-shift work among staff.

A number of studies identified the effects of positive distractions (e.g., views of nature, artwork, music, etc.) on patients: they reported significantly higher patient satisfaction and more involvement in self-care in comparison with other patients. Studies focused on the use of music in hospital settings found that playing music during stressful times reduced heart rate and anxiety and increased patient comfort.

Environmental Conservation and Sustainability in Health Care

Although health care systems are dedicated to healing and promotion of health in their communities, they are at the same time, major consumers of a wide variety of both renewable and non-renewable resources, and major producers of a vast array of solid wastes, and thus a source of pollution that contaminates air, water, and soil. There is growing recognition that this environmental impact should be reduced to enhance environmental health and sustainability, but also to achieve considerable cost savings that can result from such measures.
Effective strategies to reduce the environmental impact of health care involve comprehensive and integrated approaches which include support and commitment from the highest level of an organization, an interdepartmental environmental management team, and an environmental plan that encompassing a wide range of interventions to address key organizational issues. Interventions should aim to:

- **Reduce Energy Consumption** – Technologically advanced energy-efficient designs and energy-saving measures such as natural heating and cooling, active or passive solar heating, and/or other alternative energy sources have reduced energy use in hospitals by 40%-90%.

- **Decrease the Use of Toxic Materials** – Reductions in the purchase, use and disposal of toxic materials can be achieved by: substituting less toxic products wherever possible; eliminating dioxin emissions by avoiding the incineration of plastics and replacing PVC and other high-chlorine plastics with alternative products; phasing out the use of mercury and ensuring it is not incinerated.

- **Enhance Indoor Air Quality** – Application of new building technologies and natural building materials can maximize natural ventilation and air quality. The use of plants, water and other elements from the natural eco-system can also provide creative ways to control air contaminants.

- **Healthy Grounds and Gardens** – There is growing interest in the therapeutic role of green spaces and gardens on the healing process and some evidence that documents its positive impact.

- **Environmentally-Preferable Purchasing** – Purchasing policies can establish preferences for products that are environmentally sustainable, for example, those that are certified, have longer service life, and minimize waste.

A number of rating systems and standards support reduced environmental impact by health care systems including; accreditation standards, Green Buildings BC checklist; Leadership in Energy and Environmental Design (LEED) Rating System; and the Green Guide for Health Care toolkit.
PART I: INTRODUCTION

1.0 OVERVIEW/SETTING THE CONTEXT

In 2005, the British Columbia Ministry of Health released a policy framework to support the delivery of effective public health services. The Framework for Core Functions in Public Health identifies prevention of adverse events of the health care system as one of the core programs that a health authority provides in a renewed and comprehensive public health system.

1.1 An Introduction to This Paper

The purpose of this evidence review is to provide research information for the Ministry of Health Services and health authorities on policies, programs and strategies that can be effective in establishing a public health core program to prevent adverse effects of the health care system, at the health authority level. The paper is focused on clarifying the problems and issues related to the adverse health effects of the health care system and to identifying evidence-based prevention practices which have been shown to be successful in preventing, reducing and/or eliminating these effects, as well as those that facilitate continuous quality improvement in the field. Public health responsibilities for primordial, primary and early secondary prevention are highlighted. Where there is a lack of quality research evidence, information on “best practices” has been included.

The focus of the paper is to provide an evidence base for the development of a program that will:

- Utilize prevention strategies and epidemiological initiatives to ensure the provision of quality care in health care facilities.
- Prevent and/or control multiple resistant organisms in institutional health care settings.
- Prevent and/or reduce lapses in patient safety and medical errors in health care systems.
- Increase occupational health and safety for staff in health care facilities.
- Reduce the environmental impact of the health care system.

The scope of this paper is patient safety and the prevention of health care error and adverse environmental impacts within facilities operated by the health authorities, including hospital services including acute care hospitals and residential care facilities; and other health care facilities and services that are managed directly by health authorities such as home and community care, and mental health residential facilities. The paper does not cover family care homes, group homes, assisted living, hospice care, physician office practices and non-hospital medical/surgical facilities.
1.1.1 Background

The issue of medical error has recently received much attention in the United States,\(^1\) the United Kingdom and Australia, and is attracting growing attention in Canada. The harm done inadvertently by the health care system is not negligible: a report on adverse events\(^2\) in Canada’s health care system (Baker et al., 2004) estimated that “in 2000, between 141,250 and 232,250 of 2.5 million admissions to acute care hospitals in Canada were associated with an adverse event and that 9,250 to 23,750 deaths from adverse effects (AE) could have been prevented.”\(^3\)

Although these estimates are very broad, the data does imply that adverse events are among the most important causes of death in Canada, comparable to the number of deaths from such important conditions as stroke, chronic obstructive pulmonary disease, unintentional injury, or pneumonia and influenza.

Woolf (2004) argues that ‘lapses in safety’ and ‘medical error’ are both subsets of ‘lapses in quality’ that arise from “flaws in the design and operating procedures of systems”, and ‘lapses in care’ which go beyond a “failure to meet normative benchmarks for quality” to include the more subjective (but nonetheless important) sense on the part of patients that they are not cared for.

Although not a traditional public health field, the use of public health strategies, knowledge and skills can provide necessary support and assistance to clinical colleagues in preventing adverse health effects in the health care system. As the part of the health care system that has prevention of death, disease, injury and disability as its primary focus, public health can thus extend from the conventional role of infection control to a broader role, using epidemiological skills and population health knowledge to secure the greatest health benefits with limited resources (BC Ministry of Health, *Framework for Core Functions in Public Health*, 2005).

The adverse occupational health effects experienced by staff within the health care system are included in this report since occupational injuries and diseases are themselves a large source of disease, disability, and injury, and the issues created by these disorders can increase the risk of adverse effects for patients in health care facilities.

As part of its environmental health role, the public health role also includes a focus on reducing the environmental impact of the health care system and enhancing the health of the environment, including both the health care “built” environment as well as the health and sustainability of the surrounding natural environment.

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\(^1\) “The Institute of Medicine reports that preventable adverse patient events, including hospital-acquired infections, are responsible for 44,000-98,000 deaths annually at a cost of $17-$29 billion” (CDC, 2000).

\(^2\) An adverse event is “an unintended injury or complication that results in disability at the time of discharge, death or prolonged hospital stay and that is caused by health care management rather than by the patient’s underlying disease process” (Baker et al., 2004).

\(^3\) Although the methodology used in the US and the Canadian Reports has been criticized as significantly over-representing the burden (Birnbaum & Scheckler, 2002) and Woolf (2004) cites estimates that “perhaps fewer than 5% [of these deaths] are causally linked to errors.”
2.0 METHODOLOGY

2.1 Data Sources
The following bibliographic databases were searched to identify evidence on the effectiveness of a range of strategies to reduce adverse health impacts within the health care system. The selection criteria were limited to review articles in English for the years 2002 to 2006 or 2007. The sources used include:

- Biomedical Reference Collection.
- Cochrane Database of Systematic reviews (OVID).
- DARE Database of Abstracts of Reviews of Effects (OVID).
- Health Sciences: A SAGE full text collection.
- Medline (OVID) 1966 to present.
- ISI Web of Science (Science Citation Index Expanded, Social Sciences Citation Index, Arts & Humanities Citation Index).
- ISI Web of Science Cited Ref search for older articles that seemed to be relevant and quoted often.

Also, the websites of many government ministries and agencies, relevant associations, research networks and institutes were scanned for relevant grey literature. These ranged from provincial, national and international sites including many in the UK, US, Australia, and New Zealand.

2.2 Quality of Public Health Evidence
The availability of evidence on patient safety varies considerably ranging from relatively strong evidence on specific procedures and toxic substances, to more limited evidence on many prevention strategies particularly those that involve health promotion. Generally, study designs for public health research include qualitative as well as quantitative information, and involve fewer long-term studies and less control than the traditional “gold standard” randomized controlled trials common to clinical medicine and treatment interventions.

Where applicable, references include an evidence-quality rating in square brackets [n], following the citation in the text. The rating is applied in discussion of research outcomes, rather than in more general discussions. Where it is not used, it may be assumed that a document is rated at a [5] or [6] level.

Appendix 3 provides a brief summary of the evidence quality on major adverse effects addressed in this document.
### Core Public Health Functions for BC: Evidence Review

**Prevention of the Adverse Health Effects of the Health Care System**

The Oxford Centre for Evidence-Based Medicine (CEBM) system has been used to rate research evidence:

<table>
<thead>
<tr>
<th>Therapy/Prevention, Aetiology/Harm</th>
<th>Prognosis</th>
<th>Diagnosis</th>
<th>Differential diagnosis/symptom prevalence study</th>
<th>Economic and decision analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>SR (with homogeneity*) of RCTs</td>
<td>SR (with homogeneity*) of inception cohort studies; CDR† validated in different populations</td>
<td>SR (with homogeneity*) of Level 1 diagnostic studies; CDR† with 1b studies from different clinical centres</td>
<td>SR (with homogeneity*) of Level 1 economic studies</td>
</tr>
<tr>
<td>1b</td>
<td>Individual RCT (with narrow Confidence Interval‡)</td>
<td>Individual inception cohort study with &gt; 80% follow-up; CDR† validated in a single population</td>
<td>Validating** cohort study with good†† reference standards; or CDR† tested within one clinical centre</td>
<td>Analysis based on clinically sensible costs or alternatives; systematic review(s) of the evidence; and including multi-way sensitivity analyses</td>
</tr>
<tr>
<td>1c</td>
<td>All or none§</td>
<td>All or none case-series</td>
<td>Absolute SpPins and SnNouts†</td>
<td>All or none case-series</td>
</tr>
<tr>
<td>2a</td>
<td>SR (with homogeneity*) of cohort studies</td>
<td>SR (with homogeneity*) of either retrospective cohort studies or untreated control groups in RCTs</td>
<td>SR (with homogeneity*) of Level &gt;2 diagnostic studies</td>
<td>SR (with homogeneity*) of Level &gt;2 economic studies</td>
</tr>
<tr>
<td>2b</td>
<td>Individual cohort study (including low quality RCT; e.g., &lt;80% follow-up)</td>
<td>Retrospective cohort study or follow-up of untreated control patients in an RCT; Derivation of CDR† or validated on split-sample§§§ only</td>
<td>Exploratory** cohort study with good††† reference standards; CDR† after derivation, or validated only on split-sample§§§ or databases</td>
<td>Analysis based on clinically sensible costs or alternatives; limited review(s) of the evidence, or single studies; and including multi-way sensitivity analyses</td>
</tr>
<tr>
<td>2c</td>
<td>“Outcomes” Research; Ecological studies</td>
<td>“Outcomes” Research</td>
<td>Ecological studies</td>
<td>Audit or outcomes research</td>
</tr>
<tr>
<td>3a</td>
<td>SR (with homogeneity*) of case-control studies</td>
<td>SR (with homogeneity*) of 3b and better studies</td>
<td>SR (with homogeneity*) of 3b and better studies</td>
<td>SR (with homogeneity*) of 3b and better studies</td>
</tr>
<tr>
<td>3b</td>
<td>Individual Case-Control Study</td>
<td>Non-consecutive study; or without consistently applied reference standards</td>
<td>Non-consecutive cohort study, or very limited population</td>
<td>Analysis based on limited alternatives or costs, poor quality estimates of data, but including sensitivity analyses incorporating clinically sensible variations.</td>
</tr>
<tr>
<td>4</td>
<td>Case-series (and poor quality cohort and case-control studies§§)</td>
<td>Case-series (and poor quality prognostic cohort studies***2</td>
<td>Case-control study, poor or non-independent reference standard</td>
<td>Analysis with no sensitivity analysis</td>
</tr>
<tr>
<td>5</td>
<td>Expert opinion without explicit critical appraisal, or based on physiology, bench research or “first principles”</td>
<td>Expert opinion without explicit critical appraisal, or based on physiology, bench research or “first principles”</td>
<td>Expert opinion without explicit critical appraisal, or based on physiology, bench research or “first principles”</td>
<td>Expert opinion without explicit critical appraisal, or based on economic theory or “first principles”</td>
</tr>
</tbody>
</table>


The modifications to CEBM for this study are:

- **CEBM 3:** systematic reviews: all are graded as a 3 as there was not time to assess the presence of RCTs (CEBM 1) or cohort studies (CEBM 2) in each systematic reviews (SR).
- **CEBM 4:** cross-sectional, time series studies included in this section (comparison group present).
- **CEBM 5:** time series, case studies, descriptive epidemiological study.
- CEBM 6: qualitative studies such as surveys, thematic analysis. Note the grading of qualitative studies as a “6” does not suggest that these studies are inferior to the other categories.

2.3 Evidence Quality and Best Practices and Findings from Other Jurisdictions

A number of researchers have discussed both the limitations and benefits of public health research methods:

- It is important to find ways of understanding the differences implied in the methodologies, the variety of intellectual and practical approaches and to turn these into useful and applicable approaches for practitioners in the field (Kelly et al., 2002).

- Lomas et al. (2005) note that:
  
  o Decision makers are more likely to use broadly inclusive, colloquial definitions of evidence, though the evidence-based decision-making movement has engendered a high regard for scientific forms of evidence.

  o There are differing views on what the “evidence” in evidence-based health care should be. These may include: medical effectiveness research (context-free scientific evidence); social science-oriented research (context sensitive scientific evidence); or the expertise, views, and realities of stakeholders (colloquial evidence).

  o Some experts question the assumption that research can be applied equally to all forms of health care decisions, considering the differences between individual patient-focused medicine, the population perspective taken by health planners and the organizational viewpoint of most hospital managers.

The term “best practices” is used to reflect the range of practices that are supported and/or recommended by leading jurisdictions, by experts in the field, and/or by research studies. They could be considered “good practices”, “generally accepted practices” or “better practices” that have yielded positive results in some settings. For simplicity they are referred to as best practices in this document.

Green (2006) notes that two patterns may emerge from reviewing evidence from different sources: the different sources can converge and infer “best practices”; or it may reflect different results based on incomplete evidence or different settings and contexts. In the latter case, planners may then utilize: theory to generalize from existing evidence; experience of other practitioners and planners dealing with similar populations, problems, and circumstances; and indigenous wisdom of stakeholders who have the best intuitive understanding and familiarity with the local population and circumstances. Factors affecting the success of transferring interventions into a new setting include the social, cultural and political context of that setting, and the skills of service providers in the new setting (Armstrong, 2006; Green, 2006; Wang, 2006).
PART II: ORGANIZATIONAL/MANAGEMENT STRATEGIES TO ENHANCE PATIENT SAFETY AND QUALITY OF HEALTH CARE

3.0 ORGANIZATIONAL/MANAGEMENT STRATEGIES

A range of system-wide organizational and management strategies are presented in this section to guide risk/safety assessment and quality management, development of a culture of safety, communication and teamwork, consumer and community involvement, professional competence and ongoing education.

3.1 Provincial Legislation, Regulations and Policy

3.1.1 Legislation and Regulations

Legislation and regulations are a key consideration in developing an overall strategy to support quality health care and patient safety. Canadian provinces use a traditional licensing model to regulate institutions such as hospitals and long-term/residential facilities.

BC legislation and regulations pertinent to quality of health care, particularly patient safety and medical error, include:

- The *Hospital Act* and Hospital Act Regulation
  - The Act establishes medical staff committees that can review incidents according to section 51 of the *Evidence Act*.

- The *Hospital Insurance Act* and Hospital Insurance Act Regulations.

- The *Community Care and Assisted Living Act* and Adult Care Regulations
  - Adult Care Regulations and Child Care Licensing Regulation require a licensee to notify the caregiver and the Medical Health Officer of illness or injury (the list of reportable incidents is described in Appendix 1).

- The *Continuing Care Act* and the Continuing Care Programs Regulation
  - The Minister may appoint an administrator to deliver continuing care if there are reasonable grounds to believe the health or safety of persons receiving continuing care are at risk.

  - The Ministry of Health has issued policies such as the 1997 *Personal Assistance Guidelines* for safe home care tasks such as medications and patient lifts and transfers.
• **Pharmacy Operations and Drug Scheduling Act**
  o Enables electronic prescriptions with expansion of patient medication profiles (through PharmaNet) to assist in avoiding medication errors, duplications and dangerous combinations of medications.

• **Mental Health Act**
  o In addition to legislation, the ministry has issued BC’s Mental Health Reform Best Practices.

• **Workers Compensation Act** and Occupational Health and Safety Regulations
  o Health authorities are required to report all work-related disease and injury to the Workers’ Compensation Board.

• **Apology Act**
  o Restorative legislation that enables an apology, expressions of sympathy or regret, without implying an admission of fault or legal liability.

Environmental legislation that applies to hospitals and health care facilities includes:

  o Establishes greenhouse gas reduction planning and reporting requirements, as well as targets, beginning with 2010, for public sector organizations to become carbon neutral with respect to their greenhouse gas emissions.

• **BC Environmental Management Act** and the Canadian **Environmental Protection Act**
  o Includes penalties and liability for contravening environmental protection legislation and regulations (re: contaminated waste, hazardous waste, waste management, etc.).

**Evidence/Expert Opinion on Legislation**

Expert opinions from the literature on legislation and regulation note that:

• Legislation and regulations provide powerful incentives and sanctions capable of driving organizational change (Walshe, 2003 [4]).

• Almost all regulations use standards to communicate their expectations or requirements. There is pressure to make the standard exact and prescriptive so that the regulatory process is fair and transparent. This approach is efficient as quick assessments can be made (Walshe, 2003 [4]).

• However, limitations may result from inflexible or overly prescriptive requirements, or from lack of knowledge or inadequate input from providers and experts (Trowbridge, 2001 [5]).
Downie et al. (2006 [4]), in the Health Canada-funded report *Patient Safety Law: From Silos to Systems Final Report*, noted that home and community care, primary care and private care in Canada are unregulated or under-regulated in terms of patient safety. Gaps and weaknesses are identified as:

- Some sites of care delivery are under-regulated, some health care professionals are unregulated, and drugs and devices are under-regulated.
- Adverse events are under-reported and there are numerous barriers to sharing information across inquiry processes.
- The legal framework around patient safety relies on a decentralized system of multiple self-regulators, a high degree of relative autonomy of providers from the state, and the continuing dominance of blame and shame as the foundation of the law.

Downie et al. (2006) also point out the strength of Canada’s occupational health and safety (OHS) laws, which set out the responsibilities of governments and workplace parties as well as a framework for the internal governance of workplaces with respect to occupational health and safety. Employers, employees and other workplace parties have a general legal duty to take every reasonable precaution to ensure workplace safety.

Legal considerations also include medical and hospital liability for breaches in the standard of care and the associated issues of compensation, corrective justice and deterrence. Although cases of negligence and standards of care for physicians and other health care workers are not the focus of this paper, the issues are acknowledged as factors that may arise in the context of patient safety and medical error.

### 3.1.2 Provincial Policy

With respect to provincial policy, the Ministry of Health Services provides policy advice, expertise and best practice reviews to support health authorities on a number of topics related to the delivery of quality health care throughout the province. The Provincial Health Services Authority provides specialized support in a number of technical areas. In addition, a number of advisory and expert groups have been established including:

- The BC Patient Safety Task Force (PSTF), which includes representatives from the Ministry of Health Services and all health authorities, works collaboratively to increase patient safety by raising awareness among health professionals and by promoting improved health care policies and processes. The PSTF has several working groups for issues such as medication safety, performance indicators, surgical safety, and the Safer Healthcare Now! Campaign (which is delivered in all regional health authorities).

- A Patient Safety and Quality Council, established by the Minister of Health Services in May 2008, to provide advice and make recommendations to the Minister on matters related to patient safety and quality of care, and to bring health system stakeholders together in a collaborative partnership to promote and inform a provincially coordinated, innovative approach. The Council has a mandate to:
  - Bring a provincial perspective to patient safety and quality improvement activities;
Facilitate the building of capacity and expertise for patient safety and quality improvement;

- Support health authorities and other service delivery partners in their continuous effort to improve the safety and quality of care; and

- Improve health system transparency and accountability to patients and the public for the safety and quality of care provided in BC.

- The Provincial Infection Control Network (PICNET), established in 2005, provides advice and strategic directions through working groups on surgical site infection surveillance, antibiotic resistant organisms, and *Clostridium Difficile* surveillance.

- The BC government also funds an academic chair on inpatient safety at the University of British Columbia.

The Occupational Health and Safety Agency for Healthcare (OHS AH) in BC is jointly governed by employers and unions to improve workplace health and safety in the health care sector. Programs and expertise are provided in disability and disease prevention, occupational hygiene, ergonomics, occupational medicine, occupational psychology, education and training, and program evaluation. OHSAH also conducts analysis on occupational health indicators and initiatives, using the Workplace Health Indicator Tracking and Evaluation (WHITE™) Database.

### 3.2 Organizational Strategies – A Culture of Safety

It should be noted that the literature on organizational management strategies discussed in this section are primarily best practice examples and theoretical discussions from leading medical organizations and/or researchers. Few comparative studies and research projects were located on these topics. However, there is extensive reference to the documents *Patient Safety and Healthcare Error in the Canadian Health System: A Systematic Review* (Baker & Norton, 2004 [3]) and *Patient Safety: Achieving a New Standard of Care* (US Institute of Medicine of the National Academies, 2004 [3]).

A culture of safety is often referred to in the literature as a key best practice in improving patient safety. It can be defined as an integrated pattern of individual and organizational behaviour based upon shared beliefs and values that continuously seek to minimize patient harm from the processes of care delivery (Kizer, 1999 [4]). Such a strategy implements two complementary approaches: first, a system within which health professionals can report injuries and near misses safe from blame, humiliation, and retaliation (O’Leary, 2003 [5]); second, open and complete reporting create an environment that reliably avoids injuries and near misses. A culture of safety encompasses the following elements: shared beliefs and values about the importance of minimizing patient harm; organizational commitment to detecting and analyzing patient injuries and near misses; open communication regarding patient injury results, both within and outside the organization; the establishment of a just culture; and staff recruitment and training with patient safety in mind. (Kizer, 1999 [4]).
A culture of safety requires a shared recognition among all members of a health care delivery organization, reinforced regularly and rigorously by professional and organizational leaders, that health care is a complex, high-risk endeavour, and that regardless of how hard staff try, failures are inevitable: hazards and errors can be anticipated, and processes can be designed both to avoid failures and to prevent patient harm when failures do occur (Institute of Medicine, 2004 [3]).

In addition, the literature stresses the need for organizational commitment to a thorough analysis of injuries and near misses, followed by the development of actions to reduce injury rates, verification of implementation, their effectiveness, and identification of any unanticipated secondary effects (Institute of Medicine, 2004 [3]). Leadership involvement in, and coordination of, all these activities is deemed necessary for an effective process. Another important element is an organizational commitment to open communication. This commitment begins with leaders setting clear expectations regarding patient safety through publicized organizational goals. It includes open sharing of patient injury results, both within and outside the organization (i.e., with frontline representatives and health care overseers) as part of a transparent care delivery system (Institute of Medicine, 2004 [3]).

A “just” culture is also a key element in establishing a culture of safety. On the one hand, there is a need for staff to learn from mistakes in a supportive environment; and on the other, it is necessary to take disciplinary action when required. Processes for differentiating between blameless and blameworthy acts have been proposed (Reason & Hobbs, 2003 [5]). On the basis of experience from other industries (e.g., airlines, nuclear power, military operations, etc.), experts in the field recommend that protection from disciplinary action should be afforded to frontline workers when they report injuries, errors, and near misses even if they were personally involved. Without such protections, injury reporting rates drop drastically, and with them the ability to prevent future injuries. Health care organizations should be held accountable for designing and implementing safe processes, which in turn make it possible for frontline professionals to deliver safe care. Such protections also acknowledge that errors are nearly never intentional, nor are they caused by simple human failures alone. Three exceptions often apply however: criminal behaviour, (e.g., a physician treating a patient while inebriated); active malfeasance (e.g., a nurse who purposely violates safety policies); or cases in which an injury is not reported in a timely manner (Institute of Medicine, 2004 [3]).

The American Hospital Association (2000 [5]) summarized the organizational tactics and strategies needed to achieve a culture of safety. It highlighted the following:

- Demonstrate patient safety as a top leadership priority;
- Promote a non-punitive culture for sharing information and lessons learned;
- Routinely conduct an organization-wide assessment of the risk of error and adverse events in care delivery processes;
- Actively evaluate the competitive/collaborative environment and identify partners with whom to learn and share best practices in clinical care;
- Analyze adverse events and identify trends across events;
- Establish rewards and recognition for reporting errors and safety-driven decision making;
Foster effective teamwork regardless of a team member’s position of authority;

Implement care delivery process improvements that avoid reliance on memory and vigilance; and

Engage patients and families in care delivery workflow process design and feedback.

3.3 Epidemiological Surveillance and Information Management/Reporting

Epidemiology is the basic science of public health. It provides a framework that enables public health officials to identify important public health problems and to delineate their dimensions. Epidemiologic methods are used to define these health problems: to classify, identify, and elucidate their causes; and to plan and evaluate logical prevention and control measures. Epidemiology encompasses the study of all varieties of illness and injury as they affect defined groups of people with the ultimate aim and purpose of promoting, protecting, and restoring health (Encyclopedia of Public Health, 2003 [5]).

Standardized data on quality of care and injury detection plays a key role in patient safety by providing the information with which officials and other researchers can conduct epidemiologic analysis. Improvement teams often must try several different ways of organizing and analyzing data before finding an approach that provides optimal approaches to identifying issues and problems and their related causes (Institute of Medicine, 2000 [3]). Effective data surveillance, reporting and management systems are fundamental to detecting adverse events and near-misses. There has been no direct evaluation of specific information management tools, but case studies have found an indirect relationship between integrated data management systems and health outcomes (Brand, 2005 [2]).

Traditional reporting systems can grossly under-detect injuries. A balanced detection system necessarily relies on case finding through surveillance, voluntary incident reports systems and other data gathering methods. Evidence on the effectiveness and/or the limitations of the key information gathering methods that assist in identifying quality of care and patient safety is described in this section.

A chart prepared by the World Health Organization Working Group on Methods and Measures for Patient Safety, identifies major data gathering methods (Baker, 2007 [3]):

Table 1: Data-Gathering Methods on Patient Safety

<table>
<thead>
<tr>
<th>Retrospective</th>
<th>Prospective</th>
<th>Concurrent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Record Review</td>
<td>Rounds</td>
<td>Direct observation</td>
</tr>
<tr>
<td>Interviews</td>
<td>Prospective Analysis tools:</td>
<td>Check lists</td>
</tr>
<tr>
<td>Incident reporting systems</td>
<td>- FMEA (HFMEA)</td>
<td>Trigger tools</td>
</tr>
<tr>
<td>External audits</td>
<td>- Errors and Omissions assessment</td>
<td>Shift to shift reporting</td>
</tr>
<tr>
<td>Studies of claims and complaints</td>
<td>- Hazard Analysis</td>
<td>Medication reconciliation</td>
</tr>
<tr>
<td>Administrative data</td>
<td>- Fault Tree Analysis</td>
<td></td>
</tr>
<tr>
<td>QA audits, autopsies</td>
<td>- Hazard and Operability studies</td>
<td></td>
</tr>
<tr>
<td>End of shift reporting</td>
<td>Safety Culture Assessment</td>
<td></td>
</tr>
<tr>
<td>Trigger tools</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.3.1 Incident Reporting

Incident reporting collects data from health providers on faulty processes or undesired outcomes. It may be voluntary or mandatory. Three types of information may be included:

- **Clinical incident reporting** – involving internal reporting of patient safety incidents by clinical staff.

- **Sentinel event reporting** – involving reporting of unexpected occurrences involving death or serious physical or psychological injury, or the risk thereof, to an external statutory body.

- **Consumer incident reporting** – involving reporting of incidents by consumers via complaint mechanisms, surveys or other mechanisms (Brand, 2005 [2]).

Clinical incident reporting is the primary reporting system used within health facilities. In British Columbia, it was developed by the BC Patient Safety & Learning System (PSLS), an initiative of the Patient Safety Task Force (PSTF), to support improved patient safety throughout the province. It is the first system of its kind in Canada. The PSLS will capture data related to all patient safety events, including near-misses (where a threat to a patient’s health and safety was narrowly averted), safety hazards, patient complaints and claims. The system will provide up-to-date safety event-related reports in support of efforts to monitor, analyze and reduce the number of adverse events affecting patients in BC.

**Effectiveness Studies**

Simon (2005 [2]) has reviewed incident reporting systems for the Alberta Heritage Foundation and Coles (2001 [2]), for the NHS acute care trusts. Simon found eleven studies that assessed the effectiveness of incident reporting in a pre and post intervention design, primarily on medication error. These studies documented a benefit as well as an error reduction, although this was statistically significant for only three studies. Coles’ survey identified a number of positive changes in clinical practice as a result of incident reporting in the NHS.

Researchers report that there tends to be significant under-reporting in incident reporting systems, ranging from 50 to 96% (Simon, 2005 [2]). The barriers and incentives to incident reporting in health organizations are summarized in Table 2 (Coles, 2001 [2]).

**Table 2: Barriers & Incentives to Reporting at Individual, Organizational and Societal Levels**

<table>
<thead>
<tr>
<th>Individual</th>
<th>Organizational</th>
<th>Societal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barriers:</td>
<td>Barriers:</td>
<td>Barriers:</td>
</tr>
<tr>
<td>1) Fear of reprisals; lack of trust</td>
<td>1) Fear of litigation; costs; publicity</td>
<td>1) Legal impediments to peer review; confidentiality</td>
</tr>
<tr>
<td>2) Dependency on profession; skepticism; extra work</td>
<td>2) Dependency on organization, culture and bureaucratic system</td>
<td>2) Public trend towards disclosure</td>
</tr>
<tr>
<td>3) Exposure to malpractice or licence suspension; increased premiums</td>
<td>3) It doesn’t apply to us; they can’t understand our problems anyway</td>
<td>3) Lack of trust; lack of education about system effects</td>
</tr>
<tr>
<td>4) Loss of reputation; loss of income or job</td>
<td>4) Wasted resources and potential loss of revenue; not cost effective</td>
<td>4) Need for more effective regulations; resource intense</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5) More tax dollars to enforce; more bureaucracy</td>
</tr>
</tbody>
</table>
Individual | Organizational | Societal |
---|---|---|
Incentives:  
1) System provides confidentiality and immunity  
2) Professional values; integrity; education  
3) Prophylactic follow-up  
4) Safety saves money | Incentives:  
1) System provides confidentiality and immunity  
2) Become a leader in safety and quality; good for business  
3) Public relations; improve reputation for quality | Incentives:  
1) Ensure accountability and enforcement of reporting statutes  
2) Enhance community relations; build trust, improve health care  
3) Enhance regulatory trust; more public accountability  
4) Improve confidence in health care system |

**Source:** Coles, 2001.

**Table 3: Strategies That Encourage Incident Reporting**

The following features were associated with higher incident reporting rates and increased organizational trust (Simon, 2005 [2]).

<table>
<thead>
<tr>
<th>Strategies for increasing organizational trust</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less bureaucracy/flat hierarchy</td>
<td>Flatter organizations are better at supporting open communication between frontline workers and management, and more open, honest reporting and root cause analysis.</td>
</tr>
<tr>
<td>Staff participation in decision making/empowering staff</td>
<td>Giving frontline health providers more participation and discretion on how to do their jobs has been shown to lead to higher levels of commitment and better patient care.</td>
</tr>
<tr>
<td>Open communication</td>
<td>Managers should maintain open levels of communication when times are bad as well as good and allow two-way communication as much as possible to reach decisions and implement new processes or policies.</td>
</tr>
<tr>
<td>Human resource policies and risk management procedures</td>
<td>Systems of reward, performance appraisal, and incident analysis should be based on evidence and a consistent, just process. Rewards or incentives should be provided for reporting and showing trustworthy behaviour.</td>
</tr>
<tr>
<td>Teamwork</td>
<td>Most health care takes place in teams and a lack of effective teamwork has been found to be an important cause of patient errors. Good teams, whose roles are clear, where members feel supported, and where good internal and external dialogue takes place, provide better health care.</td>
</tr>
<tr>
<td>Leadership ability</td>
<td>An amalgamation of skills and competencies, including being able to influence others, contain anxiety, remedy problems revealed, and deal with cases fairly.</td>
</tr>
<tr>
<td>Leadership benevolence</td>
<td>Staff should be given understanding and loyalty and a sense of facing difficult times together. Includes understanding the very real difficulties of clinical care, the stress involved, the lack of resources, and the anxiety about making errors.</td>
</tr>
<tr>
<td>Leadership integrity</td>
<td>Managers must keep their word and be honest and consistent in their actions and decisions.</td>
</tr>
</tbody>
</table>

**Source:** Simon, 2005.

Other findings from studies related to the effectiveness and challenges of incident reporting are:

- Several studies suggest that the generally low reporting rates of incident reporting systems are attributed to an inadequate safety culture and leadership in a health care organization (Brand, 2005 [2]).
- The ‘over-recording’ of incidents also needs to be avoided. Some interviewees cited evidence of deliberately using such systems to target improvements in staffing or facilities. Other perverse incentives may also exist; e.g., being seen to be active,
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transferring responsibility, creating an expectation against which performance can improve (Coles, 2001 [2]).

- Several of the above mentioned studies found that using more than one method to identify patient safety incidents increases the total number of incidents detected, and that there is little overlap of the incidents detected using different methods.

- The limitations of incident reporting have been identified as:
  - Reporting is biased: it is probable that participants are more likely to report unusual, interesting or particularly dangerous incidents;
  - Ratings on the consequences of an event are subjective, with differences in interpretation based on individual professional experience, knowledge and values (Michel, 2003 [2]);
  - Incident reporting systems are “denominator” free in the sense that the population being measured is not defined in advance but must be ‘fitted’ later (e.g., a denominator could be a unit of time or a population of patients, etc.) so that comparative studies present difficulties.

3.3.2 Medical Charts and Record Reviews:
A number of studies and expert opinions discuss the value of medical charts and record reviews for information on adverse events, as follows (Michel, 2003 [2]):

- A review of medical records based on a standardized method of data collection is effective for estimating the nature, frequency and economic impact of adverse events.

- The suitability of reviewing medical records for large-scale studies in developed countries has been demonstrated, since the largest studies in the United States and in Australia have included review of thousands of medical records.

- Wolff and Bourke used a before-and-after intervention design to determine whether the review of medical records could detect and reduce adverse events occurring in emergency department attendances. They concluded that review of medical records, analysis and action can prevent recurrences.

- The use of adverse event monitoring, undertaken by trained audit or quality assurance staff who systematically reviewed case records, has been advocated as a useful hospital-wide approach to clinical audit in the United Kingdom. Review of medical records, the cornerstone of quality assurance programs in the United States and in many other developed countries, is thus considered part of quality improvement.

The literature also includes some limitations in the use of medical record reviews for information gathering:

- Only adverse events that are documented in the medical record can be recorded; it is estimated that the records miss up to 20% of adverse events. There is no information on near misses (Brand 2005 [2]).

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Reliability concerns have arisen with the review of medical records, including: incomplete documentation; and poor to moderate inter-rater reproducibility in assessment of records. Factors contributing to poorer reliability are: inability of reviewers to differentiate between cases with respect to the quality of management; bias related to the type and training of the reviewer; and difficulties in judging preventability and root causes (Michel, 2003 [2]).

Medical record reviews are resource intensive: they are the most costly and labour intensive of the information-gathering methods (Brand, 2005). For example:

- In a university-affiliated teaching hospital in the United States, the cost of a review of medical records of 3,146 admissions in a medical service came to $54,000 ($13 per admission and $116 per adverse event), whereas reporting by staff physicians based on an electronic mail system during the same four-month period was $15,000 ($3 per admission and $57 per adverse event).

- A prospective cohort study in nine medical and surgical units in a tertiary-care hospital over an 8-month period was performed using review of medical records, computer monitoring and voluntary reporting. The workload was, respectively, 55, 11 and 5 person-hours per week (Michel, 2003 [2]).

3.3.3 Interviews

Four comparative studies on the use of interviews with health professionals to gather information consistently concluded that interview-based methods are more effective than other methods for all adverse event identification, and for identifying specific risks (adverse drug events and nosocomial infections). In particular, interviews with clinical staff were found to be more effective than record reviews for identifying all adverse events in medical units, and as effective as record reviews when both the medical and surgical units were involved. In addition, interviews were more effective in identifying preventable cases (Michel, 2003 [2]).

The studies indicate the cost of prospective data collection through an interview-based surveys with health care providers was 20% greater than that of record reviews (Michel, 2003 [2]).

3.3.4 Studies of Claims and Complaints

Although comparative studies have concluded that there is a weak relationship between claims and actual adverse events or negligence (Michel, 2003), these studies provide some insight and information to complement other methods of information gathering and analysis of adverse events. For example: the multiple perspectives of patients, health providers and lawyers may assist in detecting latent errors (Thomas, 2003 [3]); and analysis of malpractice claims, often associated with multiple systems-related deficiencies, may provide an understanding of underlying systems and human factor failures that are associated with preventable adverse events (Michel, 2003 [2]).

3.3.5 Administrative Data Analysis

Although administrative data is readily available and analysis is relatively inexpensive (Thomas, 2003), few studies of this type have been successful in providing causal analysis of the
adverse events due to incomplete information. To date, there is little published national adverse event data, with the existing studies based mainly in Australia and the United States. Some small-scale local studies have been conducted but provide only an estimate of adverse event rates for the specific setting (Westwood, n.d. [3]).

Overall, administrative data analysis:

- May rely on incomplete and/or inaccurate data as the information is divorced from the clinical context (Thomas, 2003 [3]);

- The results are varied, suggesting that some of the indicators (used in the United States) may be valid only for certain purposes, and that these indicators may be used for screening but not for measuring hospital quality and safety. In general, these indicators have a very high specificity and predictive value, and a poor to moderate sensitivity (Michel, 2003 [2]).

- The reliability of administrative data is obviously closely linked to the completeness of the diagnosis codes (Michel, 2003 [2]).

3.3.6 Autopsy

Autopsies can contribute information that may assist in identifying and preventing adverse events. Michel (2003 [2]) notes that:

- The effectiveness of autopsy reports must be considered as incremental, to complement the information provided by other methods (such as review of medical records);

- Rare studies have reported how autopsy findings from representative samples of deaths in an institution may have provided an opportunity for regular and systematic revision of medical diagnoses and treatment;

- However, autopsies are not systematically performed and reveal only errors related to misdiagnosis.

3.3.7 Mortality and Morbidity Conferences:

Opinion surveys and local experiences indicate that mortality and morbidity conferences play a role in influencing hospital and local safety procedures and outcomes. However, this role may be jeopardized if the primary goal of these conferences is education, and because such conferences are frequently implemented for the purposes of meeting administrative requirements, such as quality assurance, accreditation, and other professional procedures (Michel, 2003 [2]).

In particular, cases may be selected because of their educational interest, and may not involve mortality or morbidity (Michel, 2003). Some authors advocate the epidemiological value of data from mortality and morbidity conferences; however, there are few comparative studies in this area. Thompson and Prior found that there was excellent agreement on assessments of levels of care between those given by mortality and morbidity conferences and those arising from peer review of medical records. In contrast, a hospital prospective survey, based on daily reviews, interviews with health care providers and observation conducted by a single observer, concluded
that only 20% of complications were presented at weekly mortality and morbidity conferences (Michel, 2003 [2]).

3.3.8 Direct Observation

Observation of patient care provides potentially accurate and precise information that is otherwise unavailable (Thomas, 2003 [3]). Observation-based data collection is used primarily for the analysis of errors in health care institutions, mostly active errors but also some latent errors, such as errors related to the work team, to the task, to the local environment, and to coordination between the health care providers under observation. Direct observation is used for analysis of errors, such as those occurring during preparation and administration of drugs, those occurring in operating theatres and during trauma resuscitations (Michel, 2003). Direct observation is frequently performed during criterion-based medical audit of practices for which there are safety concerns (Michel, 2003 [2]).

This approach is expensive, requires trained reliable observers, and may have challenges with confidentiality and potential hindsight bias (Thomas, 2003 [3]).

3.3.9 Data Collection in Community Care

Data collection in the community care sector is not well developed, but Baker (2007 [3]) suggests that data methods include:

- Prospectively collected safety event data using simple descriptive taxonomies.
- In-depth analysis of safety events incorporating theories of causation and harm.
- Electronic event collection systems.
- Incorporation of patient/client views.
- Emphasis on outcome measures, along with consideration of errors and near misses and components of the work environment and culture that reflect underlying conditions that impact safe care.

3.4 Risk/Safety Assessment, Risk Management and Quality Improvement

Epidemiologic analysis using data gathered through a range of different methods to detect adverse health events is generally combined with additional safety and risk assessment processes for an integrated and comprehensive approach to patient safety. Both the investigation of specific adverse events that have occurred, and ongoing surveillance and assessment is necessary to identify, prevent and/or minimize potential hazards.

A risk assessment/risk management process to improve care and patient safety was outlined by the US Committee on Data Standards for Patient Safety, US Institute of Medicine (2004 [3]):

- Injury and near-miss detection (e.g., case finding, classifying issues).
- Epidemiologic analysis (e.g., developing and using new taxonomies).
- System fixes that could improve safety (e.g., developing hypotheses for effective changes based on analysis, evidence-based strategies and best practices).
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- Prioritization (e.g., determining whether an event is part of an epidemic).
- Rapid-cycle testing (e.g., assessing effectiveness with reliance on intermediate process measures).
- Deployment and implementation.
- Holding the gains (e.g., monitoring of final outcomes and intermediate process outcomes).

3.4.1 Investigation of Adverse Events

An investigation is necessary to isolate root causes that increased the risk of the accident or adverse event and to assess whether the organization might have had some control of the circumstances that led to the event. A framework for isolating root causes includes identification of the following: the sequence of events contributing to the accident; events within that sequence that represent active errors; and points in the sequence that represent latent system faults. Root cause analysis emphasizes both “active errors” and “latent faults”, as a basis for developing changes necessary to reduce the future risk of accidents. In the past, approaches to isolating and correcting root causes in hospital quality appraisal have focused on active errors, the immediately obvious errors, slips, mistakes, and unsafe practices that occur in the course of routine work processes, and neglected “latent faults”, the problems in design, negligent maintenance, and organizational shortcomings.

Active Errors

Active errors include: slips, or unintended deviations from standard practice; mistakes which represent poor judgment, incorrect inference, or faulty reasoning; and unsafe practices or rule violations which are conscious decisions to proceed in circumstances where adverse risks are known. Uncertainty, confusion, distraction and urgency facilitate these errors. Active errors have an immediacy which makes them conspicuous events (Spaeth, 2000 [4]).

Latent Faults

“Latent” faults have been classified into the following general failure types (Wagenaar et al., 1990 [5]):

- Physical environment, including workplace design, inadequate information systems, missing defences, hardware defects, negligent maintenance, or error-enforcing conditions.
- Human behaviour including poor workflow and procedures, or lack of training.
- Management faults such as inadequate leadership, poor culture of safety, incompatible goals or a lack of communications.

The literature suggests that the investigations be conducted by a team of people from the health care organization, as personal involvement has been found to result in a higher likelihood of organizational change, in comparison to the use of external experts (Spaeth, 2000 [4]).
A formal, thorough analytical process should be followed to investigate serious medical mistakes, sentinel events, or complicated near-misses. This involves analysis of the sequence of events, finding and recording each pertinent event through interviews with appropriate staff. Often it is not enough to consider only those events that occurred immediately prior to the accident since there may be other causes, more remote in time and within the organization which must be considered. For example, the contributing causes may include: oral communication, written procedures, workplace design/physical environment, working environment, task supervision, and training (Spaeth, 2000 [4]).

Recently, hospitals in the US have been encouraged by the Joint Commission of Accreditation of Healthcare Organizations to use methods employed in private industry for investigating the root cause of adverse events. One framework for analysis of medical accidents was developed under the name of MTO (Man-Technique-Organization), originally designed by NASA and later adopted by the nuclear power industry, and now adapted to health care. MTO analysis is similar to a number of other systems, and uses processes that can be applied generally to analyze adverse events. Accidents seldom occur because of a single error. Normally several latent failures interact in a system with poor defences (flawed safety barriers). MTO uses the following steps for accident investigation:

- Develop a preliminary map of the event.
- Conduct a preliminary cause analysis.
- Conduct on-site investigation and interviews.
- Review event mapping.
- Review cause analysis.
- Conduct barrier analysis.
- Identify situational factors.
- Identify latent failures.
- Identify absent or insufficient safety barriers.
- Develop an agenda for preventive actions (Spaeth, 2000 [4]).

3.4.2 Ongoing Risk/Safety Assessment and Risk Management

Assessment of potential safety hazards on an ongoing basis is important to correct and improve system weaknesses before adverse incidents can occur. Risk identification and analysis is necessary for the following categories: physical environment and equipment; human behaviour (e.g., workflows, staffing levels, communication, training, etc.); management and administrative issues, and organizational culture and climate.
Risk assessment is defined as the process of estimating the likelihood of occurrence of specific undesirable events, the severity of the harm or damage that may be caused, together with a value judgment concerning the significance of such harm. It therefore has two distinct elements: risk estimation and risk evaluation (Gadd, 2003 [4]).

The potential frequency and impact of events is analyzed as part of a risk evaluation process. This will include adverse effects that are rare but as Brown (2007) notes “very rare errors with high immediacy and causality generate concerns over safety.” More frequent events with low immediacy and causality, such as failure to vaccinate, are often conceptualized as quality rather than safety issues. However, at a population level, high frequency but lower harm, immediacy or causality incidents may contribute more harm overall, for example, failure to detect or respond to deteriorating patients, or to address the problem of falls in hospitals.

A number of formal anticipatory failure analysis protocols are in use in private industry and these are increasingly being proposed as models for use in health care (Institute of Medicine, 2004 [3]; Spaeth, 2000 [4]). These protocols are adapted to particular environments and analyze to a greater or lesser degree the four elements that characterize hazards: source of hazard, receptors, transmission path, and defensive barriers. The common methods include:

- **Hazop (Hazard and Operability Study)** teams review the design and operation of a facility and identify potential hazards and/or problems.
- **FMEA (Failure Mode and Effect Analysis)** focuses on preventing equipment failures.
- **HACCP (Hazard Analysis and Critical Control Point)**, traditionally used to monitor food safety, considers every potential hazard and evaluates its risk probability, identifies critical points, and establishes effective control monitoring.
- **FTA (Fault Tree Analysis)** hypothesizes and develops maps of potential adverse events, illustrating ‘branches’ and ‘sub-branches of related events to identify basic faults for which failure probabilities may be estimated from an engineering perspective.

Technical issues and factors provide an opportunity to apply linear cause-effect relationships and engineering knowledge for anticipating accident sequences. However, organizational factors tend to be complex and non-linear, requiring an analytical structure that can capture information on many different dimensions (LeCoze, 2005 [5]). Hoff (2004 [4]) outlines organizational factors which act at three levels:

- Individual-level factors within the organization that may affect medical errors and patient safety including leadership, the level of education or training provided to workers, and individual responses to performance feedback or quality information;
- Group-level factors including team-related dynamics (e.g., team integration, team effectiveness, team membership, team communication), as well as the culture of the organization; and
- Pertinent structural variables including the levels of standardization, coordination, and formalization characterizing a health care process, as well as the use of decision making and key inputs such as technology.
Simon (2005 [2]) highlights the importance of gathering a wide range of information to support risk identification and analysis in health care institutions. Ideally, risks should not be identified solely through incident or near-miss reporting, but include internal and external data sources such as public health statistics, analysis of complaints and litigation, treatment standards and guidelines and related compliance, as well as patient satisfaction. An effective quality and risk management structure will seamlessly integrate information from multiple sources and through audit, human resource development, and policy or procedural modifications develop system changes that improve quality and reduce risks.

Information technology is a central feature of an effective risk management system to support the coordination of both the risk assessment process and clinical decision-making. Maillard et al. (2005 [2]) found in a systematic review that information technology solutions resulted in a relatively large effect typically observed, with 25, 50 or even 80% reductions in error being recorded; 43 of 65 studies revealed improvement in physician performance with the use of decision support systems. A Cochrane review of drug dosage advice by computer found a 6% decrease in adverse events due to medication error (Walton, 2007 [2]).

The Pennsylvania Patient Safety Collaborative found that when human failures occur, they are most often consequences of inevitable, “built-in” limitations of human cognition or endurance, such as limits on short-term memory capacity, sustained vigilance over long periods of time, judgment impacted by lack of sleep, and problem solving under stress. They note that a review of the literature suggests that risk management in health organizations should:

- Purposely and tirelessly work to design error out and safety into workplace processes in a proactive manner by addressing such issues as work hours, workloads, rotation schedules, sources of distraction, staff turnover, unit reassignment, and use of temporary staff.
- Seek to reduce variation in how patients are cared for and devise strategies to avoid reliance on memory through the use of protocols, checklists, and standardization of work processes.
- Evaluate how the number of steps, hand-offs, and persons involved in carrying out specific processes can be simplified and/or reduced to lessen the possibility of error.
- Review research and the experience of others in and outside of health care in developing alternatives to reduce the possibility of error and improve patient safety.
- Evaluate the vulnerabilities of current patient care technology and care delivery systems, and critically evaluate new technology or changes in care delivery for threats to patient safety and potential for error (Pennsylvania Patient Safety Collaborative, 2001 [3]).

3.4.3 Accreditation and Audit

Accreditation

Accreditation is intended to assist organizations to improve the quality of their performance, raise the level of patient care and demonstrate accountability. It is a voluntary model of self-regulation, with an independent agency setting standards and procedures for quality measurement. Accreditation generally encompasses quality assurance and quality improvement.
The Canadian Council on Health Services Accreditation (CCHSA) is a national, not-for-profit, independent accreditation program:

- CCHSA uses the “AIM: Achieving Improved Measurement” program and standards. AIM standards are expressed as outcome statements. Each standard is underpinned by criteria which contain structure, process and outcome requirements.

- The national standards are developed through consultation with health professionals throughout Canada, and cover a range of health service programs, including acute care, assisted reproductive technology, cancer care, community health, health systems, home care, long-term care, mental health and rehabilitation.

- There is no statutory enforcement for accreditation of health care services in Canada nor is there a link between accreditation and access to public funds. The need for organizations to comply with certain recommendations to maintain accreditation provides some capacity to monitor ongoing compliance with CCHSA standards as well as to focus on continuous quality improvement of the services provided (http://www.cchsa-ccass.ca).

CCHSA has recently included patient safety goals in its accreditation standards. It has also developed a list of sentinel events related to system or process deficiencies that can lead to death or major loss of function. Member organizations are expected to implement a reporting system for adverse events with provision for reporting, investigation and action.

Studies and expert opinion from the literature indicate that accreditation:

- Improves the quality of health care by establishing optimal achievement goals in meeting standards.

- Stimulates and improves the integration and management of health services.

- Reduces health care costs by focusing on increased efficiency and effectiveness of services.

- Provides education and consultation to health care organizations, managers, health professionals on quality improvement strategies and “best practices” in health care.

- Strengthens the public’s confidence in the quality of health care.

- Reduces risks associated with injury or infection for patients and staff (Tremblay, 2005 [4]).

Some limitations of accreditation have been noted in the literature, including:

- A 1990 study found no association between the United States’ HCFA mortality rates and hospital quality as measured by accreditation performance. (There is no more recent research that takes account of more recent changes to accreditation systems, some of which include outcome performance assessments.) There is no evidence of results for the American Baldridge or the European Foundation for Quality Management framework or other systems, but there are many reports of positive experiences using these systems as part or all of a strategy (Øvretveit, 2003 [4]);
• Repercussions of non-compliance are uncertain;
• There is often a long time between accreditation visits;
• Risks to reputations if a low grade is given;
• Costs may be high; and
• Added workload for staff (Tremblay, 2005 [4]).

Audits
Audits are independent evaluations of performance using a standard or benchmark. The auditors of most government organizations are private sector firms although the Auditor General of BC may initiate an audit on approval by the Legislative Assembly’s Select Standing Committee on Public Accounts. The audits provide independent assessments and advice with respect to government accountability and performance level. The Auditor General of BC has prepared a number of evaluations of BC health services, including: Infection Control: Essential for a Healthy BC (2007); Follow-up of 2004/2005 Report 2: In Sickness and in Health: Healthy Workplaces for BC Healthcare Workers (2007); and Preventing and Managing Diabetes in BC (2004) (http://bcauditor.com). The reports provide thorough analysis of performance, and recommendations for improvement.

Audits may also be commissioned by independent experts to provide health organizations with an assessment of performance. For example, BC’s six health authorities worked with an independent company to develop a tool to measure safe food handling levels and to conduct an audit on food handling in hospitals and long-term care facilities (http://www.phsa.ca).

The findings of the UK Commission for Health Improvement (predecessor of the Healthcare Commission) provide an interesting overview of the major causes of service quality failure. In audits performed between 2000 and 2003, factors most frequently involving all organizations at a strategic level are lack of effective performance management, combined with inadequate information systems and a board generally unaware of the performance of the organization. Similarly, at an operational level, weak risk management systems were common as well as a failure to have robust systems in place for risk assessment, incident and near miss reporting, and complaints handling across the organization. Other important recurring features were poor executive leadership with lack of strategic direction (Commission for Health Improvement, 2005 [2]).

3.4.4 Guidelines
Guidelines are discussed under specific safety issues and medical errors. Overall, the use of guidelines to enhance quality and reduce risk has been shown to be inexpensive, explicit and transparent, and able to respond to a specific context. However, in some circumstances, there has been difficulty in identifying sufficient scientific evidence, or in achieving consensus among clinicians (Angus, 2004).
3.5 Health Promotion

Health promotion, based on the World Health Organization’s *Ottawa Charter*, encompasses: building healthy policies, creating supportive environments, strengthening community action; developing personal skills, and reorienting health services. Some of these factors are related to strengthening overarching safety values and goals within health care organizations. More specific health promotion initiatives are addressed under specific safety issues and medical errors in the following sections: for example, the promotion of hand washing is one of the major interventions to decrease the transmission of hospital-acquired infections. Organizational strategies such as the use of collaboration and teams, and safety education for patients are included in this section.

3.5.1 Collaboration and Teams

Studies have found that where clinical governance and leadership encourage collaboration between health care managers and clinical leaders, change is more likely to be achieved than in environments of unilateral governance (Brand, 2005 [2]). Similarly, Risser et al. (n.d.) have found that existing research suggests that improved teamwork can have a profound impact on emergency department patient care.

Shifts in the attitudes of the health care community that support implementation of teamwork in emergency care and other services are expected to ultimately improve care delivery and reduce error rates. In particular, helpful changes in the beliefs and attitudes of caregivers relate to the possibility of personal fallibility, the complexity of care systems, assumptions about clinical error, acceptance of peer review, and requirements for caregivers skill levels. The ultimate key to implementation lies in the willingness of senior management to commit to teamwork initiatives. With this commitment, caregivers learn coordination skills and communication habits that enable them to better integrate clinical action and implement team-based, patient-focused cultural change (Spaeth, 2000 [4]).

Risser et al. (in Spaeth, 2000 [4]) discuss a structured teamwork system that is being used in a number of emergency departments in the US, using small teams of caregivers with different sets of clinical skills. The projects involve team members working closely in a coordinated fashion to define, execute, and monitor the delivery of care to patients assigned to the team. Application of this model to other acute care units of the hospital is suggested to reduce errors in high-stress/high-performance environments where caregivers are often forced to deliver care to patients under conditions of incomplete information. They suggest expansion of the model to: labour and delivery units; special care units (e.g., intensive care, critical care, neonatal intensive care); operating rooms; and post-anesthesia care units.

Teamwork behaviours can be organized into a framework of five dimensions or functions:

- Maintain team structure and climate;
- Apply problem-solving strategies;
- Communicate with the team;
- Execute plans and manage workloads; and
- Improve team skills (Spaeth, 2000 [4]).
3.5.2 Patient Education

Qualitative research conducted through focus groups has contributed to an understanding of the patient’s role in assuring safe and high-quality care (Voluntary Hospitals of America, 2000). This research found that specific information about clinical quality generated patient interest and led to recommendations that initial education efforts disseminate information about: the role of hospitals in monitoring and controlling quality; and information on clinical quality that can be used by consumers in monitoring their own care. Other focus groups have found that patient safety messages receiving the highest rankings tended to be those that indicated specific ways for patients to inform their health professionals and themselves about care issues. Messages that stressed keeping one’s doctor informed and informing oneself were better received than those seen as embarrassing or rude (e.g., asking health providers whether they had washed their hands). The conclusion was that consumer messages on reducing medical errors work best if they:

- Advocate a collaborative doctor-patient relationship;
- Specify action to be taken; and
- Clearly indicate how that action can be taken (Institute of Medicine, 2004 [2]).

A number of organizations have sponsored education activities to assist patients and their families in becoming more involved in their care. In the US, the National Patient Safety Foundation (www.npsf.org) has produced a number of publications that emphasize what patients can do to make health care safer. The Agency for Healthcare Research and Quality also has developed patient materials setting forth ways to help prevent medical errors. The Institute for Safe Medication Practice sponsors a series of newsletters designed to help patients protect themselves from medication errors (www.ismop.org). Several state-based patient safety coalitions have developed and disseminated patient education materials, and the joint commission on Accreditation of Healthcare Organizations launched the SPEAK UP campaign to help patients get involved in their own care (Joint Commission on Accreditation of Healthcare Organizations, 2002).

The importance of communication and interpersonal skills in providing quality care is highlighted in data (Beckman et al., 1994) on US malpractice suits. Seventy-one percent (71%) of threatened lawsuits in the US involved physician-patient relationship issues. The four main themes behind the lawsuits were:

- Desertion of the patient (physician sent a surrogate or was perceived by the patient to be unavailable or too important to be contacted), 32%;
- Devaluation of the views of the patient or family (physician discounted the illness and suffering, attempts to advocate on the patient's behalf and the opinion of the patient or family, or failed to listen), 29%;
- Delivering information poorly (physician failed to provide an explanation or to keep the family up to date, blamed the patient or family for a bad outcome and communicated insensitively), 26%; and
- Failing to understand the patient or family perspective (physician did not pay attention to patient discomfort, failed to solicit opinion or failed to recognize the psychosocial impact of a medical problem), 13%.
3.5.3 Staff Education and Training

Training and education of staff can be an inexpensive means to enhance workplace skills, including team building and interpersonal skills, workplace procedures and processes, etc. Studies suggest that education combined with other methods works best to change safety behaviour (Øvretveit, 2003 [4]). Of five direct intervention studies examined in a systematic review conducted in the US between 1996 and 2000, all but one of the education/training studies reported positive safety results as a result of the intervention (Maillard et al., 2005 [2]).

3.6 Conclusions – Overarching Organizational/Management Strategies

The development of a “culture of safety” within a health care organization is an integral component to supporting the various initiatives that support patient safety and quality of care. Proactive leadership and commitment from senior management is essential to facilitating an environmental that continuously seeks to enhance safety.

Integration of an effective surveillance, risk assessment and risk management structure requires support from all levels of the organization. Since research has shown that incident reporting systems significantly under-report incidents and near-misses, additional information gathering sources are necessary. Interviews with health professionals are more effective than any other methods for identifying the full range of adverse events, although the cost is somewhat higher than other methods. Other approaches, depending on needs and circumstances also yield valuable information, e.g., medical record reviews, external audits, studies of claims and complaints, administrative data, autopsies, mortality and morbidity conferences, direct observations as well as patient satisfaction surveys.

Risk assessment and risk management including investigations of adverse events after they have occurred, and ongoing assessments to anticipate, prevent and mitigate potential risks are fundamental to ensuring and enhancing patient safety. These should include established mechanisms and processes for: surveillance to detect injury and near-misses; identification of potential risks and latent faults (e.g., system faults, poor workplace design, lack of communication, etc.); epidemiologic analysis; prioritization (considering the frequency and severity of harm or potential harm); identification of evidence-based strategies and best practices to reduce risks; testing of strategies for effectiveness; implementation of prevention strategies; monitoring and assessment of outcomes.
PART III: PATIENT SAFETY ISSUES AND MEDICAL ERRORS

4.0 PREVENTION OF HEALTH CARE ASSOCIATED INFECTIONS

4.1 Health Care Associated Infections: Key Factors and Issues

4.1.1 Prevalence and Incidence

Nosocomial infections, or health care associated infections (also called hospital-acquired infections) are the second most common type of adverse event that occur in hospitals, after medication errors (CIHI, 2004) [2]. Health care associated infections (HAIs) are defined as any disease or pathology related to the presence of an infectious agent or its products, as a result of exposure to health care facilities or health care procedures (PICNet, 2007 [2]).

In 2006, researchers estimated that one in nine hospital patients in Canada acquire an infection that may force a longer stay, cause greater pain, or even death (BC data is not readily available). In the US, it is estimated that nearly 2 million patients a year get an infection in a health care facility, and of those, 90,000 or 4.5% die as a result of the infection. HAI rates for hospital patients in New Zealand are estimated to be 10%, 6.3% in Australia (1998), 6-10% in France (1999), 8.3% in Spain, and 4% in Germany (Pratt, 2003 [3]).

Research indicates that the risk of acquiring nosocomial infections is related to a number of factors, including patients’ overall health status and the diagnostic or therapeutic interventions they receive. For example, older patients and those with underlying diseases tend to be more susceptible to infection. Intensive care, surgical, and orthopaedic units also tend to have higher infection rates, perhaps because of the severity of the patients’ illness and the types of treatment they receive (CIHI, 2004 [2]).

The most common types of HAIs for adult and paediatric patients, based on a Health Canada study, are urinary tract infections (27%), followed by pneumonia (27%), surgical site infections (21%), bacteremia (16%), and *Clostridium difficile*-associated diarrhea (9%). Adult patients in intensive care units were more likely to have an infection than surgical and medical patients. For children, infections were more common in infants than in older children (CIHI, 2004 [2]). With respect to long-term care facilities, the most common infections are urinary tract infections, respiratory infections (influenza, pneumonia), infected pressure ulcers, gastroenteritis, and conjunctivitis. (NOTE: infectious diseases are addressed in the core program on communicable disease, although many of the interventions that are required within health care facilities are the identical and require strict surveillance, risk assessment and risk management. For example, highly contagious diseases such as Severe Acute Respiratory Syndrome (SARS) require clear hospital protocols for infection control precautions and outbreak management. Communicable disease outbreaks are addressed in the Health Emergency Management core program and the Communicable Disease core program.

The Public Health Agency of Canada calculated that the annual burden of illness from HAIs in Canada, including surgical wound infections, pneumonias, bacteremias, and urinary tract infections, exceeds $453 million: emerging antibiotic resistant organisms (i.e., Methicillin-resistant *Staphylococcus aureus* or MRSA, and Vancomycin-resistant *Enterococci*, or VRE) total
an additional $24-35 million. Surgical site infections (SSIs) alone are estimated to total $169.9 million per year (PICNet, 2007).

4.1.2 Key Factors and Issues

- The elderly, the very young and those with weakened immune systems are the most at risk of HAIs (National Audit Office, 2004 [2]).

- There has been an increase in the number and frequency of infections resistant to common antibiotics, and this in turn has increased the complexity of managing and controlling infection (National Audit Office, 2004 [2]):
  - In the US, 25% of HAIs involve patients in intensive care units; nearly 70% of these are due to microorganisms that are resistant to one or more antibiotics (Pratt, 2003 [3]);
  - In the UK, the proportion of Methicillin-resistant *Staphylococcus aureus* (MRSA) was almost 40% in 2003, compared to just over 2% in 1992 (National Audit Office, 2004 [2]).

- Recent reports suggest that *Clostridium difficile* (CDAD) incidence is increasing and illness is becoming more severe. A strain identified in Quebec, Toronto and six American states has been found to produce 20 times the levels of toxins than previously studied strains, and has resulted in attributable mortality rates as high as 16.7% (PICNet, 2006). In Quebec, in 2004, infections with the 027 strain caused 109 deaths over a six month period (Healthcare Commission, 2005).

- Surgical site infections (SSIs) develop in 2-5% of Canadian patients during the post operative period. Patients with SSIs have a five times greater chance of re-admission and are twice as likely to die, in comparison with non-infected surgical patients. An effective surveillance program can prevent up to 35% of such infections (PICNet, 2006).

- The adherence of health care workers to recommended hand-hygiene procedures has been poor with a mean rate of 40% (e.g., a 2006 study observed that, prior to patient contact, 67% of health care workers did not wash their hands; 22% were partially compliant, and only 11% were fully compliant). Nurses were more likely to comply with hand-washing precautions than other personnel. One study revealed that the higher the demand for hand hygiene, the lower the adherence. For example, in areas requiring high frequency and intensity of interaction with patients, such as intensive care, the adherence rate is low.

- There is an apparent shortage of physicians and/or doctoral level staff, epidemiologists, support staff, and public health and occupational health personnel with specialized training in infection prevention and control in Canada (PICNet, 2007).

- It is estimated that 30% to 50% of nosocomial infections in Canada are preventable (Zoutman, 2003) [6].
4.1.3 Current Initiatives

The Provincial Infection Control Network (PICNet), established in 2005 under the auspices of the Provincial Health Services Authority and the BC Centre for Disease Control, is responsible for providing advice and strategic interventions on relevant policy, procedures and issues across the continuum of care for health authorities. PICNet working groups are addressing: needs assessment, communications, urgent/emergent issues, and infrastructure design. As well, working groups are drafting recommendations and guidelines for: surgical site infection surveillance; antibiotic resistant organisms; and *Clostridium Difficile* surveillance.

The first report of the needs assessment working group identified three overarching themes:

- Insufficient number of skilled staff in BC to provide infection control services;
- Inconsistent standards to enable education and training on the skill sets necessary for provision of infection control services; and
- Inconsistent standards in surveillance and best practices to guide those who deliver infection control services.

The Antibiotic Resistant Organism Working Group is revising the current BCCDC Antibiotic Resistant Organisms (ARO) Guidelines to include sections on hemodialysis, occupational health issues and other areas deemed necessary. Both the Surgical Site Infection Surveillance Working Group and the Working Group on *Clostridium difficile* have developed recommendations.

The BCCDC issues the Communicable Disease Control Manual which is used extensively throughout BC for control of antibiotic-resistance organisms and for managing outbreaks. The Public Health Agency of Canada also issues guidelines that are widely used across the province. The PICNet has highlighted the need for clarity regarding which provincial organization is responsible for issuing and maintaining communicable disease standards and guidelines within and amongst the health authorities. Seeking this clarification has prompted an initiative at the provincial level (under the auspices of the Provincial Communicable Disease Policy Committee).

All BC health authorities are participating in a national safety initiative called “Safer Healthcare Now!” initiated by the Canadian Patient Safety Institute. Initially six targeted interventions were included, of which three were connected to infection control: Prevention of Central Line-Associated Bloodstream Infection, Prevention of Surgical Site Infection (selected surgeries), and Prevention of Ventilator-Associated Pneumonia (other initiatives focused on Improved Care for Acute Myocardial Infarction, MedRec (medication reconciliations) for Acute Care, and Rapid Response Teams). In 2008, four new interventions were included, including one on infection, Antibiotic Resistant Organisms (the other three are MedRec for Long-term Care, National Collaborative on Falls in Long Term, and Venous Thromboembolism). Involvement in the initiative requires the collection of baseline data on current infection rates in these areas so that future comparisons can be made to assess progress.
4.2 Prevention Strategies for Health Care Associated Infections

A wise range of prevention strategies are discussed in detail in the following sections, including:

- Integrated organizational planning;
- Information management and surveillance;
- Staffing levels and training;
- Handwashing;
- Personal protective equipment;
- Isolation of infected patients;
- Family cleaning and disinfection;
- Practices on reuse of medical devices; and
- Strategies for residential care facilities and home care.

4.3 Prevention Strategies: Integrated Organizational Planning

The BC Auditor General (2007 [2]) found that:

- Planning for infection prevention, surveillance and control by the health authorities needs to be strengthened with an integrated plan that includes infection control and management across all services. It is recognized that communicable disease control is included in public/population health plans, as well as in additional programs in some cases, however, there is a lack of integration across the continuum of all health care programs.

- Health Authority Medical Advisory Committees are providing only limited oversight of infection prevention, surveillance and control. Although these Committees are responsible for receiving reports from Infection Control Committees, they are given very limited information on infection control issues.

The Provincial Infection Control Network (PICNet) report An Assessment of Infection Control Activities across the Province of British Columbia. Needs Assessment Part Two: Staffing and Training Final Draft suggested the elements for an infection control program:

1. Developing, implementing and monitoring surveillance of health care associated infections.
2. Setting and recommending policies and procedures to prevent adverse events - these policies and procedures must be:
   - Based on scientifically valid infection prevention and control measures;
   - Practical to implement;
   - Regularly reviewed to maintain accuracy and validity;
   - Monitored for compliance;
3. Intervening directly to prevent the transmission of infectious disease.
4. Receiving and maintaining adequate resources to support effectiveness of the program.

Similarly, the UK Health Act, “Code of Practice for Clean Hospitals”, describes the organizational systems that are necessary for the prevention and control of HAIs. These include: management arrangements to include access to accredited microbiology services; clinical leadership; application of evidence based protocols and practices for both patients and staff; the design and maintenance of the environment and medical devices; and education, information and communication.

As financial resources are often a key consideration in developing enhanced programs, the cost effectiveness of implementing an effective infection control program has been explored in a number of cost-benefit studies:

- PICNet’s Surgical Site Infection Surveillance Working Group’s Strategic Plan and Option Paper (2006) demonstrates that even a 15% reduction in the surgical site infection rate will save the health care system $2.7 million per year—savings that are far more than the cost of establishing a province-wide surgical site infection surveillance program.
- A 2003 US study showed that the cost of maintaining one hospital bed for a year would support a full hospital infection control program in a 250-bed hospital (Nettleman, 2003).

4.4 Prevention Strategies: Information Management and Surveillance

Infection rate monitoring is a necessary function that is required to meet the Canadian Council on Health Services Accreditation’s (CCHSA), Patient Safety Goals and Required Organizational Practices. In BC, the Auditor General found that surveillance of infections and monitoring of infection control practices has been relatively weak, although there is increasing awareness of its importance (Office of the Auditor General, 2007 [2]).

Zoutman (2003 [6]) found that in some Canadian centres, surveillance was ineffective because data was not being reported to staff: only two thirds of hospitals routinely communicated surveillance data to staff and only a third reported surgical site infection data to individual surgeons. It was found in the Study on the Efficacy of Nosocomial Infection Control (SENIC) that success in reducing surgical site infection rates required reporting directly to surgeons. In the absence of ownership and access to such data, hospital acquired infection is perceived as a problem for the infection control team to deal with, and consequently many of the issues identified as barriers to effective infection control practice are not addressed (National Audit Office, 2004 [2]).

In the UK, it was found that 50–70% of surgical wound infections occurred post-discharge but only a quarter of infection control teams carry out any post-discharge surveillance. The most common post-discharge methods were: telephone follow-up (40%); general practice reporting
(23%); patient completed questionnaires (20%); and out-patient follow-up (23%). Three-quarters of orthopaedic and vascular clinical leads noted that they carried out a form of post-discharge surveillance, as part of their routine clinical follow-up of patients (National Audit Office, 2004 [2]).

In BC, the Provincial Infection Control Network (PICNet) has been conducting reviews and developing recommendations and standards in a number of key areas. The Surgical Site Infection Surveillance (SSI) Working Group was formed in 2005/2006 to provide a framework for a standard method of surgical site infection surveillance and reporting that can be applied according to the needs of acute care hospitals in BC. This group has recently issued a recommended strategic plan, which points out the benefits of an effective SSI surveillance program. These are:

- **Decreased Morbidity** – SSIs develop in 2 to 5% of Canadian patients during the post-operative period. Each one of these infections adds an average additional cost of $3,700 to the health care system. An effective surveillance program can prevent up to 35% of such infections.

- **Cost Savings** – Based on 100,000 inpatient surgeries in BC per year at a 5% infection rate, even a 15% reduction in infection rate will save the system $2,775,000 per year—far more than the cost of establishing a province-wide surgical site infection surveillance program.

- **Meeting Accreditation Standards** – An effective surveillance program will ensure that BC health authorities and facilities comply with the expectations of the CCHSA Patient Safety Goals and Required Organizational Practices.

- **System and Operational Improvements** – The surveillance system will equip the facilities with: a consistent and accurate method of data collection; the ability to analyze and report SSI surveillance data and give timely feedback of SSI rates to surgical teams; a system to monitor and quickly identify the presence, magnitude and risk factors of an SSI cluster or outbreak; a process to identify and promote best practices; and a means to implement changes that are based on surveillance data analysis in order to minimize the occurrence of SSIs.

PICNet recommends that each health authority create a local group to design, implement and manage the SSI program in their institutions. This group will select SSI surveillance suitable for their specific needs and the surgical procedures performed, using the standardized surveillance methods agreed upon with SHAIP-BC. Features include:

- Principles that ensure accountability at the health authority level; voluntary implementation; provincial coordination and support for systems at the facility and Health Authority level; publicly released results accompanied by a detailed interpretation in order to prevent misinterpretation; public release of information authorized by the individual health authorities; provincial release of information based on the pooling of health authority results with no institutional or surgeon-specific rates for comparisons.
Surveillance that is focused on a few frequently performed surgical procedures with a significant SSI rate. This information can then be used as indicators for assessing the system. The selected surgical procedures need to be of sufficient numbers; have a minimum of technical variations; have a clinically important and statistically significant infection rate to justify surveillance (e.g., hip replacement surgeries and complications arising from infections after hip replacement).

A surveillance system that is able to report findings back to the individual facilities; have processes in place for the interpretation of results; make constructive recommendations on improvements.

Post-discharge surveillance can be done by patient questionnaire, phone surveys, information from outpatient visits or doctor’s offices, lab culture results, and/or selective data mining (for example MSP fee codes).

Audits can be used as an alternate method of assessment in small facilities where surveillance of surgical site infections is not applicable because of the low frequency of procedures. Audits should be part of all surveillance programs; be performed in all facilities on a regular basis at a frequency that resources allow; vary with the type of institution and the resources available; be used in a judicious manner; and include recommendations to address deficits; include follow-up at scheduled intervals to assess progress (PICNet Surgical Site Infection Surveillance, n.d.).

Several other countries have recently developed similar surveillance systems and may provide useful templates for the BC program. The health care associated infections surveillance system in Scotland: Scottish Surveillance of Healthcare Associated Infections Program (SSHAIP http://www.hps.scot.nhs.uk/haic/sshaip); and/or the program in Victoria State in Australia: Victoria Hospital Acquired Infection Surveillance System (VICNISS http://www.vicniss.org.au/) may serve as program delivery models for BC. Both systems have robust methodologies that have been adapted from the US NNIS (US National Nosocomial Surveillance http://www.cdc.gov/ncidod/dhqp/nnis.html) system. The Scottish system’s mandate to place emphasis on creating local ownership of surveillance data matches the framework outlined by PICNet’s Surgical Site Infection Surveillance Working Group. The two-tiered surveillance approach from Victoria State in Australia acknowledges the different surveillance needs for small and large hospitals. (PICNet Surgical Site Infection Surveillance (nd).

4.5 Prevention Strategies: Staffing Levels and Training

4.5.1 Staffing Levels

The Infection Control Alliance (an alliance between the Canadian Infectious Disease Society, the Community and Hospital Infection Control Association and Health Canada) has recommended a ratio of one Infection Control Practitioner (ICP) per 175 active care beds. 80% of Canadian hospitals fail to meet this standard. Health Canada has been considering even more stringent standards: these envisage one practitioner per 115 acute beds, and one per 250 long-term beds. These ratios would drop further for institutions with critical care beds. Although there have been recent improvements in Canadian hospitals, in 2003, 40% of infection control programs had fewer ICPs than recommended (Zoutman (2003) [6].
PICNet (2007) recommends the following staff level ratios for ICPs and infection control physicians in BC.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Ratio of ICPs and IC Physicians</th>
<th>Responsibilities</th>
</tr>
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| Acute care | 0.8 to 1.0 ICP per 100 to 175 occupied acute beds | • staff education  
• surveillance  
• professional development  
• outbreak management  
• antmicrobial resistance management  
• committee work  
• administration of IPC program  
• new products evaluation consultation of renovation/construction projects  
• policy and procedure development/implementation  
• communicable disease management |
|          | 1 FTE infection control physician for every 1000 occupied acute beds |                                                        |

The number of certified Infection Control Practitioners required for a comprehensive program has not been firmly established, but the general guideline is 1 for every 150–175 acute care beds and 1 for every 150–250 residential care beds, taking into consideration the complexity of care (Office of the Auditor General, 2007 [2]).

An additional staffing issue relates to general staffing levels. Outbreak investigations have indicated an association between infections and understaffing or overcrowding including poor adherence to hand-hygiene policies in situations of high workload (CDC, 2003 [3]).

These problems are demonstrated in a prospective cohort study (Hugonnet, 2007 [1]) of 415 intensive care patients. The overall median nurse-to-patient ratio, per 24 hours, was 1.9 (range 1.8–2.2). Fluctuation in the daily nurse-to-patient ratio was mainly due to changes in the number of patients. Findings were:

- Infection rates were higher with lower nurse-to-patient ratios. The daily proportion of infected patients was correlated neither with the nurse-to-patient ratio of the same day, nor with the preceding day, but was correlated with the nurse-to-patient ratio of 2, 3, and 4 days prior. The nurses’ training level was not associated with nosocomial infection.

- Infection rate was more than two times higher among patients staying more than 7 days than among patients staying less than 7 days. Hospital mortality rate among infected and noninfected patients was 36.2 and 19.0%, respectively. ICU mortality rate was 24.6% among infected and 10.6% among noninfected patients. Median length of stay in hospital was 28 days among infected patients and 16 days among noninfected patients. (Hugonnet, 2007 [1]).

Hugonnet concluded that under the pressure of increased workload, health care workers do not comply with infection control measures due to time constraints. However, the causal pathway linking low staffing level and infections is likely to be complex (Hugonnet, 2007 [1]).
4.5.2 Staff Education and Training

Education and training focused specifically on enhancing knowledge of HAIs and the importance of infection control programs appears to be an important factor. Related research includes:

- Programs for teaching and updating staff on infection control practices were present in 83.2% of Canadian hospitals; however, only 23.5% had similar programs for medical staff (Zoutman, 2003 [6]).

- Fewer than 60% of Canadian hospitals have a physician serving as infection control director. Those who fill these roles sometimes lack formal training, while others have a role that is spread across multiple institutions. Infection control practitioners tend to be either nurses (88%) or laboratory technologists (10%) who learn on the job. 55% are certified—usually by the Certification Board of Infection Control and Epidemiology in the United States (Health Canada, 2003 [5]).

- No formal orientation is offered for new physicians joining the medical staff of BC health authorities, and no ongoing education provided on infection control for medical staff, although it is recognized that infection control issues may be raised as part of morbidity and mortality rounds or grand rounds, or be a topic of discussion at departmental or medical staff meetings. However, as all health authorities require medical staff continuing education, infection control should be added to this schedule (Office of the Auditor General, 2007 [2]).

- The focus of the education interventions is to encourage a behaviour change through improved understanding of the problem that the facility is trying to control. Whether the desired change involves hand hygiene, antimicrobial prescribing patterns, or other outcomes, enhancing understanding and creating a culture that supports and promotes the desired behaviour, are viewed as essential to the success of the intervention (CDC, 2006 [3]).

- Several studies have identified that both a lack of knowledge of guidelines and non-adherence to guideline recommendations are widespread and require ongoing in-service education and training (Pratt, 2007 [3]).

4.6 Prevention Strategies: Handwashing

Hand hygiene is a primary measure to reduce infections. There is ample epidemiologic evidence to demonstrate that many infections are transmitted from one person to another via the hands of health care providers. Hands are easily contaminated during the process of care-giving or from contact with environmental surfaces in close proximity to the patient. Without adherence to published recommendations for hand hygiene and glove use, health care providers are more likely to transmit infections to patients (CDC, 2006, Management of Multidrug-Resistant Organisms [3]). Though the action is simple, the lack of compliance among health care providers is problematic throughout the world. Following recent understanding of the epidemiology of hand hygiene compliance, new approaches have proven effective (WHO, 2005 [3]).
Lautenbach (2001) defines the term *handwashing* as several actions designed to decrease hand colonization with transient microbiological flora, achieved either through standard handwashing or hand disinfection. Standard handwashing refers to the action of washing hands in water with detergent to remove dirt and loose, transient flora. Hand *disinfection* refers to any action where an antiseptic solution is used to clean the hands (i.e., medicated soap or alcohol). Handwashing with bland soap (without disinfectant) is inferior to handwashing with a disinfecting agent. Hygienic *handrub* consists of rubbing hands with a small quantity (2-3ml) of a highly effective and fast acting antiseptic agent.

### 4.6.1 Compliance

Average compliance rates are usually estimated at below 50%. They tend to vary between hospital wards, professional categories, and work conditions. For example, a study in Montréal found that nurses were more likely to comply with hand-washing precautions related to methicillin-resistant *Staphylococcus aureus* than physicians, orderlies, visitors, and housekeeping personnel. However, they were less likely to do so than occupational and physical therapists (CIHI, 2004, p. 63). As well, recent surveys demonstrate that although most health care workers recognize the importance of handwashing in reducing infections, they routinely overestimate their own compliance with this procedure (Lautenbach, 2001 [3]).

A survey of a BC health authority (2006) conducted by the Auditor General (2007) found that, based on 1,825 observations before patient contact, 67% of health care workers did no hand washing at all, 22% were partially compliant and only 11% were fully compliant. The audit also measured hand washing compliance before and after an invasive procedure (including Foley catheter insertion, suctioning, drawing blood, peripheral IV start, intubation). Based on 263 observations before a procedure and 292 after, the results were: 74% of health care workers did not do a hand wash before the procedure and 44% did not do so on completing a procedure. 7% were fully compliant before a procedure and 22% after a procedure; 19% were partially compliant before a procedure, and 34% were partially compliant after a procedure (BC Auditor General, 2007).

In the US, the CDC found that adherence of health care workers to recommended hand-hygiene procedures has been poor, with mean rates of 5%–81% (overall average: 40%) (CDC, 2003, *Guideline for Hand Hygiene*). The CDC also found that the higher the demand for hand hygiene, the lower the adherence: on average, adherence decreased when the intensity of patient care exceeded 10 contacts per hour. The lowest adherence rate (36%) was found in intensive-care units, where indications for hand hygiene were typically more frequent (on average, 20 contacts per patient per hour). The highest adherence rate (59%) was observed in pediatric wards, where the average intensity of patient care was lower (an average of eight contacts per patient, per hour) (CDC, 2003, *Guideline for Hand Hygiene* [3]).

Failure to comply is a complex problem that includes lack of motivation and lack of knowledge about the importance of hand washing. It may also be due to real or perceived obstacles, such as understaffing, inconveniently located hand washing facilities, an unacceptable hand washing product or dermatitis caused by previous hand washing (PHAC, 1998, *Hand Washing, Cleaning, Disinfection* [3]). WHO identified additional perceived barriers to appropriate hand hygiene: lack of participation in hand hygiene promotion at an individual or institutional level; a lack of role
models for hand hygiene; lack of institutional priority for hand hygiene; lack of administrative sanction for noncompliance/rewards for compliance; and lack of an institutional safety climate (WHO, 2005, *Guidelines on Hand Hygiene* [3]).

### 4.6.2 Evidence-Based Studies and Strategies

#### The Geneva Study

A Swiss initiative used an uncontrolled before and after study design to assess effectiveness of a multifaceted hospital-wide campaign which combined the use of posters, intensive feedback on performance of health workers, and alcohol handrub placed at every bedside. Care was taken to ensure the support of senior doctors, nurses and managers to persuade them of the importance of hand hygiene. A key factor was involvement of senior managers who attended meetings throughout the early planning and implementation stages and fully supported the campaign.

Several researchers have reviewed the results of the Geneva campaign:

- Adherence to recommended hand-hygiene practices improved progressively from 48% in 1994 to 66% in 1997. Whereas recourse to handwashing with soap and water remained stable, frequency of hand disinfection markedly increased during the study period, and the consumption of alcohol-based hand-rub solution increased from 3.5 to 15.4 liters per 1,000 patient-days during 1993–1998. The increased frequency of hand disinfection was unchanged after adjustment for known risk factors of poor adherence. During the same period, both overall health care–associated infection and MRSA transmission rates decreased. The observed reduction in MRSA transmission may have been affected by both improved hand-hygiene adherence and the simultaneous implementation of active surveillance cultures for detecting and isolating patients colonized with MRSA. The experience from the University of Geneva hospitals constitutes the first report of a hand-hygiene campaign with a sustained improvement over several years (CDC, 2003, *Guideline for Hand Hygiene* [3]).

- Gould (2007) notes that over a period of six years HAI was reduced by 44% in the University of Geneva hospitals. MRSA colonization rates fell by 50%. Continuing high levels of compliance are being achieved by combining use of alcohol products with intensive feedback on performance to health workers, resulting in a ‘continuous Hawthorne effect’. (Gould, 2007, *The Clean Your Hands Campaign*).

- Gould also identified ingredients that contributed to the success of the Geneva campaign, including: strong institutional commitment and support for the campaign, involvement of health workers, and excellent communication between staff of all grades. These were key contextual features of the Geneva initiative, which may be difficult to replicate in other studies, especially in countries where resources to perform infection control activities in health care facilities is limited (Gould, 2007, *Interventions to improve hand hygiene* [3]).

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4 The “Hawthorne effect” is a phenomena well-known in the human resource development field—by merely participating in a test, trial or study the participants (or patients) have a better experience because of the focusing of interest toward them which is gratifying and thus rewarding for its own sake. For this reason, the persons involved document better results irrespective of the change provided or the treatment experienced.
Core Public Health Functions for BC: Evidence Review
Prevention of the Adverse Health Effects of the Health Care System

- Although the campaign provides evidence of effectiveness, there were methodological issues that make the findings difficult to generalize. The intervention was limited to a single hospital. In the absence of suitable controls, an interrupted time series design was employed which is considered less robust than controlled trials. Moreover, when such research designs are used, the intervention should not affect the study outcomes. This was not the case in Geneva, where observation of hand hygiene was unobtrusive, but not covert (Gould, 2007).

The Clean Your Hands Campaign (CYHC)

The CYHC was launched by the UK National Patient Safety Agency in April 2005. All acute care NHS Trusts in England and Wales were supplied with a toolkit which comprised selected interventions drawn from the literature (primarily from the Geneva study) and considered by policy makers to have the potential to promote handwashing in clinical acute care settings. The interventions included: placement of alcohol-based products at every bedside and ward entrance; a system of repeated audit and feedback to encourage compliance; the use of posters and other promotional materials to remind staff and visitors to use alcohol handrub; and encouragement of patients to ask staff if they have decontaminated their hands before contact. The results were:

- Initial increases in compliance were coupled with reductions in HAIs, but there was limited follow-up and analysis.

- Posters were introduced in conjunction with other interventions, so it was not possible to determine their specific contribution. A review of the literature on the impact of posters and promotional materials could find little evidence that the knowledge and/or the training messages they convey result in increased lasting compliance with any type of health care intervention, including hand hygiene. They conclude that the format and presentation of posters suitable for promoting compliance requires careful design: they need to be eye-catching and appropriately framed (Gould, 2007, The Clean Your Hands Campaign [5]).

- The value of a patient’s role in ensuring that health workers wash their hands is equivocal. It appears to be based on the work of a single research study limited by short follow-up and located in an affluent part of the country where patients may be more comfortable challenging health workers than in less affluent areas. The appropriateness of hospital patients taking responsibility for their safety by asking health workers to wash hands has been severely criticized on the grounds that ensuring appropriate standards of infection control should be a fundamental and accepted part of every health workers’ role (Gould, 2007, The Clean Your Hands Campaign [5]).

- Gould (2007) also notes that policy makers seeking to implement the CYHC in the UK have ignored the contribution of contextual factors in the organization likely to influence success.

A number of studies or commentary on specific single interventions have also been identified. There include:

- A study conducted in an intensive-care unit demonstrated that it took nurses an average of 62 seconds to leave a patient’s bedside, walk to a sink, wash their hands, and return to patient care. In contrast, an estimated ¼ of this time is required when using alcohol-based
handrub placed at each patient’s bedside. Providing easy access to hand-hygiene materials is mandatory for appropriate hand-hygiene behaviour and is achievable in the majority of health care facilities (CDC, 2003, *Guideline for Hand Hygiene* [3]).

- Alcohol products are inexpensive and have excellent bactericidal activity against most Gram-negative and Gram-positive bacteria. A factor probably contributing to substantial success of the Geneva initiative, which has been overlooked by UK policy makers, is that the alcohol handrub used in Geneva incorporated chlorhexidine gluconate 0.5%. Chlorhexidine binds to the stratum corneum and remains effective for some time after it has been applied (Gould, 2007, *The Clean Your Hands Campaign* [5]).

- Two laboratory studies highlight the need for continued evaluation of the use of alcohol-based handrubs within the clinical environment. The first study, using European Union (EU) reference standards raises the possibility that alcohol-based gels may not be as effective as handrubs for short durations of use. Also, alcohol is not effective against some microorganisms such as *C. difficile*, will not remove dirt and organic material and may not be effective in some outbreak situations (Pratt, 2007 [3]).

- Ward housekeepers appear to have made a significant contribution to the success of the Geneva initiative. They replace posters promoting hand hygiene and ensure that handrub and other products are readily available. There are reports that in NHS wards, soaps, antiseptics and gloves run out at inconvenient times, operating as a disincentive to hand hygiene. Making sure supplies are always available is considered part of the ward housekeeper role in the CYHC, but this new grade of staff has not been as widely introduced as recommended (Gould, 2007, *The Clean Your Hands Campaign* [5]).

- A survey noted that approximately 75% of health care workers reported that rewards or punishments would not improve handwashing, but 80% reported that easy access to sinks and availability of hand washing facilities would lead to increased compliance (Lautenbach, 2001) [3]. Numerous studies have examined the effect of performance feedback on hand hygiene. Different approaches have been taken, ranging from verbal one-to-one feedback to written group feedback. Researchers note that campaigns are effective, in part, because health workers are aware they are being observed, but once the intervention ceases, its effect is not sustained (Gould, 2007, *The Clean Your Hands Campaign*) [5]. It has also been found that staff are more likely to respond positively to feedback that is given sensitively and takes into account factors such as heavy workload than if they feel 'policed' (Gould, 2007, *Interventions to improve hand hygiene* [3]).

- Several studies, conducted in various types of institutions, found that adherence varied by hospital ward and by type of health care worker, including modest and even low levels of adherence to recommended hand-hygiene practices in some cases. These results indicate that educational sessions may need to be designed specifically for different types of personnel (CDC, 2003, *Guideline for Hand Hygiene* [3]).
5.6.3 Success Factors

The WHO identified critical factors for the success of large-scale hand hygiene promotion in their Guidelines on Hand Hygiene. These include: involvement of the combined expertise of many professional groups; the presence of drivers for improvement; adaptability of the program; political commitment; policies and strategies that enable spread and sustainability; the availability of necessary finances; coalitions and partnerships; local ownership; the presence of external support agencies; the capacity for rapid dissemination and active learning; links to health care regulation; economies of scale that can be achieved through central production; and the capacity for public–private partnerships (WHO, 2005, Guidelines on Hand Hygiene [3]).

In a systematic review of 21 intervention studies to improve hand hygiene compliance, reviewers concluded that:

- Single interventions have a short-term influence on hand hygiene;
- Reminders have a modest but sustained effect;
- Feedback increases rates of hand hygiene but must be regular;
- Locating alcohol-based preparations near patients improves the frequency with which health care workers clean their hands;
- Multi-faceted approaches have a more marked effect on hand hygiene and rates of HAI than a single intervention;
- The use of alcohol-based handrubs near patients is consistently associated with greater compliance by health care staff (Pratt, 2007 [3]);
- A combination of education with written information, reminders and continuous feedback on performance were more useful than other interventions assessed (Gould, 2007, Interventions to improve hand hygiene [3]).

4.7 Prevention Strategies: Personal Protective Equipment

The use of gloves, gowns and/or facemasks by health care workers is widely recommended for use in certain procedures and in dealing with certain infections. For example:

- Expert opinion suggests that the primary uses of personal protective equipment are to protect staff and reduce opportunities for transmission of microorganisms in hospitals. However, several studies have identified that both a lack of knowledge of guidelines and non-adherence to guideline recommendations are widespread and require ongoing in-service education and training (Pratt, 2007 [3]).

- One study demonstrated that vancomycin resistant enterococcus (VRE) remained on the hands of health care workers after the removal of gloves. Therefore, the use of gloves as a method of barrier protection reduces the risk of contamination but does not eliminate it and hands are not necessarily clean because gloves have been worn (Pratt, 2007 [3]).

- Three studies evaluated the use of gloves with or without gowns for all patient contacts to prevent VRE acquisition in ICU settings. Two of the studies showed that use of both gloves
and gowns reduced VRE transmission while the third showed no difference in transmission based on the barriers used (differences in outcome and differing methodologies make comparisons difficult, i.e., adherence to the protocol, the influence of added precautions, and colonization pressure were not consistently assessed). (CDC, 2006 [3]).

- A systematic review failed to reveal any robust experimental studies on the value of health care workers wearing surgical facemasks. It indicated that protective eyewear offered protection against physical splashing of infected substances into the eyes (although not on all occasions) but that compliance was poor (Pratt, 2007 [3]).

### 4.8 Preventions Strategies: Isolation of Infected Patients

Although isolation of patients with infectious diseases is frequently recommended for patients with HAIs, there are a number of factors that must be taken into account. For example, it is necessary to reduce contamination through environmental cleaning and hand washing, and by restricting the inappropriate use of antibiotics (Healthcare Commission, 2005 [2]). Also, physicians must balance competing needs and issues related to the isolation of patients. New research suggests that while isolating patients may help to prevent the spread of disease, it may leave patients at higher risk for other adverse events. A study which compared the experience of patients isolated for MRSA (methicillin-resistant *Staphylococcus aureus*) colonization with that of non-isolated patients in two large North American hospitals, found that isolated patients were twice as likely to experience adverse events, defined by the researchers as injuries caused by medical management. The study found that failures in supportive care, such as falls and pressure ulcers, were eight times as likely. Furthermore, isolated patients reported being less satisfied with their treatment and had less documented care (CIHI, 2004 [2]).

### 4.9 Prevention Strategies: Facility Cleaning and Disinfection

A review of international literature highlights a growing recognition of the relationship between the effective cleaning of hospitals and the health and safety of patients and staff. The public and the media also believe that there is an indisputable link between cleanliness and hospital acquired infection. (National Audit Office, 2004 [2]). A common reason given for environmental contamination by a multidrug-resistant organisms (MDRO) is the lack of adherence to facility procedures for cleaning and disinfection. CDC notes that monitoring for adherence to recommended environmental cleaning practices is an important determinant for success in controlling transmission of MDROs and other pathogens in the environment (CDC, 2006 [3]).

The evidence also suggests that education and training interventions have positive results on cleaning and disinfection practices. For example, an educational and observational intervention, which targeted a defined group of housekeeping personnel, resulted in a significant decrease in the acquisition of VRE in a medical ICU (CDC, 2006 [3]).

As well, the decontamination of shared equipment is essential. A systematic review identified a number of studies demonstrating that pathogens can be recovered from a range of non-invasive clinical equipment, including stethoscopes, lifting equipment, and ultrasound probes. Following decontamination, none of the studies demonstrated a link to infection in a patient. This equipment should be appropriately decontaminated after each use with detergent and water (Pratt, 2007 [3]).
4.10 Preventions Practices on Reuse of Medical Devices

Another area that has received considerable attention is the reuse of medical devices designed for a single use. Opponents of this practice argue that hospitals cannot guarantee that they are reprocessing devices safely or that the full capabilities of the device are maintained. Others argue that dollars saved through reuse can be directed to other priorities and that restrictions will encourage manufacturers not to make reusable devices. For example, it has been estimated that Manitoba’s decision to ban the reuse of single-use devices that penetrate skin or make contact with blood or sterile body cavities cost the province about $5.5 million (CIHI, 2004).

In 2001, the Canadian Nosocomial Infections Surveillance Program (CNISP) surveyed 741 acute care hospitals about reuse of 67 critical or semi-critical devices and 17 others used in respiratory procedures. Examples included cardiac angiocatheters and laparoscopic instruments. In total, 403 (53%) acute care facilities responded to the survey. For each of 25 specific devices investigated, at least some facilities reported reusing the device. Similarly, CIHI data show that 13% of dialysis facilities across the country reported reusing dialyzers in 2001, down from 16% in 2000 (CIHI, 2004).

The Canadian Healthcare Association recommends that health care facilities which plan to reuse medical devices establish reuse committees and protocols. Although a 2001 survey found widespread reuse across Canada, only 38% of hospitals with more than 250 beds and 3% of smaller hospitals said that they had reuse committees (CIHI, 2004).

4.11 Preventions Strategies for Residential Care Facilities and Home Care

4.11.1 Key Factors and Issues

Elderly patients in the hospital and long-term care facilities are particularly susceptible to infection (Smith, 1997 [3]). The CDC estimates that 1.5 million nosocomial infections occur annually in residents of long-term care facilities in the US: this translates to an average of one infection per resident per year. The studies found nosocomial infection prevalence rates ranging from 2.7% to 32.7%, and incidence rates ranging from 10.7% to 20.1%, or 2.6 to 7.1 infections per 1,000 resident days. The most common infections found in long-term care facility surveys are urinary tract infections (UTIs), respiratory infections (influenza, pneumonia), infected pressure ulcers, gastroenteritis, and conjunctivitis (Smith, 1997 [3]).

The prevalence of methicillin-resistant Staphylococcus aureus (MRSA) in nursing homes in the US is now 9-34%. Similar data for Canada are not available, but prevalence rates are thought to be lower (PHAC, 1999 [3]).

Antimicrobial resistance rates are strongly correlated with hospital size, tertiary-level care, and facility type. Even though the frequency is low in long-term care facilities, MDRO infections can cause serious disease and mortality, and colonized or infected long-term care residents may serve as reservoirs and vehicles for MDRO introduction into acute care facilities (CDC, 2006). PHAC (1999) notes that most long-term care residents with MRSA or VRE became colonized during previous admission to acute care centres, and may then re-introduce the pathogens into acute care centres. Because of persistent carriage and slow turnover of residents, there is a cumulative increase in prevalence over time. (PHAC, 1999 [3]).
There are some additional challenges to infection control in long-term care facilities, such as shared rooms and toilets, inadequate hand washing facilities, common dining rooms and living areas, wandering or confused residents, high resident to staff ratios, non-professional staff, and limited resources for infection control (PHAC, 1999 [3]). Conversely, characteristics that support a lower risk of transmission include residents who are generally not severely ill, have few invasive devices and are usually fully dressed with minimal contamination of the environment (PHAC, 1999 [3]).

With respect to home care, there is little evidence to suggest that provision of health care in the home setting results in substantial disease transmission. Most infections in this setting are related to procedures and devices such as urinary or intravascular catheters (PHAC, 1999, Routine Practices [3]). The majority of home care providers, in a survey, reported that hygiene issues were the reason for their difficulties. (2004 [6]).

4.11.2 Prevention Strategies

The BC Auditor General recommends that health authority contracts with providers of residential care services identify requirements in the Performance Management Framework for contractors including: infection control policies and procedures; a wound management policy and procedure; a risk management plan; and a staff training plan before opening (Office of the Auditor General, 2007 [2]).

The value of education for infection control staff of long-term care facilities has long been recognized and confirmed by surveys. For example, one study analyzed the effects of a 2-day, intensive basic training program on 266 infection control personnel. Trainees not only demonstrated an increase in post-course knowledge but, at 3- and 12-month follow-up, had a significant increase in implementation of key infection control practices (Smith, 1997 [3]).

Although prevention measures are primarily the same as in acute care hospitals, it may be necessary to adapt these to the circumstances in long-term care facilities. Experts note that:

- Handwashing is the most important infection control measure in long-term care facilities, as well as in the hospital. Unfortunately, inadequate handwashing has been noted in long-term care, as in other settings. (Smith, 1997 [3]).

- It is essential that everyone providing care in the community is educated about hand decontamination, the appropriate use of gloves and protective clothing, and the safe disposal of sharps (Department of Health, 2006 [5]).

- Additional precautions, as well as routine practices, are necessary to prevent infections transmitted by the airborne or large droplet routes. These may be indicated for residents with certain highly transmissible or epidemiologically important microorganisms (PHAC, 1999 [3]).

- Residents of long-term care facilities, and home care clients and their families, should understand the nature of their infectious disease and the precautions being taken, as well as the prevention of transmission of disease to all family members and friends (PHAC, 1999 [3]).
Transportation services should have policies and procedures in place for transporting residents with transmissible infections. If any additional precautions are indicated during transport, the facility should inform the personnel transporting the resident (PHAC, 1999 [3]).

The program should be involved in quality management (QM), environmental review, antibiotic monitoring, product review and evaluation, and reporting of diseases to public health authorities (Smith, 1997 [3]).

4.11.3 Staffing Levels

PICNet, has outlined staffing suggestions for residential care in the report, An Assessment of Infection Control Activities across the Province of British Columbia. Assessment Part Two: Staffing and Training Final Draft (p.12):

<table>
<thead>
<tr>
<th>Setting</th>
<th>Ratio of ICPs and IC physicians</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>1 FTE per 150-200 occupied beds in long-term care</td>
<td>• Staff education&lt;br&gt;• Surveillance&lt;br&gt;• Professional developments&lt;br&gt;• Outbreak management&lt;br&gt;• Antimicrobial resistance management&lt;br&gt;• Committee work&lt;br&gt;• Administration of IPC program&lt;br&gt;• New products evaluations consultation on renovation and construction&lt;br&gt;• Policy and procedure development implementation&lt;br&gt;• Communicable disease management</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>At least 1 ICP per program with access to external infection control experts (infectious disease specialist)</td>
<td>• Surveillance&lt;br&gt;• Outbreak management&lt;br&gt;• Education&lt;br&gt;• Policies and procedures including dirty laundry, housekeeping&lt;br&gt;• Occupational health&lt;br&gt;• Resident health&lt;br&gt;• Lab resources</td>
</tr>
<tr>
<td>Home &amp; community care</td>
<td>At least 1 ICP/communicable disease nurse per program with access to external infection control experts (infectious disease specialist)</td>
<td>• Coordination of care as patients move from institutional to other health care sectors&lt;br&gt;• Surveillance of infectious diseases&lt;br&gt;• Community consultation&lt;br&gt;• Outbreak management&lt;br&gt;• Infection prevention and control education for formal and informal caregivers&lt;br&gt;• Orientation and continuing education for staff&lt;br&gt;• Marketing of basic infection and control measures (handwashing, vaccinations)</td>
</tr>
</tbody>
</table>
4.12 Conclusions – Health Care Associated Infections

Prevention and control requires long-term plans that include management commitment, clinical leadership, sufficient staff, and staff that are trained in infection control practices, evidence-based protocols, standards and practices, an environment that is designed and maintained for a high level of hygiene, as well as education, information and communication for both staff and patients.

Surveillance and monitoring systems that are linked to systems and operational improvement processes are important for early identification of infections including reporting in a timely way to infection teams, and in the case of surgical site infections, to individual surgeons. A surveillance system that encompasses interpretation of results, identification of best practices and development of recommendations is an especially important element in ensuring improvements.

Compliance with hand hygiene practices requires ongoing education as a number of studies reveal only short-term gains in this important preventive measure. Multi-component strategies are most effectively when they involve consistent and sustained initiatives rather than short term or single component strategies. It appears that factors supporting compliance over time were: strong institutional commitment and support for hand-washing campaigns, involvement of health care workers in campaigns, and excellent communication between staff at all levels.
5.0 PREVENTION OF MEDICATION ERRORS

5.1 Key Factors and Issues

5.1.1 Prevalence and Incidence

A recent CIHI survey notes that 1 in 10 adults with a health problem report receive the wrong medication or dose. This is the same ratio as adults contracting a nocosomial infection (CIHI, 2007).

A number of studies have estimated the extent of medication errors:

- In BC, the province-wide PharmaNet system captured 35.3 million prescriptions in 2003 and flagged more than 7.9 million for potential interactions. Of these, about 12% (948,000) were classified as “most significant,” generally requiring action to reduce the risk of a serious adverse interaction; 6% were deemed “possibly significant”; and 82%, were in a “moderate” category, indicating that pharmacists should assess patient risk and take action as needed (CIHI, 2004).

- In Canada, 19% of hospital Registered Nurses reported in 2005 that medication error involving patients in their care had occurred “occasionally” or “frequently” in the past year (Statistics Canada, 2005).

- In Australia, 2–4% of all hospital admissions are medication-related, with higher rates for emergency admissions, even higher rates for admission to medical wards, and the highest rates in the elderly, rising to >30% for unplanned admissions in patients >75 years of age. Two-thirds of events were considered to have no or minor sequelae, 19% moderate sequelae, and 3% significant sequelae (Runciman, 2003).

- UK audits conducted at the ward-level suggest that medicines were a factor influencing the admission for one in every 69 acute care patients (Healthcare Commission, 2007).

5.1.2 Adverse Effects, Causes and Contributing Factors

- Inappropriate drug therapy most often results in an allergic reaction or affects the skin (34.4%) and is attributed to anti-infectives. The next most frequent adverse outcomes are: hepatotoxicity or nephrotoxicity (14.3%), adverse outcomes affecting the cardiovascular system (e.g., bradycardia or hypotension) (13.2%), hematologic effects including electrolyte imbalances and bleeding (13.2%), and central nervous system effects such as over-sedation or confusion (10.5%) (Kanjanarat, 2003).

- An overview of the stage at which errors occur in the medication process are:

<table>
<thead>
<tr>
<th>Reference</th>
<th>Prescribing</th>
<th>Transcribing</th>
<th>Dispensing</th>
<th>Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHRQ (March 2001)</td>
<td>39-49%</td>
<td>11-12%</td>
<td>11-14%</td>
<td>26-38%</td>
</tr>
<tr>
<td>Kanjanarat (2003)</td>
<td>56%</td>
<td>6%</td>
<td>4%</td>
<td>34%</td>
</tr>
<tr>
<td>Santell (2003)</td>
<td>15%</td>
<td>26%</td>
<td>21%</td>
<td>37%</td>
</tr>
<tr>
<td>Franklin (2005)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lisby (2005)</td>
<td>39%</td>
<td>56%</td>
<td>4%</td>
<td>41%</td>
</tr>
</tbody>
</table>
Aspden (2007) [5] identified the frequency of errors at each stage of the medication:

<table>
<thead>
<tr>
<th>Stage</th>
<th>Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordering</td>
<td>• Lack of knowledge of the drug</td>
</tr>
<tr>
<td></td>
<td>• Lack of information about the patient</td>
</tr>
<tr>
<td></td>
<td>• Rule violations</td>
</tr>
<tr>
<td>Transcription and</td>
<td>• Transcription errors</td>
</tr>
<tr>
<td>Verification</td>
<td>• Lack of knowledge of the drug</td>
</tr>
<tr>
<td></td>
<td>• Lack of information about the patient</td>
</tr>
<tr>
<td>Dispensing</td>
<td>• Faulty drug identity checking</td>
</tr>
<tr>
<td></td>
<td>• Drug stocking and delivery problems</td>
</tr>
<tr>
<td></td>
<td>• Rule violations</td>
</tr>
<tr>
<td>Administration</td>
<td>• Lack of knowledge of the drug</td>
</tr>
<tr>
<td></td>
<td>• Infusion pump and parenteral delivery problems</td>
</tr>
<tr>
<td></td>
<td>• Slips and memory lapses</td>
</tr>
<tr>
<td></td>
<td>• Lack of information about the patient, faulty drug identity</td>
</tr>
<tr>
<td></td>
<td>checking, faulty interaction with other services, faulty</td>
</tr>
<tr>
<td></td>
<td>dose checking</td>
</tr>
</tbody>
</table>

Santell found the most frequently reported causes of medication error (both harmful and overall) were performance deficit and failure to follow accepted procedure/protocol. However, these often occurred in combination with other factors which contributed to the event. Contributing factors relate to circumstances surrounding the error, such as environmental influences and staffing issues. The most common factor was distractions (n = 18,645, 49%) (Santell, 2003 [5]).

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Distractions</td>
<td>49%</td>
</tr>
<tr>
<td>Workload increase</td>
<td>22.9%</td>
</tr>
<tr>
<td>Staff inexperience</td>
<td>17.3%</td>
</tr>
<tr>
<td>Staffing, insufficient</td>
<td>12.5%</td>
</tr>
<tr>
<td>Shift change</td>
<td>7%</td>
</tr>
<tr>
<td>Floating</td>
<td>4%</td>
</tr>
<tr>
<td>Performance deficit</td>
<td>38%</td>
</tr>
<tr>
<td>Procedure/protocol not followed</td>
<td>20%</td>
</tr>
<tr>
<td>Documentation</td>
<td>12%</td>
</tr>
<tr>
<td>Computer entry</td>
<td>11%</td>
</tr>
<tr>
<td>Knowledge deficit</td>
<td>10%</td>
</tr>
<tr>
<td>Communication</td>
<td>10%</td>
</tr>
<tr>
<td>Written order</td>
<td>6%</td>
</tr>
<tr>
<td>Drug distribution system</td>
<td>4%</td>
</tr>
<tr>
<td>Handwriting illegible/unclear</td>
<td>3%</td>
</tr>
</tbody>
</table>

One of the main factors contributing to medication errors is lack of access to drug information by physicians, nurses, and pharmacists at all points during the ordering, administration, and dispensing process (Massachusetts Coalition, 1999 [5]).

Look-alike (labelling), sound-alike (name confusion) medications have been identified as a significant contributor to medication adverse events. A related concern is the use of potentially confusing abbreviations, symbols, and dose designations (CIHI, 2004). McCarter (2003 [5]) noted that roughly one of every four errors reported to MERP (US...
National Coordinating Council for Medication Error Reporting and Prevention) involves a pair of drugs whose names look or sound alike (McCarter, 2003 [5]).

- Patient factors include:
  - CIHI (2004) [5] found that the more doctors a patient sees, and the more prescriptions a patient has, the more likely a patient is to report having experienced drug errors or medical mistakes;
  - Seniors represent about 12% of the Canadian population, but they take almost 33% of prescribed drugs (CIHI, 2004). Approximately 3.3% (2,673) of the geriatric errors reported to MEDMARX (the US National Database for Medication Errors) during a two-year period caused some level of patient harm. This was more than double the 1.58% occurrence of harm reported for all medication error records submitted during that same period. More than half (55%) of these errors occurred during the administering phase, in contrast to only 32% of all errors reported to MEDMARX. (Santell, 2005 [5]).
  - Medical errors can be linked to the patient’s condition, for example, prescription errors frequently result from failure to adjust dosages for the patient’s age, allergies, body mass, and for decreased renal, cardiac, or liver function (Phillips, 2002 [5]).
  - ADEs are more likely to result in life-threatening consequences in intensive care unit patients than in others (AHRQ, 2001 [5]).

- Patient transfer issues:
  - Studies indicate that most medication errors occur at patient care–transition points (hospital admission, transfer from one unit to another, and discharge to home or another facility). During these transitions, the transfer of medication information often is incorrect or incomplete. An estimated 46% of all medication errors occur during such transitions (Burke (2005) [5], (Chief Pharmaceutical Officer, 2004 [5]).
  - Studies of patient discharge summaries have revealed a high percentage of error, ranging from 16% to 36% (Lisby, 2005 [4]). Nickerson (2005 [1]) found that retrospective medical chart reviews revealed that 67/119 (56.3%) of the control patients were discharged from the hospital with an inconsistency or omission in the printed medication discharge list.

- A range of staffing issues has also been identified as risk factors for medication errors:
  - Medication error has been positively associated with working overtime, role overload, working a 12-hour shift (compared to shorter shifts), perceived staffing or resource inadequacy, low co-worker support, and low job security (Statistics Canada, 2005).
  - The UK Audit Commission (2001) accepts that the increasing pace of work in hospital may increase error rate.
Roseman & Booker (1995) constructed a longitudinal study that assessed the effects of a range of workload factors. They found errors increased in line with the number of shifts worked by agency staff but errors decreased when shortfalls in staffing levels were covered by permanent staff working extra hours. Overall, researchers have found that the risk of making an error increased when hospital nurses worked more than 12 hours per shift, worked overtime, or worked more than 40 hours per week (Armitage, 2003 [5]; Burke, 2005 [5]; Santell, 2003 [5]; Phillips, 2002 [5]).

32% of 175 nurses questioned on the contributory factors in drug error believe that distractions and interruptions were a key factor (Armitage, 2003 [5]). Similarly, Santell, 2003 [5]), above, estimated distractions accounted for 49% of medication errors;

Poor inter-staff communication, inexperienced staff, new residents, and introduction of new medical techniques have also been identified as risk factors (Phillips, 2002 [5]).

It is estimated that adverse drug reactions (ADRs) are documented in only three-quarters of all cases (Runciman, 2003 [5]). UK Trusts estimate that 22 per cent of incidents go unreported (National Audit Office, 2005 [2]).

5.1.3 Current Status of Medication Safety in Canadian Hospitals

The current status of medication safety in Canadian hospitals was assessed through a survey conducted by the Institute for Safe Medication Practice in 2003. The survey was based on Medication Safety Self-Assessment™ (MSSA), which assists hospitals in identifying areas of risk in medication use. The MSSA was adapted for use in Canada. It revealed (Greenall, 2005):

Canadian hospitals scored the highest in management of medication delivery devices, environmental factors, and in drug standardization, storage and distribution:

- The highest score related to sequestering of hazardous chemicals from patients and drug preparation areas (aggregate response was 85% of the achievable score).
- The next highest score was for the use of proven infection control practices in storage, preparation and administration of medications (aggregate score of 80%).

The lowest scores were for: patient information, communication of drug orders and other drug information, staff competency and education, and patient education:

- The lowest score was availability of essential patient information (aggregate score of 40%).
- Categories that scored under 50% included: communication of drug orders in a standardized way, strategies for differentiating between look-alike/sound-alike drug products, provision of ongoing education about medication error prevention, encouragement of practitioner reporting, and multidisciplinary analysis of errors.
The score for management of error in a non-punitive way was 80% or greater, an encouraging result that suggests a safety culture is becoming evident.

Automatic screening of medication orders for patient allergies received a response of 80%; however, less than 20% was obtained for making patient allergies a mandatory field.

Mandatory entering of patient weights and a direct interface between the pharmacy and laboratory computer systems to automatically alert practitioners to the need for potential drug therapy changes also received a score under 20%.

Comparisons based on hospital demographics, such as bed size, type and specialty, revealed similar patterns of response, suggesting that hospitals of all sizes and types face similar challenges regarding their medication use systems.

Other findings revealed that Canadian hospitals were lacking in implementing high leverage safety strategies such as bar coding for medication administration, computerized physician order entry (CPOE) and creation of designated medication safety positions. The average aggregate scores of these characteristics were less than 35%. Follow-up by ISMP Canada suggested that high cost and complexity posed barriers to implementing these technologies.

The priority areas for action by BC were: manufacturer labelling/packaging and strategies for look-alike/sound-alike drug names; provision of ongoing safe medication education for practitioners; and active analysis of errors for system redesign.

5.1.4 Additional Factors and Issues

US studies on the cost of medication errors in the health care system concluded that they cause an additional length of hospital stay averaging 4.6 days with a cost of $5857 per case (Aspden, 1997). The total annual cost for the US, based on a conservative incidence rate of 400,000 preventable adverse drug events, with each incurring hospital costs of $5857, the total cost was estimated to be $3.5 billion, in 2006 dollars (Aspden, 2007). With respect to emergency room visits and admissions attributable to a prior error, the estimated cost was $10,375 per case (2001 data) (Aspden, 2007).

Medication errors can be difficult to identify. They may be intercepted before they reach the patient, reach the patient but be unnoticed, noticed but not be reported if the patient has not come to any harm. (UK Chief Pharmaceutical Officer, 2004 [5]).

There is a lack of standardization for medication error terminology. An ongoing controversy involves the definition and appropriate use of common nomenclature and an overall taxonomy for medication safety. This problem impacts the reliable measurement of medication safety and the comparison of interventions across different centres (Classen, 2003) (Yu et al., 2005). In particular, it is important that error reporting schemes differentiate between adverse events that are the result of medication error and those that have occurred during correct therapeutic drug use (UK Chief Pharmaceutical Officer, 2005).
The CIHI Canadian Medication Incident Reporting and Prevention System (CMIRPS) (2005) adopted definitions for reporting medication incident terms in Canada. Definitions for key terms are (see Appendix 2 for the full list):

- **Adverse drug event (ADE)** – an injury resulting from a medical intervention related to a drug (includes harm due to both adverse drug reactions and medication errors).

- **Adverse drug reaction (ADR)** – a noxious and unintended response to a drug, which occurs at doses normally used or tested for the diagnosis, treatment or prevention of a disease or the modification of an organic function.

- **Medication incident** – any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer.

- **Medication error** – any error in prescribing, dispensing or administration of medication.

- **Near-miss** – an occurrence with potentially important safety-related effects which, in the end, was prevented from developing into actual consequences.

- **Sentinel event** – an unexpected occurrence involving death, serious physical or psychological injury, or risk thereof. Serious injury specifically includes loss of limb or function (CIHI, 2005).

### 5.1.5 Current Initiatives

#### British Columbia

BC PharmaNet is a province-wide network that links all BC pharmacies and other health care sites to a central Ministry of Health database. It provides clinical drug information, supports drug dispensing, drug monitoring and prescription claims processing. It is in the process of being upgraded to integrate electronic patient records (EHRs) and to include more comprehensive patient medication profiles. This new eHealth program is supported by significant investments from Canada Health Infoway, which assist provincial projects that further the goal of creating EHRs for 50% of Canadians by the end of 2009. The improvements are designed to improve patient safety, enhance decision-making, improve coordination and delivery of care, prevent over-consumption of prescription drugs by unintended duplication or fraud, and promote better cost management. Prescribers will be able to enter prescriptions directly into PharmaNet and pharmacies will be able to retrieve the e-prescription for dispensing. The profiles will also be updated when a patient is discharged from hospital, with a summary of relevant medication and any updates to clinical conditions.

The British Columbia Therapeutics Initiative was established in 1994 by the Department of Pharmacology and Therapeutics in cooperation with the Department of Family Practice at University of British Columbia to provide physicians and pharmacists with up to date, evidence based, practical information on rational drug therapy. The Initiative is an independent organization, which is arms-length from government, the pharmaceutical industry and other
vested interest groups. The Therapeutics Initiative is funded by the BC Ministry of Health through a grant to the University of British Columbia.

**Federal Government**

Canadian Medication Incident Reporting and Prevention System (CMIRIPS) is currently being developed through a joint process defined in the CIHI/Health Canada Contribution Agreement for CMIRIPS (CIHI, 2005):

- Health Canada provides: secretariat support for the CMIRPS Operations Committee and Advisory Committee, conducts studies on adverse drug reactions related to medication incidents, and liaises with drug manufacturers to address any issues relating to medication incidents;

- Institute for Safe Medication Practices (ISMP) Canada takes the lead in: collecting and processing individual practitioner data, conducting root cause analysis for selected medication incidents, developing and disseminating information bulletins and conducting analytical studies regarding preventative strategies;

- CIHI takes the lead in: collecting and processing standardized health service organization data, developing a system capable of query and analysis, and conducting analytical studies and ad hoc requests.

In addition, Health Canada is currently responsible for maintaining the mandatory Canadian Adverse Drug Reaction Monitoring Program (CADRMP), a program that includes data pertaining to medication incidents which resulted in adverse drug reactions.

ISMP Canada operates two reporting systems (CIHI, 2005b):

- The National Voluntary Medication Incident and “Near Miss” Reporting Program is a voluntary, non-punitive medication incident reporting program modeled on the Medication Error Reporting Program (MERP) jointly run by ISMP (in the United States) and the United States Pharmacopeia (USP). Individual practitioners or consumers can report a medication incident through this system. Approximately 100 reports are received each year.

- An institutional-based system called Analyze-ERR is a software tool designed by ISMP Canada and ISMP (United States) for use in institutions to track and analyze medication errors. The aim is to create a computerized database of medication events for storage, retrieval, follow-up and analysis. Analyze ERR is currently in use in about 35 Ontario facilities. The two major components enable recording the factual account of the incidents, and conducting root cause analysis by systematically examining the contributing factors.
5.2 Prevention of Medication Errors

Prevention strategies are discussed in the following sections. These include interventions targeted to each stage of the drug distribution chain, and to other major risk factors that have been shown to contribute to medication error. The strategies are:

- Drug distribution chain:
  - Prescribing and transcribing;
  - Dispensing;
  - Administering drugs;
- Prevention strategies for specific drug types;
- Other prevention strategies;
- Prevention of medication errors in residential care.

It must be emphasized that these strategies require surveillance and monitoring based on a variety of information gathering processes, risk assessment and risk management activities. These processes are discussed in Part 2, Organizational/Management to Support Patient Safety.

5.3 Prevention Strategies: Prescribing and Transcribing

A clinically meaningful prescribing error is defined as occurring when “as a result of a prescribing decision or prescription writing process, there is an unintentional significant reduction in the probability of the treatment being timely and effective or an increased risk of harm when compared to generally accepted practice.” It is important to note that it is not considered to be a prescribing error if other prescribers with the same level of qualification and experience would do likewise (Cousins, 2005 [5]).

5.3.1 Causes of Prescribing and Transcribing Errors:

- The reasons for prescribing and transcribing errors include: inadequate knowledge of the patient and their clinical condition, inadequate knowledge of the drug, calculation errors, illegible handwriting, drug name confusion and poor history taking. Factors such as unfamiliar work environment, fatigue and workload may contribute to the risk of error; as well as poor team communication, poor physical and mental well being (Chief Pharmaceutical Officer, 2004 [5]; Cousins, 2005 [5]).

- Medication errors can also occur when prescriptions or orders are written or transcribed from one medication chart to another. The high frequency of discrepancies in drug form between medical records and medication charts were caused by nurses’ interpretation of drug prescriptions, and lack of drug formulation in the medical record (Lisby, 2005 [4]; Runciman, 2003 [5]).
The restrictive nature of drug formularies in some hospitals may pose a problem in clinical practice and can lead to non-adherence (e.g., differences between primary care formularies and the hospital formulary, etc.) (Guchelaar, 2005 [5]).

5.3.2 Prevention of Prescribing and Transcribing Errors

Clinical Pharmacist Consultation

A systematic review of literature published between 1966 and 1999 by the Cochrane Collaboration suggested that expanding pharmacists’ roles can be beneficial to patients and physicians alike. Since then, further studies have supported this approach, e.g., a 2003 U.S. study found that when pharmacists participated in medical rounds in hospital, drug errors fell by as much as 78% (CIHI, 2004).

Researchers found “strong” evidence for the benefit of clinical pharmacists in reducing ADEs in hospitalized intensive care unit patients. Another study provides modest support for the impact of ward-based clinical pharmacists on the safety and quality of inpatient medication use (Kaushal, 2001 [3]). Similarly, Aspden (2007 [5]) found that there is “medium strength” with respect to the evidence and efficacy of including a pharmacist on patient care rounds, and having a pharmacist available on call after hours of pharmacy operation. The evidence in the outpatient setting is less substantial, and not yet convincing (Kaushal, 2001 [3]).

McCarter (2003 [5]) noted that clinical pharmacy consultation services can be at the level of order review in the pharmacy or participation in decision-making processes at the site of care delivery. He suggested that the latter intervention may be most effective in environments more prone to error, or in environments where error is more likely to result in serious injury. Since error rates are higher in ICU environments, and paediatric and elderly populations are more prone to injury; ICUs, neonatal ICUs, oncology units, transplant units, geriatric units and similar settings may be best suited for this type of intervention (McCarter, 2003 [5]).

Pharmacists may also play a role at the time of discharge. One study reported the impact of clinical pharmacists’ consultation for geriatric patients at the time of discharge, with pharmacists serving as consultants to physicians and reinforcing patients’ knowledge of their medication regimen. The roles of clinical pharmacists are similarly diverse in studies of ambulatory settings. Here they include the provision of consultative services, patient education, therapeutic drug monitoring, and even follow-up telephone calls to patients. The study of geriatric patients at the time of discharge demonstrated clinically and statistically significant decreases in medication errors (Kaushal, 2001 [3]).

The UK Healthcare Commission reported in 2007 [2] that:

- When clinical pharmacy staff visited wards, it resulted in one safety intervention for every 26 patients seen;
- The importance of pharmacy staff involvement in the care of patients has been demonstrated by acceptance of a large proportion of their interventions – changes were made in the choice or dose of a medicine 4 times more often than there was no change;
Where patients are taking a number of medicines, reviews by pharmacy staff will continue to generate therapeutic interventions due to the risk of interactions between medicines;

Timely clinical pharmacy involvement is one way to provide an independent check on prescribing activity (Healthcare Commission, 2007 [2]).

Computerized Provider Order Entry (CPOE) and Clinical Decision Support Systems (CDSS)

Computerized Provider Order Entry (CPOE) systems refers to a variety of computer-based systems for ordering medications. They automate the ordering process and help to ensure standardized, legible, and complete orders. In addition, computer-based Clinical Decision Support Systems (CDSS), which are often built into order entry systems, can facilitate tasks such as drug selection, dosage, and duration calculations (CIHI, 2004 [5]).

CPOE specifically has been cited as one of the most effective measures for reducing medication errors.

- Computerized medication order entry has the potential to prevent an estimated 84% of dose, frequency, and route errors, based on research funded by the US Agency for Healthcare Research and Quality (AHRQ). These studies indicate that anywhere from 28% to 95% of ADEs can be prevented with these systems. For example, at least two studies attribute 42% to 60% percent of ADEs to excessive drug dosage for the patient's age, weight, underlying condition, and renal function. Automated systems are available that prompt doctors to take these factors into consideration when ordering medications (AHRQ, 2001 [5]).

- CPOE has been shown to: increase accuracy and legibility of the order; support institution-specific recommendations; integrate clinical decision support into the order-entry process; optimize physician, nurse, and pharmacist time; provide drug allergy checks; and identify drug interactions and incorrect dosages. Detailed reviews of these benefits have been published (Oren, 2003 [5]; Massachusetts Coalition, 1999 [5]; McCarter, 2003 [5]; CIHI, 2004, Health care [5]; Aspden, 2007 [5]; National Audit Office, 2005, A Safer Place [2], Chief Pharmaceutical Officer, 2004 [5]).

- Overall CPOE is associated with a significant reduction in hospital stay (Walton, 2001 [2]).

- While the literature supports CPOE’s beneficial effect in reducing the frequency of a range of medication errors and potential for harm, there is little research evidence demonstrating a decrease in actual patient harm (Kaushal, 2001 [3]; Hughes, 2005 [5]; Guchelaar, 2005 [5]).

- Where an ADE is not preventable, computerized systems can detect ADEs early so that health care providers can initiate interventions to mitigate the effects and lessen the severity of the reaction. Rather than rely on hospital staff to prepare written incident reports to track adverse events, improve quality, and assess risk (only 6% of ADEs are reported by this method), automatic systems can improve detection considerably (AHRQ, 2001 [5]).
Although it has been shown that implementation of a basic CPOE system can cause a major improvement in medication safety, there were only marginal improvements with the addition of sophisticated features to the system (Guchelaar, 2005 [5]).

Almost all CPOE systems include or interface with Clinical Decision Support Systems (CDSSs) of varying sophistication. Basic CDSSs may include suggestions or default values for drug doses, routes, and frequencies. More sophisticated CDSSs can provide drug guidelines for the physician, drug allergy information, drug-laboratory value checks, drug-drug interaction checks, in addition to providing reminders about corollary orders (e.g., prompting the user to order glucose checks after ordering insulin). Research on CDSSs indicate:

- Although doses with CDSSs tended to be higher than those used by unaided doctors, toxic drug levels and adverse effects were significantly reduced. This suggests that the computers helped doctors to tailor the dose of the drug more accurately to the individual patient. Higher doses with computer support may lead to more rapid therapeutic control, bringing benefits for patients and reducing the time spent in hospital (Walton, 2001 [2]).

- At times, CDSSs are implemented without CPOE. Isolated CDSSs can provide advice on drug selection, dosages, and duration. More refined CDSSs can incorporate patient-specific information (e.g., recommending appropriate anticoagulation regimens), or incorporate pathogen-specific information such as suggesting appropriate anti-infective regimens. After viewing such advice, the physician proceeds with a conventional handwritten medication order. CDSSs, on their own, appear to prevent a range of medication errors, but with few data transcribing reductions in ADEs or improvements in other clinical outcomes. The studied CDSSs address focused medication use (e.g., antibiotic dosing) rather than the more general aspects of medication use; they demonstrated statistically significant reductions in medication errors, as well as some decreases in ADE rates (Kaushal, 2001 [3]).

- Researchers caution that faulty decision support data can lead to inappropriate ordering choices by physicians. In addition, it is critical that the trigger level for warnings appropriately balance alarm sensitivity and specificity. The systems must have thresholds that provide physicians with warnings in situations with potential for significant harm, without being overwhelmed by “false alarms.” Another potential risk is hardware outage or software instability. For example, the reliability needed with CPOE is much higher than that required for systems that simply report laboratory results (Kaushal, 2001 [3]; Kaushal, 2003 [3]).

- In summary, studies provide some evidence that CPOE with CDSSs can substantially decrease medication errors in broad as well as in more focused areas. Despite the significant impact on medication errors, the reduction in ADEs did not achieve statistical significance in one study, and achieved only borderline significance in outcomes in the other study. Two RCTs and observational studies are noted. (Kaushal, 2001 [3]; Centre for Reviews and Dissemination, 2005 [5]).
**Other Supports**

Electronic medical records have been recognized as a fundamental element in developing automated health care systems. They can: provide timely access to comprehensive and essential clinical patient information to guide drug selection and regimen, reduce errors related to allergies, reduce errors related to order transcription, the use of abbreviations and name confusion (Hughes, 2005 [5]).

To help health professionals avoid error-prone prescribing, the Institute for Safe Medication Practices has compiled an updated list of medications with names that look-alike and sound-alike to alert providers and patients to those that may avoid confusion – [www.ismp.org/PDF/ErrorProne.pdf](http://www.ismp.org/PDF/ErrorProne.pdf) (CIHI, (2004).

### 5.4 Prevention Strategies: Dispensing Medications

#### 5.4.1 Causes of Dispensing Errors

Dispensing errors refer to an error detected and reported after a medication has left the pharmacy department (Cousins, 2005 [5]). Key features of dispensing errors include:

- The rate of dispensing errors in studies of hospital pharmacy departments were found to be 0.8% in one study, and in others, 0.4% and 0.08% (Runciman, 2003 [5]). Cousins (2005 [5]) reported an average incidence of 18.1 errors per 100,000 items dispensed across 19 hospital pharmacies;

- Cousins (2005 [5]) also found:
  - The most common errors involved the supply of the wrong medicine (23%), the wrong strength of the prescribed medicine (23%), the wrong directions for use (10%), and the wrong quantity of medicine (10%). 44% constituted other errors;
  - Factors contributing to the errors were ‘look alike’ and ‘sound alike’ medicines (33%), high workload and/or low staffing (23%), inexperienced staff (20%), transcription (14%) and 10% attributed to other causes; and
  - The errors were usually detected by nurses (45%), hospital pharmacists (17%), patients (17%) and other hospital staff (21%).

- Lisby (2004 [5]) found that the most common error types at the dispensing stage were unordered or omitted doses.

- Many dispensing errors are due to drug name confusion, failure to clarify an ambiguous or badly written prescription, similar packaging or lack of a check by a second person (Chief Pharmaceutical Officer, 2004 [5]).
5.4.2 Prevention of Dispensing Errors

The UK Chief Pharmaceutical Officer (2004 [5]) has noted that measures to reduce dispensing errors include:

- Formal dispensary checking systems and procedures;
- Providing patients with the opportunity to ask questions about their medicines; and
- Ensuring appropriate training and assessment of competency in dispensing and checking prescriptions accurately.

Unit Dosing

Unit-dose dispensing, including automated unit-dose dispensing, has become ubiquitous in American hospitals and a standard of care in the delivery of pharmacy services (JCAHO) (Murray, 2001 [3]). Single unit doses are prepared in hospital pharmacies to simplify administration of medications to patients. Automated unit dose dispensing devices appeared in the 1980’s; they are drug storage devices or cabinets that electronically dispense medications in a controlled fashion and track medication use. Their principal advantage lies in permitting nurses to obtain medications for inpatients at the point of use. Most systems require user identifiers and passwords, and internal electronic devices track nurses accessing the system, track the patients for whom medications are administered, and provide usage data to the hospital's financial office for the patients' bills (Murray, 2001 [3]).

The automated dispensing systems are stocked by centralized or decentralized pharmacies (in nursing units or wards, with a single decentralized pharmacy often serving several units or wards). More advanced systems provide additional information support aimed at enhancing patient safety through integration into other external systems, databases, and the Internet. Some models use machine-readable code for medication dispensing and administration. The invention and production of these devices brought hopes of reduced rates of medication errors, increased efficiency for pharmacy and nursing staff, ready availability of medications where they are most often used (the nursing unit or inpatient ward), and improved pharmacy inventory and billing functions.

Although the capacity of such systems to contribute to patient safety appears great, and the practice of unit-dose dispensing is generally well accepted, surprisingly few studies have evaluated the clinical impact of these devices (Murray, 2001 [3]).

- Studies on unit-dosing are overall relatively consistent in showing a positive impact on error reduction, although many contain methodologic problems and somewhat heterogeneous results. In contrast to other practices related to medication use, none of the studies evaluated Level 1 outcomes, such as actual adverse drug events (Murray, 2001 [3]).
- Research over the years continues to support the effectiveness of unit-dosing systems on reducing medication errors including: eliminating the need for calculation, measurement, preparation and handling on the nursing unit; making drugs available in ready-to-administer fashion; and providing a fully labelled package that stays with the medication up to its point of use (Massachusetts Coalition, 1999 [5]).
Automated Dispensing Machines (ADMs)

Dispensing of medications can be automated and, if linked with point-of-care barcode scanning and information systems, have the potential to decrease medication errors and increase effectiveness and work efficiency of the distribution process. When linked with point-of-care bar-coding and associated information systems, they ensure an electronic match between the physician-ordered medication and the corresponding administered medication. Automatic dispensing machines allow medications to be stored on nursing units and be retrieved quickly and conveniently (Guchelaar, 2005 [5]; Oren, 2003 [5]).

Research on ADMs indicates:

- The effects of ADMs on medication error rates and cost effectiveness compared with traditional systems are inconclusive (Guchelaar, 2005 [5]). Five studies observed a decrease in medication errors associated with ADMs; however, considerable interuser variability in the reduction of medication errors had been documented (Oren, 2003 [5]).

- Other researchers have noted that although the implementation of automated dispensing reduces personnel time for medication administration and improves billing efficiency, reduction in medication errors have not been uniformly realized. Indeed, some studies suggest that errors may increase with some forms of automation. There is no evidence to suggest that outcomes are improved with the use of these devices (Murray, 2001 [3]).

- One researcher noted that human intervention may prevent these systems from functioning as designed, particularly if pharmacists and nurses override some of the patient safety features. They point out that technology is not a solution for inadequate or faulty processes or procedures (Murray, 2001 [3]).

5.5 Prevention Strategies: Administering Drugs

5.5.1 Medication Administration Errors

- Errors in administering medications (excluding wrong time errors) range from 2.4-11.1% (Aspden, 2007 [5]). In one study, the error rate at a decentralized pharmacy intravenous admixture unit operated by skilled pharmacy technicians was 2% (7 of 330 intravenous doses were judged as errors because of poor aseptic technique) compared with 71% when nurses made the preparations on the ward (Guchelaar, 2005 [5]).

- Omissions and wrong time errors were the most frequently reported errors (Santell, 2003 [5]).

- Administration errors have been linked to risk factors that contribute to other errors, for example, the greatest risks of medication administration error are the first 48 hours after admission and the first 48 hours after prescribing (Cousins, 2005 [5]).
• One study found that 150 of 412 (36%) doses were administered without verbal verification of the patients’ identity (Lisby, 2005 [4]). Another study noted concern about the high rate of missing patient wristbands and pointed out that this would present a major difficulty in the use of automated identification methods such as barcodes (National Patient Safety Agency, 2004 [5]).

• A number of studies have compared error rates between the different medicine supply systems used in hospitals. Where administration is based on ‘ward stock’ systems (i.e., where a ward has bulk stock for many patients that must be measured and dispensed by staff), error rates ranged from 15% to 20%, but where individual patient supply was used, (i.e., when hospital pharmacies measure and dispense unit doses intended for individual patients), error rates ranged from 5% to 8% (Runciman, 2003 [5]).

• Observational methods have been proven to be a valid and reliable method to detect preparation and administration errors. Retrospective chart review and incident reporting appear to be less robust methods in this area (Cousins, 2005 [5]).

5.5.2 Prevention of Administration Errors

Procedural Measures

• A report by the UK Chief Pharmaceutical Officer (2004 [5] notes that safe administration cannot be entirely delegated to those actually giving the drug – risk management must be built into the whole medication process. In hospitals drug administration is the final step in a multidisciplinary process. Professionals should work together to integrate the various steps so that the patient receives medicines safely. The recommended range of measures to ensure safe administration of medicines includes:

  o Appropriate training for all staff involved in the handling of medication;
  o Clear drug administration procedures in all settings where medicines are given;
  o Double checking by a second person in defined, high risk circumstances, e.g., intravenous infusions, complex calculations (National Patient Safety Agency, 2004 [5]);
  o Discussing the medication with patients or carers at the time of administration and involving them in checking where appropriate;
  o Storing all medicines safely and in such a way that the risk of drug selection errors are minimized;
  o Controlling the availability of high risk drugs; and
  o Utilizing information technology to support prescribing, dispensing and medicine administration.
The National Patient Safety Agency (2005 [5]) recommended, based on a review of the studies on administration error, that: manual checking arrangements should be subject to risk assessment in the same way as any other procedure; there is a need for greater emphasis on and understanding of ways of ensuring compliance with checking procedures. Bedside identity checking is the final opportunity to pick up any errors. It would appear to be a major source of matching errors, suggesting that work on manual matching procedures should focus on bedside checks rather than earlier stages in the process.

Hughes (2005 [5]) noted the importance of actively engaging patients in discussion of the medication to verify identity as well as to discuss the medication, dose, and route (and alert the prescribing, dispensing, or administering clinician to potential problems such as allergies or past drug–drug interactions) (Hughes, 2005 [5]).

Studies have shown that involvement of patients in effective management of their medicines reduces the length of stay and rate of re-admission to hospital. Two key reasons for allowing patients, or in some cases their carers, to administer their own medicines while in hospital are: it ensures that patients remain empowered, which can reduce the stress involved in their stay in hospital and allow them to take their medicines at the optimum time; it allows hospital staff to ensure that patients are competent enough to manage their medicines in order to reduce any problems after discharge (Healthcare Commission, 2007 [2]).

Computerized Medication Administration Records (CMARs)

CMARs allow integration of drug purchasing, distribution, and patient information into a comprehensive database. Potential benefits include consistency in medication documentation, clear records of administration, consistency of directions, and precise dosage information. A computerized system also potentially improves productivity through printouts of fill lists, labels, and utilization reports and by allowing pharmacists and nurses to focus on patient care (Oren, 2003 [5]); (Massachusetts Coalition, 1999 [3]). There are no studies located that confirm CMARs improve patient outcomes through the reduction of errors or improvements in work processes (Oren, 2003 [5]).

Barcode-Enabled Point of Care Systems (BOPC)

Bar coding verifies medications and patients, automates the record of medication administration to specific patients, is used in dispensing and verification processes, and counteracts the misreading of drug names and dosages. The US Food and Drug Administration now requires bar codes on most drugs. Bar coding has the potential to improve patient safety from a number of perspectives, ranging from accurate patient identification to correct medication use and improved medical record keeping. The technology can ensure that the appropriate drug is being dispensed and administered and accurately recorded when the drug is received and administered by the nurse (Oren, 2003 [5]; Hughes, 2005 [5]). The research literature notes:

- BPOC closes the loop of a safe distribution process: CPOE, pharmacy system, ADM and BPOC. According to several studies, most errors occur in the ordering part of the distribution process, with one-third occurring in the administration process. Although
error rates can be reduced in each part of the medication use process separately, the only solution that can provide an overall reduction in medication errors is an integrated approach spanning each of the components (Guchelaar, 2005 [5]; Lisby, 2005 [4]).

- Experts estimate that barcodes could reduce medication errors by as much as 80%. In a study at a Veterans Affairs medical centre, 5.7 million doses of barcoded medication were administered with no single reported error. It is reported that wrong patient, wrong drug and wrong dose errors have been eliminated, and medication errors as a whole were reduced by 87% (Cambridge Consultants, 2005 [5]).

- Barriers to effective CPOC include: the cost of scanners; introduction of human error through manual loading of equipment and bar-code verification; limited number of portable scanners; complexity of the bar-coding systems; lack of universal bar codes; packaging changes needed for bar codes on unit doses; problems related to doses such as half a tablet; costly relabeling using a standard that needs to be defined (Hughes, 2005 [5]).

- AUTROS Healthcare Solution, a wireless medication management system, implemented at West Park Hospital in Toronto uses wireless communications to link physicians, nursing teams, and hospital pharmacists with the patient at the point of care to provide a streamlined matching and tracking system (Cambridge Consultants, 2005 [5]). When a patient is admitted, he or she receives a bar-coded wrist bracelet. Whenever the bracelet is scanned, the bar coding identifies the patient to the hospital’s information system. When a physician or nurse uses the Autros touch-screen tablet at bedside, a flicker of its infra-red light swept over the bar code gives the care-giver instant access to the patient’s medical record. Immediately on-screen appear any drug allergies the patient may have and their current prescription record. To order new medication, the physician can simply select it from an on-screen database displayed on the hand-held tablet. This immediately places the order in the hospital’s information system and relays it to the pharmacy.

- One of the greatest challenges with implementing a BPOC system has been how to support flexibility in the event of failure. There has been significant variability in how this was achieved in different hospitals.

### 5.6 Prevention Strategies Related to Specific Drug Types

A number of drugs present special challenges and risks:

- Santell (2003) noted the following drugs most involved in error: insulin (4%), Heparin (3%), morphine (3%), potassium chloride (3%); Cefazolin (2%), Warfarin (2%), Furosemide (2%), Levofoxacin (2%), Albuterol (2%), Vancomycin (2%). Many other studies have similar lists, e.g., AHRQ (March 2001), Kanjanarat (2003), Runciman (2003), Cousins (2005), ISMP Canada Practitioner ISMP Reports, ISMP US Survey of 350 practitioners, Phillips (2002).

- Problems related to anticoagulants, including failure to prescribe and adequately manage the drugs, account for up to one-third of potentially preventable adverse medication events, as determined by medical record review, and are ranked second after
antineoplastic drugs as being responsible for medication-related hospital admissions (Runciman, 2003 [5]).

- The number of errors associated with a drug may be high merely because the drug is frequently used, rather than because it has a high error rate (Phillips, 2002 [5]).

5.6.1 Prevention of Errors Related to Specific Drug Types

Safeguards for specific drug types are described below (these are provided as examples and not meant to be exhaustive).

Chemotherapy

Chemotherapy is an example of a medication that has a small safety margin. Numerous cases of errors leading to inappropriate treatment, severe patient injuries or deaths are reported in the literature. Errors can occur during the three major steps of medication process—prescribing, compounding, and administration—and include under- and overdosing, schedule and timing errors, wrong drugs, infusion-rate errors, wrong administration route, omission of drugs or hydration, improper preparation of drugs, and chemotherapy given to the wrong patient (Bonnabry, 2006).

The prevalence of medication errors associated with antineoplastic agents, as with other drug categories, is not precisely known, but one study, based on self-reporting, estimated a chemotherapy overdose error rate of 0.06%, with 13% of the responding centres having experienced at least one case. Another study, based on direct observation, measured, in a centralized setting, overall and major preparation error rates of 0.45 and 0.19%, respectively (Bonnabry, 2006).

To circumvent risks for patients and health care workers, several major principles are widely applied (Bonnabry, 2006):

- Centralize the preparation in the pharmacy, in class II vertical laminar airflow cabinets or isolators;
- Limit the number of persons handling antineoplastic agents to better protect them;
- Some authors have also demonstrated the usefulness of closed transfer systems to reduce surface contamination, and recovery of antineoplastic agents in the urine.

The most frequently cited actions to minimize the risk of errors in the process are (Bonnabry, 2006):

- Improve the education of physicians, pharmacists, and nurses;
- Standardize prescriptions by creating template order sets;
- Increase the performance of dose-verification by multiplying independent checks; and
- Improve patient information.
Information technologies can theoretically be useful to secure the process – one study measured a reduction of antineoplastic prescription errors after the introduction of a computerized system; however, few studies have been conducted in this specific area (Bonnabry, 2006).

**Intravenous Medications**

Error rates for intravenous medications tend to be higher than for oral medicines. Administration errors (excluding wrong time errors) usually ranging from 2.4% - 11.1%. Several recent studies identified error rates (including wrong time errors) in European hospitals: 132 out of 273 (49%) errors in four UK centres, 34 out of 161 observations (21%) in a German hospital, and 5 out of 100 (5%) in a French centre) (Cousins, 2005 [5]; Aspden, 2007 [5]). In these studies, the causes of error included:

- The most common error was administering intravenous doses at the wrong rate - usually too quickly; the second most frequent deviation was preparing the intravenous doses with the wrong diluent.

- It may be argued that practitioners have insufficient time to administer intravenous bolus injections safely. This observation is supported in the UK by the high percentage of wrong time errors (defined as administration of intravenous medicines 1 hour or more from the prescribed time) (Cousins, 2005 [2]).

- Two problematic intravenous administration practices, or violations, frequently occurred: bypassing of the drug library and overriding alerts including the use of inappropriate boluses. This was probably the case, in part, because the pump setup made it easy for nurses to bypass the drug library and because overrides were frequent (Rothschild, 2005 [5]).

- Lack of appropriate labelling was a frequent error in results from the UK and German hospitals indicating that a significant percentage of products that are not labelled are not used immediately and are stored temporarily in the clinical area before administration. Practitioners intending to administer these products may be confused over the identity of the medicine, dose, or the intended patient (Cousins, 2005 [2]).

- The preparation area was never cleaned in the UK hospitals (0%), it was properly cleaned in 18 (4%) cases in the German wards, and in 81 cases (81%) in the French centre. Hands were not washed (0%) in any of the four hospitals in the UK nor were sterile gloves worn, non-sterile gloves were worn in one hospital in order to protect nurses from the medicines. Hands were washed in the German hospital in 22 cases (5%) and in 91 preparations (91%) observed in the French hospital (Cousins, 2005 [2]).

- In all three countries difficulties were encountered by hospitals in developing and maintaining intravenous procedures. Without agreed procedures of this type it is very difficult to teach, maintain, and audit safe practice (Cousins, 2005 [2]).

- There is little research demonstrating the importance of infection controls during the preparation of intravenous medicines in ward areas. It appears there is a general assumption that intravenous medicines are being prepared for immediate use and that the risk of infection is small. However, recent research in a German hospital following the
deaths of two patients from meningitis caused by contamination of contrast media found other contaminated multiple dose vials in ward areas, and poor handling and storage of these types of medicine (Cousins (2005 [2]).

In the US, the most common error reported was incorrect dosing of titratable drugs (Cousins, 2005 [2]; Rothschild, 2005 [5]). Rothschild (2005 [5]) also noted that most preventable ADEs were serious or life-threatening (18 of 25, 72%).

ISMP Canada notes that infusion pumps are being used to deliver almost all intravenous fluids including many high risk medications. Medication errors involving infusion pump use could result in serious or even fatal patient outcomes. Since 1985, there have been several hundred reports of incidents with the use of infusion pumps in the United States, and about 300 of these resulted in patient deaths (www.ismp-canada.org).

The prevention of intravenous medication errors include:

- Errors were shown to be less frequent in two hospitals equipped with pharmacies that provide ready-to-administer “centralized intravenous additive” (CIVA) services, and in the three hospitals that could provide industry prepared ready-to-use products (Cousins, 2005)[2], (Massachusetts Coalition, 1999 [5]).

- It has been suggested that the pharmaceutical industry could provide design solutions to assist practitioners to maintain and track product identity in clinical use, such as ready-to-use pre-filled syringes and infusions, diluent products that can be permanently connected to drug vials during administration, and ampoules and vials with flag labels. These labels can be transferred to easily label syringes and infusion bags (Cousins, 2005 [2]).

- Training: Providing clinical staff with more readily available information concerning diluents may help to reduce the use of the wrong diluent. The clinical importance and use of this information can be reinforced as part of intravenous therapy training. This information could be added by the manufacturer or hospital pharmacy department as an additional warning label in large text to the outside of the medicine packaging (Cousins, 2005 [2]).

- Guidelines: The intravenous procedures in the Manual of Clinical Nursing Procedures in the UK has recently been supplemented by a publication by the Royal College of Nursing (Standards for Infusion Therapy published in 2003). The use of national (and professionally endorsed) procedures of this type is seen as very helpful in defining safe practice. However, individual institutions have a responsibility to audit the implementation of these procedures regularly and to provide feedback to practitioners on those areas of practice that are out of compliance with procedure (Cousins, 2005 [2]).

- Equipment – Although one study found that smart intravenous pumps with decision support capabilities have the capacity to intercept many dangerous medication errors and unsafe practices that would have been difficult to identify otherwise, they did not reduce the overall rate of serious medication errors (Rothschild, 2005 [5]).
Potassium Chloride (KCl)

The Ontario Ministry of Health and Long-Term Care, the Ontario Hospital Association and the Institute for Safe Medication Practices Canada worked jointly to implement strategies and safeguards for the prevention of patient injury from errors with potassium chloride. In 2002, a survey on the disposition of potassium chloride injectables was conducted, and a follow-up survey was conducted in 2003 to track implementation of prevention measures:

- The percentage of Ontario hospitals stocking concentrated KCl in patient care areas dropped from 62% to 26%.
- The stocking of concentrated KCl in Emergency departments dropped from 65% to 35%.
- The stocking of concentrated KCl in ICUs dropped from 50% to 35%.
- 71% of hospitals indicated they made changes to KCl distribution in the past 6 months, i.e., after the first survey and other professional communications and during the time of the project (January to June, 2003).
- 63% of hospitals plan to make changes in the near future.
- Implementation of automatic substitution policies regarding concentrated KCl doubled from 21% to 43%.
- Hospitals that have standards for administration and use of potassium chloride rose from 38% to 57%.

5.7 Other Prevention Strategies

Other medication errors may result from a lack of coordination and information sharing among care/service providers and with patients, particularly at transition points of care such as shift changes, discharge, and patient/client movement between health care services and sectors. For example, an estimated 46% of all medication errors occur during such transitions according to the UK Chief Pharmaceutical Officer (2004 [5]).

Effective mechanisms for transfer of information at interface points the following:

5.7.1 Medication Reconciliation

Barnsteiner (2005) [5] notes that a “medication reconciliation process” specifying medications and maintaining a current, accurate list of those a patient has received at different points in care, has been shown to decrease the incidence of medication errors during care at points of transition. As part of that process, the accuracy of the list is validated and it is reviewed and amended, if necessary, at specified times. A reconciliation record usually includes the name of the medication, dosage, frequency, and route of administration, as well as known allergies to medication.
Medication reconciliation is one of the six ISMP Safer Healthcare Now! interventions to reduce adverse events in health care. ISMP Canada is leading the “Canadianizing” of the Getting Started Kit for the Medication Reconciliation intervention of the campaign. In addition, the role of ISMP Canada provides support to teams as they make the complex system changes that medication reconciliation requires. Medication reconciliation requires (Safer Healthcare Now, 2005):

- Creating the most complete and accurate list or Best Possible Medication History (BPMH) of all home medications of each patient;
- Using that list when writing orders;
- Comparing the list against the physician’s admission, transfer, and/or discharge orders; identifying and bringing any orders to the attention of the physician and if appropriate making changes to the orders ensuring the changes are documented.

Similarly, the Canadian Council on Health Services Accreditation (2007) suggests that a demonstrated, formal process (protocol, order sets, forms, instructions and guidelines) be established to reconcile patient medication upon admission, referral, or transfer, across the organization, including documentation of a comprehensive list, and a process that involves shared responsibility, involving the patient/client, nursing staff, medical staff, and pharmacists as appropriate.

The UK Chief Pharmaceutical Officer (2004) recommends that on discharge, the patient’s drug regimen and treatment plan need to be communicated in a timely and reliable way to ensure safe and seamless transfer of care back to the primary care team. Staff should ensure that patients understand their discharge medicines and can take them properly. Shared care protocols should address medication issues comprehensively – this is particularly important when they include ‘high risk’ drugs such as methotrexate. When patients are transferred from home to a care home, or between care homes, the patient may be transferred to the care of a different provider. Effective communication in advance of such transfers will ensure continuity in the supply of medicines.

Pronovost and colleagues implemented a medication reconciliation process to be used upon discharge from the ICU, entailing the reconciliation of prehospital, ICU-admission, and ICU-discharge medications. Before implementation of that process, 94% of ICU discharge medication orders needed changing, and 24 weeks afterward, none did. Pronovost and colleagues reported that once systems were refined, a paper reconciliation intervention took 20 minutes on admission to the ICU and 20 minutes at discharge from it, and that electronic systems take less time (Barnsteiner (2005).

5.7.2 Seamless Care

In Canada the term “seamless care” describes the desirable continuity of care delivered to a patient in the health care system across the spectrum of caregivers and their environments. Medication reconciliation is a key component of seamless care (Safer Healthcare Now, 2005). Baker and Norton (2004) have also identified improved communication and coordination as a critical patient/client safety improvement strategy; in particular between patient care teams, and between hospital and community-based providers.
Pharmacist involvement has also been identified as an important element in coordination of seamless care. In one study, the majority (83.8%) of the drug therapy problems identified by a seamless care pharmacist were ‘somewhat significant’ or ‘significant’, with the significant category accounting for 56.6% of all events. An average of 0.74 inconsistencies and omissions were identified per intervention patient; and an average of 3.59 per intervention patient at discharge (Nickerson, 2005 [1]).

5.8 Prevention of Medication Error in Residential Care

5.8.1 Medication Errors in Residential Care

- Adverse drug events (ADEs) have been linked to preventable problems in elderly patients such as depression, constipation, falls, immobility, confusion, and hip fractures (Fick, 2003 [5]).

- A study on Saskatchewan residential care (Clatney, 2005) found:
  - Polypharmacy: Individuals were dispensed an average of 8.8 different drugs, as classified by different generic drug names;
  - Benzodiazepines: More than 1/5th of elderly residents were chronically dispensed a benzodiazepine. Of the chronic users, 1 in 9 were dispensed two or more concurrently, and almost 1 in 4 were chronically dispensed a dosage above the maximum recommended amount for an elderly person (Benzodiazepines increase the risk of adverse effects in the elderly, such as falls, confusion, and delirium - these risks increase significantly with higher doses, even among long-term users);
  - High-risk, potentially avoidable drugs (Beers criteria): 28% of elderly residents received at least one high-risk, potentially avoidable drug from the Beers list, on a chronic basis; this increased to 33% when the chronic drug use condition was removed.

- Aspden notes the following US data on residential care (2007):
  - Excluding wrong time errors, omission of an ordered medication is generally the most common type of drug administration error in nursing homes;
  - In four studies, administration errors (including wrong time errors) per 100 opportunities/doses were 6, 12.2, 14.7, and 20. Because a typical medication pass in long-term care exceeds 2 hours, it is impossible for the nurse to deliver all medications within 1 hour of the scheduled time; thus wrong time errors are predictably high in this setting;
  - Transitions from nursing home to other settings are a time of high risk for adverse events due to prescribing or transcription errors.

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5 The Beers criteria were developed to survey and analyze clinical medication use in older adults. It is based on expert consensus developed through an extensive literature review with a bibliography and questionnaire evaluated by nationally recognized US experts in geriatric care, clinical pharmacology, and psychopharmacology using a modified Delphi technique to reach consensus (Fick et al., 2003).
5.8.2 Prevention Strategies

- **Interdisciplinary case management** – A growing body of evidence suggests that physicians, pharmacists, nurses, and other providers working in an integrated team can significantly improve health outcomes and system efficiency. The evidence also strongly supports the pharmacist's role on the team. Randomized controlled trials have evaluated team models where clinical pharmacists have key responsibilities in providing direct patient care, developing resources to help patients understand their medications, coordinating drug management between the acute and primary care settings, and promoting optimal prescribing. These models have been shown to reduce use of benzodiazepines, non-steroidal anti-inflammatory drugs and inappropriate medications, and to decrease costs. As well, some evidence, although weaker, supports the inclusion of other team members (e.g., one observational study demonstrated benefits of a physician, nurse and pharmacist team, and another involving geriatricians, pharmacists, social workers, nurses, dieticians and other staff showed fewer inappropriate medications after implementation of the team) (Jorgenson, 2004 [5]).

- **Medication therapy management** – Two studies found that pharmacist reviews along with education/case conferencing resulted in decreased drug use (Aspden, 2007 [5]).

- **Medication review every three months** – Wasko-Lacey et al. assessed the impact of a 1999 policy implemented in a Saskatchewan Health District which mandated that each resident receive a medication review at least every three months, preferably by an interdisciplinary team. Residents who received the medication review (41%) were less likely to experience a drug related adverse event and were less likely to be physically restrained (Jorgenson, 2004 [5]).

- **Practice feedback and benchmarking** – Practice feedback (providing prescribing data as feedback to an individual provider or a facility) has been shown to be a powerful motivator for change when combined with benchmarking (benchmarking provides a reference point against which the feedback can be measured). It allows providers and managers to identify areas of practice that can be improved, as well as track progress toward improvement goals. Practice feedback and benchmarking have been extensively studied in the long-term care literature. These studies consistently suggest that effective use of practice feedback and benchmarking improves prescribing patterns and reduces overall drug costs. This strategy is also most effective when it is interactive (e.g., one-on-one review of feedback reports vs. mailed feedback reports) and when it is combined with other interventions such as educational outreach or academic detailing (Jorgenson, 2004 [5]).

- **Educational outreach** – Educational outreach strategies have proven to be effective at improving prescribing in the long-term care environment. They are commonly used in conjunction with other quality improvement initiatives such as practice feedback and benchmarking, or the use of decision support tools. Educational outreach is intended to complement other quality improvement strategies; it is not a stand-alone initiative (passive distribution of educational materials has usually shown little impact on providers' practice). The literature indicates that effective outcomes occur when:
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- Outreach is interactive;
- All members of the care team are included (e.g., nurses, special care aides, physicians, pharmacists, recreation therapists, etc.);
- Decision supports or written information are provided for future reference; and
- It is combined with other interventions (e.g., practice feedback and benchmarking) (Jorgenson, 2004 [5]).

- **Academic detailing** – Academic detailing is a tool of choice in many educational outreach programs. Adapted from the marketing approach used by pharmaceutical companies, the strategy involves an academic detailer, usually a specially trained pharmacist, visiting providers in their office. During these one-on-one or small group meetings, the detailer provides physicians with unbiased, comprehensive education on pharmaceutical care. Academic detailing has been successfully used in Saskatchewan to improve quality in many settings, including long-term care (Jorgenson, 2004 [5]). A Saskatchewan program called RxFiles, is expanding to most major centres in the province, using a web site combined with decision-support tools such as newsletters and professional development downloads. Studies have shown it improves quality of drug management in Saskatchewan long-term care (Clatney, 2004 [5]).

### 5.9 Conclusions

The prevention of medication errors in health care facilities requires a wide range of strategies including clear procedures and protocols, trained staff with access to comprehensive information on available drugs and patient histories, along with coordinated systems which enable good communication and collaboration. Particularly effective strategies emerging from the literature reveal the value and importance of an expanded role for pharmacists in providing clinical pharmacy consultation services, particularly where there is a high risk of harm such as ICUs, neonatal ICUs, oncology units, transplant units, geriatric units and similar settings. Also, pharmacist involvement in medication reconciliation (a current, accurate comprehensive list of medication use when patients are in transition among care providers and care sectors), and in the provision of ‘seamless care’ are key strategies that have demonstrated effectiveness.

As well, evidence reveals that the use of automated systems in many medication functions are enabling significant and major advances in the prevention of errors. In particular, Computerized Provider Order Entry (CPOE) and computer-based Clinical Decision Support Systems (CDSS) both on their own, and when used in combination, are able to facilitate the accuracy and legibility of medication orders, avoid drug interactions and incorrect dosages, and integrate clinical decisions and the order-entry process. The use of Barcode-enabled Point of Care (BPOC) automated systems are also reported as having a major impact on reducing medication errors at the time of administration; one study found errors were reduced by 87% (Cambridge Consultants, 2005).
6.0 PREVENTION OF FALLS

6.1 Key Factors and Issues

6.1.1 Prevalence and Incidence

- In 2004 in BC, 852 seniors died either directly or indirectly as a result of having a fall, and 10,091 were hospitalized. More women than men over the age of 65 died either directly or indirectly from falls, most likely because women outnumber men in this age group. In 2004, 517 senior women died directly or indirectly from a fall compared to 335 men (Herman, 2006).

- In the past decade in BC, there has been a significant reduction in the rate of deaths from falls among seniors, as well as corresponding reductions in hospitalizations rates for falls among seniors (Herman, 2006). The 2004 Provincial Health Officer report on falls noted that it is unclear whether this decline results from a change in hospital management, an increased tendency to treat and release elderly people in the emergency department and provide support at home, or the effect of an improved fall preventions strategy in BC combined with an increase in outpatient services (Herman, 2006).

- In Canada, between 2000-2003, about 0.9 people aged 65 and over per 1,000 surgical and medical hospitalizations broke a hip after admission (i.e., 1 inpatient sustained a hip fracture for every 1,124 surgical and medical hospitalizations over age 65 years) (CIHI, 2004).

- In Ontario, between 1997-1998 and 2002-2003, 4% to 5% of longer-term patients in complex continuing care settings in Ontario had a fall recorded on their quarterly assessment (complex continuing care residents are primarily elderly people who are functionally impaired and/or clinically complex) (CIHI, 2004).

- The American Geriatrics Society et al. (2001) estimates that in the US:
  - In the age 65-and-over population as a whole, approximately 35% to 40% of community-dwelling, generally healthy older persons fall annually. After age 75, the rates are higher.
  - Among older people in nursing homes and hospitals, there are 1.5 falls per bed annually, almost three times the rates for community-dwelling persons age 65.
  - Overall, approximately 5% of older people who fall require hospitalization; while 10% to 25% of those in residential care who fall require hospitalization.

- In the UK, fall rates in hospitals and care homes vary from 3 to 13 falls per 1000 bed days (Oliver, 2007):
  - An average of 4.8 falls are reported annually for every 1,000 bed days in acute care hospitals (National patient Safety Agency, 2007).
  - About 30% of falls in hospitals and care homes result in physical injury and 3-5% in fracture (Oliver, 2007).
Up to 20% of admissions to general hospitals for hip fractures are from care homes.

Residents of care homes fall 2 to 6 times a year (Oliver, 2007).

### 6.1.2 Key Factors and Issues

**Risk Factors and Causes Of Falls**

- The most important risk factors for falls include muscle weakness, a prior history of falls, difficulties with gait and balance, visual impairment, arthritis, functional limitations, depression and the use of psychotropic medications (Rubenstein et al., 2007) [5]. A key concern is not simply the high incidence of falls in older persons (young children and athletes have an even higher incidence of falls) but rather the combination of high incidence and a high susceptibility to injury. This propensity for fall-related injury in elderly persons stems from a high prevalence of comorbid diseases (e.g., osteoporosis and age-related physiological decline that make even a relatively mild fall potentially dangerous (American Geriatrics Society et al., 2001).

- Overall, risk factors include:
  - The incidence of falls and the severity of fall-related complications rise steadily after age 60 (American Geriatrics Society et al., 2001).
  - Previous falls are a strong predictor of future falls e.g., residents in Ontario continuing care homes were at least 5 times more likely to have fallen in the last 30 days, if they had experienced a fall in the previous 31 to 180 days (CIHI, 2004).
  - Multiple risk factors increase the risk of falling dramatically: the percentage of persons falling increased from 27% for those with no or one risk factor to 78% for those with four or more risk factors (American Geriatrics Society et al., 2001 [3]).
  - The prevalence of falling increases with rising chronic disease burden (American Geriatrics Society et al., 2001 [3]).
  - Muscle weakness is a significant risk factor for falls, as is gait deficit, balance deficit and the use of an assistive device. Any lower extremity disability (loss of strength, orthopaedic abnormality or poor sensation) is associated with increased risk (American Geriatrics Society et al., 2001 [3]).
  - There is a consistent association between psychotropic medication use (i.e., neuroleptics, benzodiazepines, and antidepressants) and falls in all care (American Geriatrics Society et al., 2001 [3]).
  - Vitamin D deficiency is particularly common in older people in residential care facilities and may lead to abnormal gait, muscle weakness, osteomalacia and osteoporosis (Rubinstein et al., 2007).

- Extrinsic risk factors include environmental hazards such as poor lighting, slippery floors, uneven surfaces, inappropriate footwear, clothing, walking aids or assistive devices, etc. (Rubinstein et al., 2007).
Characteristics of Falls Injuries

A World Health Organization report (Todd, 2004) notes:

- 20% and 30% of those who fall suffer injuries that reduce mobility and independence and increase the risk of premature death.

- Approximately 10% of falls result in serious injury, of which 5% are fractures; the most common age-related fractures are wrist, spine, hip, humerus, and pelvis.

- While the proportion of fractures is low, the absolute number of older people suffering fractures is high, placing heavy demands on health care systems.

- Hip fractures comprise approximately 25% of fractures resulting from falls in the community; however, the incidence is higher in residential settings, with rates up to 81 per 1000 person years. At least 95% of hip fractures are caused by falls: approximately half of all fallers who fracture their hips are never functional walkers again and 20% will die within six months.

- Depression, fear of falling and other psychological problems—“post-fall syndrome”—are common effects of repeated falls. Loss of self-confidence as well as social withdrawal, confusion and loneliness can occur, even when there has been no injury.

- Experts suggest that osteoporosis, a risk factor for fractures, contributes to higher rates of injury among women as an estimated 1 in 4 women over the age of 50 has osteoporosis, compared to 1 in 8 men (CIHI, 2004).

Cost and Attitudinal Issues

- BC data on the average costs of hospitalization for fall-related injuries among seniors provides an indication of cost burdens: $18,508 for hip fractures; $11,571 for upper limb injuries; $14,425 for head injuries; and $14,135 for abdomen, lower back, lumbar spine and pelvis injuries. The average length of hospital stay is almost 50% longer for falls when compared to all other causes of hospitalization for people over the age of 65. The 2004/2005 estimated hospital costs of fall-related injuries among seniors were $151 million, down from $175 million in 2000/2002 (Herman, 2006).

- A 2000 analysis of medical payments in the US found that the direct medical cost of fatal and nonfatal fall injuries was $19.5 billion. $19.3 billion for non fatal injuries included 63% (12.1 billion) for injuries that required hospitalization, 21% (4.1 billion) for injuries treated in emergency departments, and 16% (3.1 billion) for injuries treated in outpatient settings. Overall falls accounted for 5% of all medical expenditures for persons aged 65 years and older (Rubinstein, 2007).

- Research reveals that a relatively low percentage of clinicians believe many falls cannot be prevented, highlighting the need for cultural change to occur in an organization if a falls minimization strategy is to be successful (Victorian Quality Council, 2006 [5]).
6.1.3 Current Initiatives

BC Falls Prevention Coalition

The BC Falls Prevention Coalition (BCFPC) is a multisectoral collaborative of individuals representing regional and provincial organizations that are concerned with the need to reduce falls and fall-related injuries among older adults in British Columbia. Through networking, education, research and the implementation of evidence based prevention, BCFPC members seek to reduce the rate and severity for falls by collaborating to effect change in policy and programming at local, regional and provincial levels. Working as a network, BCFPC seeks to maximize potentials of member’s programs, reduce the possibilities of duplication, and exchange resources and information. Its function is to:

- Create a comprehensive, evidence-based and clinically relevant provincial strategy directed towards the reduction of falls and fall-related injuries;
- Identify and engage key stakeholders in fostering an environment that promotes collaboration, coordination and support;
- Act as a central, web-based repository for falls and fall-related injury prevention initiatives, assessment and evaluation tools, and educational materials;
- Offer guidance to and endorse existing and future falls prevention programs/initiatives in BC;
- Provide a forum for the exchange of best practices evidence for falls and fall injury prevention provincially, nationally and internationally;
- Recommend surveillance strategies and promote the development of standardized definition and measurement tools; and.
- Develop guidelines for evaluating existing and future measurement tools used in the prevention of falls in order to be of assistance to all BCfPC members (Herman, 2006).

Guidelines

Dr. Vicky Scott and Bronwen Duncan have identified a wide variety of clinical guidelines for seniors’ fall prevention in Clinical Guidelines for Seniors Falls Prevention, published by the BC Ministry of Health, Office for Injury Prevention. The guidelines address all care settings.
6.2 Prevention Strategies – Falls in Acute Care Hospitals

6.2.1 Causes and Contributing Factors

Patient factors associated with a greater risk of falling include:

- Hospital patients have a higher risk of falling than people in the community:
  - As important as identifying risk factors is appreciating the interaction and probably synergism between multiple risk factors as studies have shown that the risk of falling increases dramatically as the number of risk factors increase (American Geriatrics Society et al., 2001);
  - Surgery may affect a patient’s mobility or memory and associated sedation, pain relief, anaesthetic or other medications which may increase the risk of falling;
  - Delirium increases the risk of falling and is particularly likely to affect patients on medical wards;
  - Patients with dementia are more likely than those without memory problems to require hospital admission, and are at least twice as vulnerable to falls;
  - Hospital patients have to rapidly adapt to changes in their strength and mobility, both as they become ill and as they recover (National Patient Safety Agency, 2007 [5]).

- Other characteristics associated with high rates of falls in hospitals include incontinence or urinary frequency, and acute illness that can cause sudden changes in physical health, abilities and functions. In addition, immobility and extended bedrest can diminish coordination and body strength, undermine balance and increase body sway, and cause postural hypotension (Rubenstein et al., 2007 [5]; Joanna Briggs Institute, 2007 [3]).

- Hospital settings associated with an increased risk include:
  - Rehabilitation units and geriatric departments have a higher incidence of patient falls.
  - Patients who have a diagnosis of congestive heart failure, general medical disease, neoplasms or a cerebrovascular accident may have a greater risk of falling (Joanna Briggs Institute, 2007 [3]; Pulcins, 2004 [5]).
  - Patients with mental health and learning disabilities are at high risk of falling (Healthcare Commission, 2006 [2]).

- In all age groups, females were more prone to breaking a hip in hospital settings than males. The incidence of in-hospital hip fracture also increased with age, as did the differences between male and female rates. In the oldest age group, those 90 and older, the risk of in-hospital hip fracture for females (2.4 per 1,000 admissions) was considerably higher than for males (1.4) (Pulcins, 2004 [5]).
Environmental factors are also important contributing factors to falls:

- Aspects of the hospital environment that may have an impact on the risk of falls or injury include:
  - Flooring surfaces that are uneven, slippery, hard/dense, and patterned (that can create an illusion of slopes or steps);
  - Lighting, including poor lighting, sudden changes from dim to bright lighting, and poor location of light switches;
  - The design of doors, hand rails, toilets and bathrooms;
  - The distance and spaces between hand holds, beds, chairs and toilets;
  - The line of sight for staff observing patients;
  - Trip hazards including: steps, clutter, furniture, medical devices and their stability (National Patient Safety Agency, 2007 [5]).

- A study suggesting that 50% of falls in institutional settings could be attributed to environmental factors is often cited; however, the study took place in an environment where all residents were not only independent in self-care, but “able to do simple housekeeping” and, therefore, not typical hospital patients). In data from the UK, environmental factors were identified in 5% of reports, either as a single risk factor or combined with patient factors (National Patient Safety Agency, 2007 [5]).

Studies on the times and places when hospital falls occur, reveal that:

- There are consistent time-of-day patterns for falls between weekends and weekdays, and across weekdays. Fall rates begin to rise around 9am and peak in the period between 10am and 12noon, when patients are most likely to be active. There are fewer falls around 8am, 12noon and 5pm (mealtimes), and during the night, with the fewest falls occurring between midnight and 1am (National Patient Safety Agency, 2007 [5]).

- The majority of falls occur from, or near, the patient's bed, and can account for up to half of all falls. Other common locations include the corridor, bathroom and toilet. Patient transferring from one location to another, usually involving a bed or chair, is the most commonly cited activity at the time of the patient's fall. Other activities commonly associated with falls include walking, toileting and sitting in a chair, commode or wheelchair. One study in a rehabilitation setting found over half of all falls involved a wheelchair (Joanna Briggs Institute, 2007 [3]).

Other factors and statistics:

- In UK hospitals (National Patient Safety Agency, 2007):
  - Falls comprise about 1/3 of all types of patient safety incidents reported from acute care hospitals; an average of 4.8 falls reported for every 1,000 bed days.
94% of all falls in acute care hospitals and 88% in mental health units occur in inpatient areas; the remaining falls occur mainly in therapy departments, outpatient and day services areas, corridors, car parks and hospital grounds.

Of these reported falls: (65%) resulted in no harm, although even a fall without injury can be upsetting and lead to loss of confidence, increased length of stay, and an increased likelihood of discharge to residential or nursing home care; 31% per cent of the falls resulted in low harm (i.e., bumps, bruises, minor cuts and grazes; and 3-5% resulted in moderate harm. Also, 26 reports of falls appear to have directly resulted in death. These were predominantly from head injuries (17 deaths) or followed fractured neck of femur (seven deaths). Mortality subsequent to fractured neck of femur is estimated at 18%, including deaths from underlying illness as well as deaths at least partly attributable to the fracture. This suggests that around 95 further deaths may have occurred following the estimated 530 fractured neck of femurs.

- In Australian hospitals, 38% of all patient incidents involve a fall (Joanna Briggs Institute, 2007).
- Canadian data on the number of falls in acute care hospitals is not available.

6.2.2 Prevention Strategies for Hospital Falls

Comprehensive Hospital Falls Prevention Plans

Scott (2003 [3]) notes that best practices for an organization-wide plan that focuses on falls prevention should include the following components:

- A facility-wide collaborative approach to falls prevention including a multidisciplinary team with direct responsibility for the implementation and evaluation of fall prevention activities;
- An educational and awareness raising program for all staff, support staff, residents, family members and visitors;
- A falls surveillance systems for monitoring the nature and severity of falls and contributing factors;
- A system for assessing fall and injury risk upon admission and over time;
- A visual mechanism for identifying high-risk falls, such as a bracelet or coloring coding on charts or above beds;
- A formal process for investigating individual falls and implementing tailed prevention plans;
- A policy for investigating facility-wide fall and injury patterns and using collaborative process for prioritizing and implementing appropriate preventions;
- An evaluation plan designed to determine the effectiveness of specific strategies and overall approaches to falls prevention; and
• A process for recognizing and rewarding the efforts of staff and residents for their falls prevention efforts.

Scott (2003 [3]) notes that these components are seen as a dynamic model of falls prevention programming that includes input from those affected by the problem and those with the capacity to reduce the risk of falling.

**Patient Risk Screening/Risk Assessment**

According to the RAND report on falls prevention among the US Medicare population, the strongest trend for success focuses on fall risk assessment followed by tailored interventions, which depending upon identified risk factors, can range from single interventions to a multifactorial approach (Scott, 2003 [3]).

The use of assessment tools to identify patients at risk of falling is a common feature identified in many studies. Assessment can identify patients with a high risk of falling and appropriate interventions can then be instituted to minimize the risk (Joanna Briggs Institute, 2007 [3]). Assessment is commonly utilized at different stages including:

- Admission of patients to the hospital or to a new department;
- Post operative patients;
- Elderly patients on prescribed analgesics or sedatives;
- Confused and elderly patients before settling at night (Joanna Briggs Institute, 2007 [3]);
- After a patient has fallen. The literature emphasizes that falls can be an indication of an underlying illness, or a sign that a patient’s condition has deteriorated. Because patients may fall more than once, each fall should trigger a review to determine whether additional interventions are necessary to reduce the risk of further falling, including medical assessment where appropriate (National Patient Safety Agency, 2007 [5]).

Assessment of fall risk typically involves either the use of multifactorial assessment tools (MAT) that cover a wide range of fall-risk factors, or functional mobility assessments (FMA) that typically focus on the physiological and functional domains of postural stability including strength, balance, gait and reaction times. Some tools provide simply a mechanism to screen for high-risk populations while others also allow for tailoring of interventions based on assessment. Scott (2007) notes that:

- The choice of a tool in a clinical context needs to reflect the purpose for which the tool is to be applied. If the purpose is to screen for high-risk populations, a tool is needed that is quick and easy to apply, yet has good sensitivity and specificity. If the purpose is to reduce risk, the tools need to reliably identify remedial risk factors on which interventions can be focused.

- In a systematic review of assessment tools in the acute care setting, 12 studies examined eight different tools. Sensitivity results ranged for 66 to 93% and specificity results from 25 to 88%. There are no tools that show consistently strong predictive values across two
or more settings (i.e., community, home-support, long-term and acute care settings). As well, a number of studies fail to document the validity or reliability measures to support their recommendations. The lack of studies on the predictive validity likely reflects the fact that such assessments are not conducted to predict risk, but to identify areas where medical intervention is required.

- Two studies that were conducted in the acute care setting reported predictive values above 70% for both sensitivity and specificity. The STRATIFY tool applied by Schmid correctly predicted 93% of fallers and 78% non-fallers; and applied by Oliver, correctly predicted 93% of fallers and 88% of non-fallers (Scott et al., 2007).

Some researchers have noted that some studies attempting to evaluate falls risk assessment tools have been poor quality or used inadequate methods of evaluation. In summarizing results, many risk assessment tools have generally had good inter-rater reliability but are unable to reliability predict risk levels. Another limitation is that tools do not measure environmental factors that may impact on a patient's likelihood of falling during hospitalization, nor factors such as new staff, patient acuity and occupancy rates of the department (Joanna Briggs Institute, 2007 [3]).

While some form of patient assessment is obviously needed, there is currently no evidence to suggest that the generic risk assessment tools identified in the literature offer any additional benefits over tools that are used within a single institution and have been developed based on that population's characteristics (Joanna Briggs Institute, 2007 [3]).

The use of fall-risk assessment as part of a multifactorial approach for the prevention of falls is supported by evidence of strong associations between multiple risk factors and falls, as well as from experimental studies demonstrating significant fall reductions where assessment is combined with tailored interventions (Gillespie et al., 2003).

**Risk Management Plans**

The most common approach to fall prevention in reviewed studies was a program of multiple interventions aimed at minimizing an individual patient’s risk of falling. Implementation of these programs or plans has been shown to be effective in the non-hospital setting, although the effectiveness has not yet been demonstrated in hospital settings. Current studies appear to be somewhat contradictory, with some reporting a reduction in the number of falls, while others report no change or an increase in the number of falls. The quality of the studies is variable with many providing little information on the methods used, the intervention or the actual results. Information regarding how interventions were selected and implemented was not provided in many studies. Despite the uncertain research evidence a program of individualized multiple interventions is the most common approach to fall prevention and represents current best practice based on expert opinion (Joanna Briggs Institute, 2007 [3]).

Rubenstein et al. (2007 [5]) notes that while there are few rigorous studies of fall prevention in hospital settings, there are some promising interventions that need to be tested in controlled trials, in particular interventions that focus on: patient mobility; toileting; increased supervision; restraint reduction; medication reviews; and multi-component strategies. It should also be noted
that the American Geriatrics Society et al. (2001 [3]) suggested that the evidence is insufficient to make recommendations for or against multifactorial interventions in acute hospital settings.

A range of multifactorial interventions have been used in hospitals where the number of falls have been reduced. These include:

- Strategies to review patient medications including: frequently reviewing prescribed medications; checking patients receiving laxatives and diuretics; limiting combinations of medications when possible (e.g., sedatives, analgesics, etc) (Joanna Briggs Institute, 2007 [3]).

- Detection and treatment of medical conditions associated with falls including delirium, cardiovascular illness, osteoporosis, incontinence, eyesight problems.

- The use of physiotherapy, exercise and access to walking aids (National Patient Safety Agency, 2007 [5]).

- Attention to special toileting needs including: placing patients with urgency near toilets; checking patients who are receiving laxatives and diuretics; toileting at risk patients routinely; instructing male patients prone to dizziness to void whilst sitting (Joanna Briggs Institute, 2007 [3]).

- Interventions related to impaired mobility include: non-skid footwear; providing physical therapy; instructing patients to rise slowly; walking high risk patients; repeating activity limits to patient and family; assisting in transfer of high risk patients; walking patients in the corridor once or twice per shift (Joanna Briggs Institute, 2007 [3]).

- Measures to address altered mental status, the most commonly identified risk factor include: re-orientating confused patients; orientating patients to the hospital environment; moving confused patients close to nurses station; encouraging family members to sit with confused patients; nursing confused patients in low beds (Joanna Briggs Institute, 2007 [3]).

Some facilities have formalized the communication of a patient's risk of falling by incorporating a diagnosis or problem such as "At Risk of Falling" or "Potential for Injury" in their records and charts. Others have developed a standardized nursing plan for patients at high risk of falling, or a rehabilitation plan for patients after they experienced a fall. The concept of Universal Fall Precautions has been used, acknowledging that all patients are potentially at risk of falling, although there are limited descriptions of how this is incorporated into clinical practice (Joanna Briggs Institute, 2007 [3]).

**Interventions Involving Equipment and Technology**

- **Wrist bands** – Some studies mention providing coloured wristbands to patients at high risk of falling, or putting symbols by the patient’s bed, such as a leaf or falling star. It is not always clear what action is expected to follow these, but the studies imply that staff should observe these patients closely. Some studies refer to special observation, where a member of staff constantly watches a patient who is at very high risk of falls, or to
moving patients within the ward so they can be observed more easily. One good quality RCT centred on coloured wristbands found that there were no decrease in falls or injury as a result of their use (National Patient Safety Agency, 2007 [5]; Joanna Briggs Institute, 2007 [3]; Todd, 2004 [5]).

- **Alarms** – Movement alarms are pressure sensors or infra-red beams that alert staff if the patient moves. The literature review found only one small hospital study of alarm devices, which concluded that there is no evidence that alarm devices are effective in preventing falls. A RCT found no benefit in using a pressure sensitive alarm that was placed between the patient and mattress. One uncontrolled trial found that alarms attached to patients’ legs were effective, but because of the size and methods used in the study, the results must be interpreted with caution. Among hospitalized patients there is insufficient evidence for or against the use of bed alarms (National Patient Safety Agency, 2007 [5]; Joanna Briggs Institute, 2007 [3]; Todd, 2004 [5]; American Geriatrics Society et al., 2001 [3]).

- **Hip protectors** – No specific research on the effectiveness of hip protectors in acute hospitals has been published, although they were part of successful multifactorial interventions in a hospital environment (Todd, 2004 [5]).

- **Restraints** – There are currently no studies that evaluate the effectiveness of restraint devices in an acute care setting. Bedrails are commonly used to minimize falls from hospital beds, but descriptive studies have shown that patients fall from bed despite bedrails being raised. While bedrails come in varying lengths, there is no information on which are the most effective in stopping falls. There is also no evidence available on which patients will benefit by the use of bedrails. From the studies reviewed, it is clear that bedrails and restraint devices do not provide complete protection from falls. There is some suggestion that physical restraint of patients can be replaced by other fall prevention strategies without an increase in patient falls, but this has not been supported by rigorous research (Joanna Briggs Institute, 2007 [3]). The American Geriatrics Society et al. (2001 [3]) notes that restraints have been traditionally used as a falls prevention approach but no evidence has been found to support their use; furthermore, restraints have major, serious drawbacks that can contribute to serious injuries.

**Prevention of Environmental Risks**

As the majority of falls occur at the patient's bedside, most studies utilized some interventions aimed at minimizing this risk. Examples include: ensuring the bed is in a low position; ensuring bed brakes are on; using bedrails if appropriate; ensuring patient can reach necessary items; using half bedrails to reduce patient’s need to climb over the rails to leave the bed (Joanna Briggs Institute, 2007 [3]). Other studies have pointed to the value of: fitted bed sheets; non-slip chair mats; ultra-low beds; sensor lights; non-slip flooring; extended bedside call bells; magnets to keep doors open; low-shine floor cleaning; improved floor cleaning, improved seating (National Patient Safety Agency, 2007 [5]).
Falls involving wheelchairs, chairs and commodes have been reported in descriptive studies. Interventions used to reduce these risks include: using safety straps or seat belts in chairs and wheelchairs; using geriatric chairs; using latex mesh in chairs to prevent patients slipping; selecting suitable chairs that have arm rests and are of appropriate height for rising and sitting (Joanna Briggs Institute, 2007 [3]).

Other interventions focus on the activities of patients and aim to minimize the risks caused by the hospital environment. These interventions focus on minimizing obstacles and clutter near the patient's bedside, improving lighting, stabilizing beds and bedside furniture, using nightlights at bedside and toilet, placing grab bars near toilets which are fitted vertically rather than in a horizontal position (Joanna Briggs Institute, 2007 [3]).

Staff Training
Educational activities are a common component of fall prevention programs. They generally include:

- Staff training to increase awareness of high risk patients and prevention strategies;
- Educating the patient and family about the risk of falling, safety issues and their mobility limitations;
- Teaching patients to make position changes slowly;
- Educating all new and high risk patients including orientating patients to their bed area, ward facilities and ways to obtain assistance (Joanna Briggs Institute, 2007 [3]).

Some studies have reported that training increases the awareness of health care workers about risk factors associated with patient falls and appropriate prevention strategies, and that this 'consciousness raising' may play an important role in reducing patient falls. Because this issue has not been addressed by any study, it is not known how long the effect of increased awareness is maintained; however, it appears that activities that promote or increase staff awareness of patient falls should be incorporated into any fall prevention program (Joanna Briggs Institute, 2007 [3]).

6.3 Prevention Strategies – Falls in Residential Care Facilities
This section includes information on research studies that address residential care facilities specifically – rather than duplicate general information on preventive interventions it may be useful to also refer to preceding sections.

6.3.1 Prevalence and Incidence

- Scott’s Review of Best Practices in Falls Prevention for Residents of Long-term Care Facilities (2003) found that about 51% of residents in long-term care facilities fall at least once each year with a fall incident rate of approximately 1.6 falls per bed annually.

- Furthermore, 10% to 25% of these falls result in serious injuries that require medical treatment. The risk of sustaining a hip fractures is 10.5 times higher for women who are
in facilities than if they were living in the community, and less than 15 percent of facility residents who sustain a hip fracture regain pre-injury ambulation status (Scott, 2003).

- Similarly, Rubenstein et al. (2007) found 30% to 50% of all nursing home residents fall each year and of these 40% fall twice or more each year. A 1994 analysis estimated that there were about 1.5 falls per bed per year.

- Institutionalized elderly persons fall three times more often than elderly persons living in the community (Rubenstein, 2007).

- Of residents hospitalized for fall-related injuries, 1998/99 to 2002/03: 75% had injuries to a major joint, femur, pelvis, hip or thigh, 40% of which were hip fracture: and an additional 11% had injuries to the upper limbs, lower limbs or spine (PHAC, 2005).

### 6.3.2 Causes and Contributing Factors

- Rubenstein et al. (2007 [5]) notes that nursing home residents may be more vulnerable to falling because of: a high level of frailty; multiple co-morbidities; a higher rate of cognitive deficits; inactivity; the side effects of medications; higher nurse to patient ratios; and limited availability of physiotherapists and occupational therapists (Rubenstein et al., 2007 [5]).

- Studies show that the mechanisms likely involved in bone loss in institutionalized older adults include lack of exercise, low dietary intakes of calcium and vitamin D, as well as lack of sun exposure (Scott, 2003 [3]).

- As is the case for all settings (i.e., community, hospital and long-term care), there is a consistent association between psychotropic medication use (i.e., neuroleptics, benzodiazepines, and antidepressants) and falls (American Geriatrics Society et al., 2001 [3]).

### 6.3.3 Prevention Strategies for Falls in Residential Care Facilities

Best practices for an organization-wide comprehensive falls prevention plan are described by Scott (2003 [3]) under prevention strategies for falls in acute care hospitals (section 6.2). These initiatives would similarly apply to residential care facilities.

As noted earlier, there is strong evidence for success focused on fall risk screening and assessment followed by the development and implementation of tailored interventions, which depending upon identified risk factors, can range from single interventions to a multifactorial approach (Scott, 2003 [3]). The evidence tends to be weaker for other interventions - compared to community interventions, interventions in acute care hospitals and nursing homes have been studied less frequently (Rubenstein et al., 2007 [5]). The limitations of existing studies may be a result of any of the following: small sample sizes, weaker research designs, lack of control for potential confounding factors or outcome measures that did not include falls or key risk factors in LTC settings (Scott, 2003 [3]).
Patient Risk Screening/Risk Assessment

Falls prevention in most health care settings involves screening for fall risk at admission and periodically thereafter (Rubinstein et al., 2007 [5]). Risk factors include those that are not amenable to change, such as age and sex, and factors that can be targeted for change, such as poor balance, muscle weakness, medication use, etc. - the latter group of potentially changeable factors are the focus of the studies reported below. However, knowledge of all risk factors can help in identifying those at greatest risk and for designing appropriate prevention strategies (Scott, 2003 [3]).

In a review of assessment tools, Scott (2007 [3]) reported:

- In residential or long-term care settings, six studies examined ten different tools: sensitivity scores ranged from 43 to 91% and specificity from 39 to 82%. The Mobility Fall Chart showed 85% sensitivity and 82% specificity in a developmental study but only 43% sensitivity and 69% specificity in a follow-up study. The Downton index demonstrated high sensitivity yet failed to produce acceptable specificity. A number of tools failed to measure outcomes in some categories.

- Scott suggests that it might be argued that development of screening tools to predict falls in high-risk populations, such as residents of long-term-care homes, is of limited use as all residents should be considered high risk and therefore receive an assessment linked to evidence-based interventions.

Multifactorial Risk Management Programs

There is overall consensus among a number of literature reviews on falls prevention that multifactorial falls prevention strategies are the most effective approach in demonstrating a reduction in the number of fallers and the frequency of falling, and that a multifactorial approach should be implemented as part of an overall, comprehensive falls prevention program (Scott, 2003 [3]).

In long-term care and residential care settings there is some evidence for appropriate multifactorial interventions for all residents (not only those with dementia and cognitive impairment), as follows:

- Medications – Reduction of medications was a prominent component of effective fall reducing interventions in community-based and long-term care multifactorial studies (Class I evidence). Multifactorial studies suggest that a reduction in the number of medications in patients who are taking more than four preparations is beneficial (American Geriatrics Society et al., 2001 [3]).

- Vitamin D and calcium supplements – The use of Vitamin D and calcium to enhance bone and muscle strength have been found by a number of researchers to be supported by strong evidence (Rubenstein et al., 2007 [5]; Scott, 2003 [3]). For example, Todd (2004 [5]) noted a recent RCT revealed fewer falls in a group receiving vitamin D and calcium supplementation compared to a control group (Todd, 2004 [5]). However, Oliver (2007 [3]) reported the use of high dose calcium and vitamin D proved to be effective in
three studies in care homes but ineffective in a more recent and larger study, suggesting that effects might be setting and population specific.

- **Exercise**
  
  - Exercise as a fall prevention strategy in nursing homes has been linked to improved muscle strength, gait and endurance (Rubenstein et al., 2007 [5]). Todd (2004 [5]) also notes there is evidence to support exercise programs for those at high risk, as well as gait training and advice on appropriate use of assistive devices. Oliver (2007 [3]) reported the evidence is now mounting for exercise and balance training in care homes.
  
  - The American Geriatrics Society et al. (2001 [3]) found evidence on exercise to be the strongest for balance training, with less evidence for resistance and aerobic training and little data regarding the intensity or type of exercise. They report that successful programs have consistently been over 10 weeks duration and that exercise needs to be sustained for sustained benefit. There is only preliminary evidence to support the use of Tai Chi. There is a dearth of studies involving men. Exercise programs work best within a multifactorial fall-prevention program but there is evidence that they work alone as well.

- Other interventions noted by researchers include nutritional review and supplementation (Todd, 2004 [5]).

- Environmental modifications are also seen as an important component along with other interventions (Scott, 2003 [3]). (For environment modifications, see section 6.2.2 Prevention of Environmental Risks).

**Interventions Involving Equipment and Technology**

A variety devices and equipment can be used as part of multifactorial prevention strategies:

- **Hip protectors** – Hip protectors have been demonstrated to substantially reduce hip fractures in older people in residential care settings. Their effectiveness depends on the model, correct placement and adherence. Reduction in fracture rates has been shown with hip protector use in residential care facilities in Denmark, England, Finland and the Netherlands, although it should be noted that they do not reduce the risk of falling nor do they reduce injury to any other part of the body. The available evidence for hip protectors reveals that: hip protectors do not reduce the incidence of a second hip fracture in community-dwelling older people; adherence to hip protector wear is improved by staff education; investigation of osteoporosis risk and appropriate interventions is an important complementary strategy (Todd (2004 [5])).

- **Other devices** – Footwear, environmental modifications, ambulation devices, bed alarms and surveillance systems are examples of devices for which there is limited evidence. Scott (2003 [3]) notes these common sense strategies and practical solutions have not been studied using rigorous research methods or have only been tested as part of a package of multiple strategies and not yet shown to be independently effective in
reducing falls or fall risk factors; however, many of them are in common use in institutional settings and are supported in the non-scientific literature (Scott, 2003 [3]).

Staff Training
A number of researchers have noted the value of staff education and training as a component in multifactorial prevention programs:

- Staff education programs on fall prevention in long-term care and assisted living settings is recommended as a guideline by the American Geriatrics Society (2001 [3]). Staff education was also found to be a component of successful nursing home programs by Rubenstein et al. (2007 [5]).

- There is little evidence for educational strategies when given in isolation of other interventions. However, education is seen as an important component of other strategies (Scott, 2003 [3]; Todd, 2004 [5]).

6.4 Prevention Strategies – Falls in Home Care and Community Care
These prevention strategies are intended to support home care services provided by the health authorities, as well as to provide a basis for education and advocacy initiatives that health authorities may engage in to enhance support by private health care providers and community service organizations working with elderly people.

Information is presented on research studies that address home and community care services specifically. Rather than duplicate general information on preventive interventions, references are provided to previous sections that also apply to the home and community setting.

6.4.1 Rate of Falls and Contributing Factors

- Both the incidence of falls and the severity of fall-related complications rise steadily after the age of 60. In the age 65-and-over population as a whole, approximately 35% to 40% of community-dwelling, generally healthy older persons fall annually. After 75, the rates are higher (American Geriatric Society, 2001).

- Between 20% to 30% of those who fall suffer injuries that reduce mobility and independence and increase the risk of premature death. Approximately, 10% of falls result in serious injury, of which 5% are fractures (WHO, 2004).

- Among the general population of seniors, the factors strongly associated with risk of falling include a history of prior falls, muscle weakness, poor gait or balance, visual impairment, arthritis, functional limitation, depression, and use of psychotropic medications. Furthermore, having multiple risk profiles increase the risk exponentially (Scott, 2007).

- Among active seniors living in the community, fall risk tends to be mostly related to mobility status, exposure to hazardous environments and risk-taking behaviours, such as climbing ladders. Seniors who require support to live in the community tend to be more susceptible to falls due to the direct effects of health problems such as arthritis,
depression, use of psychotropic medicines and the functional consequences of a chronic
disease (Scott, 2007).

- Most non-injurious falls (75% to 80%) are never reported to health professionals (WHO,
  2004).

- A non-injurious fall can still be fatal if the person is unable to get up from the floor and
cannot summon help. Lying on the floor for more than 12 hours is associated with
pressure sores, dehydration, hypothermia, pneumonia, and death. Almost 50% of people
who fall require help to get up after at least one fall, but only 10% of falls result in a lie of
greater than one hour (WHO, 2004).

- Depression, fear of falling and other psychological problems—“post-fall syndrome”—are
  common effects of repeated falls. Loss of self-confidence as well as social withdrawal,
  confusion and loneliness can occur, even when there has been no injury (WHO, 2004).

- Recurrent falls are a common reason for admission of previously independent elderly
  persons to long-term care institutions; one study found that falls were a major reason for
  40% of nursing home admissions (Rubinstein, 2007).

6.4.2 Prevention Strategies for Community-Dwelling Seniors

Research demonstrates that the most effective fall prevention interventions involved
individualized clinical assessment of fall risk factors, performed by a physician, combined with
strategies directed toward reducing these risks (Rubenstein et al., 2007 [5]).

Risk Assessment

Health professionals utilize fall risk assessment tools to identify modifiable risk factors among
those who are at greatest risk of sustaining a fall or a fall related injury. High-risk groups—such
as persons with recurrent falls, persons prone to injurious falls, or persons presenting after a
fall—require a more comprehensive and detailed assessment (American Geriatrics Society et
al., 2001 [3]).

The essential elements of any fall-related assessment includes details about the circumstances of
a fall (including a witness account), identification of the subject’s risk factors for falls, any
medical comorbidity, functional status, and environmental risks (American Geriatrics Society et
al., 2001 [3]).

In a systematic review of assessment tools used in the community setting, the most common
setting for risk assessment tests, 14 studies tested 23 tools. All reported strong inter-rater
reliability measures of 80% with 2 exceptions. Sensitivity results ranged from 14% to 94% and
specificity results from 38% to 100%. The Elderly Fall Screening Test demonstrated
discrimination between fallers and non-fallers of 83% sensitivity and 69% specificity. In another
study, the 5 Minute Walk, the Five-Step test and the Functional Reach all reach sensitivity and
specificity values greater than 70% (Scott, 2007 [3]).
Individualized Risk Management Plan

Based on the results of the risk assessment, it is necessary to develop a prevention strategy consisting of individualized interventions focused on minimizing the specific risk factors. Components of this individualized risk management plan could include:

- **Exercise**
  - Overall, exercise interventions were found to reduce the risk of falls by 12% and the mean number of falls by 19%. Exercises were focused on improving balance, strength, flexibility and endurance. Effective exercise programs included Tai Chi groups, balance and gait training, and strength building. Exercise was effective in reducing falls when used alone and when included as part of a multicomponent intervention (Rubenstein et al., 2007 [5]).
  - Todd (2004 [5]) found that group-based balance exercise is effective in lowering risk in selected groups (people who are at risk and frequent fallers) if led by an appropriately qualified professional. Individually tailored home-based exercise programs administered by qualified personnel reduce falls in women over 80 years living in the community, are cost effective at reducing both falls and injurious falls, and the effect is sustainable over 2 years. Balance training, such as Tai Chi, can reduce falls in people with mild strength or balance deficits. Group exercise is the most important part of a multifactorial community-based program encompassing exercise, vision and home hazards. Successful exercise programs have consistently been longer than 10 weeks duration. Exercise needs to be specific (dynamic balance, strength, endurance and gait training), progressive and sustained to have continuing benefit. Strategies for coping on the floor after a fall can be practiced safely in a group environment (Todd, 2004 [5]).

- **Medication management** – For all settings (i.e., community, long-term care, hospital, and rehabilitation), there is a consistent association between psychotropic medication use (i.e., neuroleptics, benzodiazepines, and antidepressants) and falls. Multifactorial studies suggest that a reduction in the number of medications in patients who are taking more than four preparations is beneficial (American Geriatrics Society et al., 2001 [3]).

- **Vision** – Patients should be asked about their vision and if they report problems: their vision should be formally assessed, and any remediable visual abnormalities should be treated. There are no randomized controlled studies of interventions for individual visual problems despite a significant relationship between falls, fractures, and visual acuity. Fall-related hip fractures were higher in patients with visual impairment (American Geriatrics Society et al., 2001 [3]).

- **Home hazard assessment and modification** – CIHI (2004) notes that a Cochrane Collaborative systematic review found that assessment and modification of the home environment was successful in preventing falls in the elderly.

- **Multicomponent programs** – Some of the most effective interventions have involved multicomponent programs. Such interventions may incorporate a variety of components: risk factor screening; tailored exercise, or physical therapy to improve gait, balance, and
strength; environmental modification; medication management; and other elements such as education about fall risk factors, referrals to health care providers and having vision assessed and corrected (Rubenstein et al., 2007 [5]). For example:

- The evidence for falls reduction is strongest in interventions that have selected high-risk populations and take a multi-faceted patient-centred approach to prevention. Effective interventions used in a multifactorial programs include: home-based professionally prescribed exercise, to promote dynamic balance, muscle strengthening and walking; group programs based on Tai Chi-type exercises or dynamic balance and strength training as well as floor coping strategies; home visits and home modifications for older people with a history of falling; medication review, particularly for those on four or more medicines and withdrawal of psychotropic medications where feasible (Todd, 2004 [5]).

- Studies on behavioural and educational programs have demonstrated benefit when included in multifactorial interventions, but have not been effective when provided in isolation (American Geriatrics Society et al., 2001 [3]).

- Municipal governments also have an important role to play in the design and maintenance of safe public environments intended to reduce the risk of falling of community members (Rubenstein et al., 2007, Ch. 3 [5]).

- It is essential that bone health be addressed if effective care is to be provided for older people and the costs associated with falls and fractures constrained (Healthcare Commission, 2006 [2]). A number of medications used widely to prevent or treat osteoporosis (e.g., hormone replacement therapy, calcium, vitamin D, antiresorptive agents) reduce fracture rates. However, these agents do not reduce rates of falls per se. There is a wealth of information concerning hormone replacement therapy and vitamin D in osteoporotic fractures, including ample prior analyses and practice guidelines (See published guidelines on therapy for osteoporosis (American Geriatrics Society et al., 2001 [3]).

Other Prevention Strategies

Other prevention strategies aimed at community-dwelling seniors includes:

- **Promotional and educational activities** – A falls minimization strategy may include: falls awareness week; equipment expo; posters; an education package as part of annual credentialing processes; and visible executive support for the strategies (Victorian Quality Council, 2006 [5]).

- **Multidisciplinary planning and reporting** – Health and social care agencies need to work together to prioritize fall prevention as part of their overall strategy for promoting healthy ageing and developing a coherent multidisciplinary programs. These should be implemented with national data collection mechanisms to evaluate interventions by outcome (e.g., fall/fracture rates) (Todd, 2004 [5]). Current practices for recording falls and fall-related injuries need to be standardized to enable better data collection on the person, place, time and circumstances of a fall (Rubenstein et al., 2007 [5]). The following data was seen as useful in the project: falls per 1,000 bed days, with
consideration being given to setting target levels based on the patient mix; multiple fallers; percentage of clients/patients receiving a fall risk screening and risk assessment; percentage of patients that were re-assessed after a fall; audits on environmental factors that were could contribute to falls (Victorian Quality Council, 2006 [5]).

- **Education and cultural change** – There is a need for cultural change to ensure the falls minimization strategy is seen as an integral part of patient care. This requires leadership, a multidisciplinary approach, reporting to the Board on progress, executive level responsibility for falls strategy, necessary resources and equipment, feedback regarding local results, local falls champions, streamlined documentation, and public education and awareness (Victorian Quality Council, 2006 [5]).

### 6.5 Conclusion: Prevention of Falls

The evidence is particularly strong for patient screening/assessment for falls combined with the development and implementation of individualized risk prevention interventions that include multiple components. These multifactorial interventions include a range of measures which have been studied to varying degrees. Those with the strongest evidence include muscle strengthening, balance retraining, and specialized and sustained exercises, as well as vitamin D and calcium supplementation, review and modification of medications, and staff education and training programs.

In addition, there are a range of guidelines that can provide valuable advice and support to health care providers in this field. Also, as Scott (2003 [3]) has pointed out, a number of common sense, practical solutions, which although not yet tested or only partially tested using rigorous research methods, are in common usage and are supported in the non-scientific literature. These include: patient monitoring and surveillance systems, use of appropriate footwear, ambulation devices, and a range of environmental modifications.

While consideration of research evidence and promising practices for specific interventions are a fundamental consideration, it is also essential to address organizational and management practices which support falls prevention. Implementation of a comprehensive falls prevention program in acute care and residential care facilities is regarded as an important best practice that can facilitate, coordinate and enhance continuous improvements in this field.
7.0 PREVENTION OF PRESSURE ULCERS

7.1 Key Factors and Issues

7.1.1 Prevalence and Incidence

The high prevalence of pressure ulcers is a significant health care concern. In Canada, the prevalence and incidence rates are (Registered Nurses Association of Ontario [RNAO], 2005):

- A survey of over 14,000 patients from 45 health care institutions across Canada estimated the prevalence of pressure ulcers as: 25.1% in acute care hospitals; 29.9% in non-acute facilities (long-term care, nursing homes, etc); 22.1% in mixed health care facilities (acute and non-acute); and 15.1% in community care.

- Overall, the average estimate of the prevalence of pressure ulcers in all health care institutions across Canada was 26.2%, suggesting that pressure ulcers are a significant concern in all health care settings in Canada.

- Estimates of incidence rates have suggested that up to 10% of those admitted to hospital develop a pressure ulcer, the elderly being at the highest risk with approximately 70% of all pressure ulcers. In those individuals who develop pressure ulcers, approximately 60% occur in the acute care setting – usually within the first two weeks of hospitalization.

- With the increased acuity of those admitted to hospital, it is estimated that 15% of elderly patients will develop pressure ulcers within the first week of hospitalization. In the long-term care setting, pressure ulcers are most likely to develop within the first four weeks of admission.

In the UK, the following prevalence rates for pressure ulcers have been reported:

- Bick (n.d.) estimated that UK rates are: acute care hospitals: 7-19% (1993 data); nursing homes: 7.5% (1994 data); community: 0-15% (1997 data); hospice: 21-33% (1999 data).

- Estimates on the rates of pressure ulcers vary widely because of differences in definition and grade of ulcer, the patient population and care setting. New pressure ulcers incidence are estimated to occur in 4% – 10% of patients admitted to acute hospitals in the UK, the precise rates depending on case mix (Royal College of Nursing [RCON], 2003).

Analysis of US pressure ulcer rates prepared for the Agency for Healthcare Research and Quality, found (Agostini, 2001):

- Among hospitalized patients, prevalence ranges from about 3% to 11%.

- The National Health and Nutrition Examination Survey found that less than 20% of pressure ulcers arise in non-institutional environments.

- In 1990 a large, prospective epidemiologic study reported the one-year incidence for pressure ulcer development in nursing homes to be 13.2%, with prevalence reports ranging from 7% to 23% in a systematic review. Risk-adjusted rates of new pressure ulcers have been reported to decrease by 25% from 1991 to 1996, based on a follow-up study.
7.1.2 Major Considerations and Issues

- The Registered Nurses Association of Ontario (2005) definition of “pressure ulcers, also known as pressure sores, bedsores and decubitus ulcers, are areas of localized damage to the skin and underlying tissue. This damage is generally a result of external forces – pressure, shear and/or friction”.

- The Royal College of Nursing (2003) describes pressure ulcers as:
  
  o Damage is caused by a combination of factors including pressure, shear forces, friction and moisture. Pressure ulcers can develop in any area of the body. In adults damage usually occurs over bony prominences, such as the sacrum. Presentation in infants and children is more likely to occur, for example, on the occipital area or ears.

  o Pressure ulcers have been associated with an increased incidence of infection including osteomyelitis.

  o Research indicates that pressure ulcers represent a major burden of sickness and reduced quality of life for patients, their carers and their families.

  o Often patients require prolonged and frequent contact with the health care system, and suffer much pain, discomfort and inconvenience.

  o The presence of pressure ulcers has been associated with a two- to four-fold increase of risk of death in older people in intensive care units.

- At-risk patients include the elderly, debilitated and immobile (e.g., patients with a prostheses, body brace or plaster cast), those with severe acute illness (e.g., those in intensive care units) and individuals with neurological deficits (e.g., spinal cord injuries). Ulcers also occur in patients with obesity and in pregnancy (RNAO, 2005 [3]; RCN, 2005 [3]).

- Malnutrition is a significant problem for the elderly, and is a risk factor for the development of pressure ulcers. Rates of malnutrition in the institutionalized elderly are estimated to affect 23% - 85% of the population, while the rate for those being admitted to hospital is estimated to range from 20% - 50%. The risk for pressure ulcers increase by 74% with the combination of immobility, stress to the immune system and loss of lean body mass (muscle) (RNAO, 2005):

- Mortality is associated with pressure ulcers – several studies have reported mortality rates as high as 60% for elders with a pressure ulcer within one year of discharge from hospital. The pressure ulcer is not generally the cause of death, but rather it develops after a decline in the health status of the older person (RNAO, 2005).

- Pressure ulcers are often used as an indicator of the quality of care provided by nursing homes (Agostini, 2001):

  o Pressure ulcers are one indicator of care measured by US nursing homes as part of the mandatory Minimum Data Set (MDS), which is required for participation in
Medicare and Medicaid. Part of the MDS evaluation includes the Resident Assessment Instrument, which serves as a guide to assess pressure ulcers and other pertinent clinical problems;

- Both the OECD and the Joint Commission have adopted pressure ulcer prevalence as a measure of patient safety;
- Ontario, Australian and the UK have suggested that pressure ulcers be used as a measure of nursing care quality.

- While pressure ulcers are a performance indicator, there are also related data issues including: difficulties in differentiating pre-existing practices; inaccurate recording of data and, the consistency and reliability of the data. Although greater standardization of the classification of pressure ulcers has been achieved, it is not universal (McLoughlin, 2006 [5]).

- Changes in the skill mix and/or the number and type of nurses may impact on the incidence of pressure ulcers within an organization because nursing is responsible for the assessment and implementation of protocols for the treatment of pressure ulcers (although evidence is limited) (Ontario Ministry of Health and Long-term Care [5]).

### 7.1.3 Costs to the Health Care System

Canadian, British and American reviews estimate significant costs for the treatment of pressure ulcers, particularly when considering the fact that most pressure ulcers are preventable.

Costs reported in Canada include:

- The Canadian Association of Wound Care (2004) reported on a study conducted in the late 1990s that estimated the cost of treating an individual with a pressure ulcer within a long-term care facility to be an average of $24,050 for three months of treatment. Similarly, a recent case study estimated the total cost for 12 weeks of treatment in the community, including electrical stimulation, to be $27,632 (RNAO, 2005).

- Pressure ulcers have been linked to an increase in nursing care time, increased length of stay, higher hospital costs, increased co-morbidity, sepsis, and a fourfold increase in mortality in cases developing bacteremia. Each of these increases has costs attached to them (Ontario, Ministry of Health and Long-Term Care, 2002).

The Royal College of Nursing (2003) has estimated costs for the UK:

- The financial costs to the NHS are considered to be substantial. In 1993, the estimated cost of preventing and treating pressure ulcers in a 600-bed general hospital was between £600,000 and £3 million a year.

- The cost of treating a grade 4 pressure ulcer was calculated in 1999 to be £40,000 a year. More recent cost data suggest that treating ulcers varies from £1,064 for a grade 1 ulcer to £10,551 for a grade 4 ulcer with total costs in the UK estimated as being £1.4–£2.1 billion annually, equivalent to 4% of the total NHS expenditure.
Costs reported in the US include:

- Costs associated with the treatment of pressure ulcers in the United States have been conservatively estimated to be $500 to $50,000 (US) per ulcer, with more severe wounds being significantly more expensive to manage than less severe ulcers. It was estimated that the total US cost for pressure ulcer treatment was at that time $1.3 billion dollars annually and rising (Agency for Health Care Policy and Research, 1992).

- Both hospital costs and length of stay are significantly higher for patients who develop pressure ulcers during hospitalization. In the nursing home in particular, failure to prevent this adverse outcome carries increasing liability—the median settlement for pressure ulcer-related disputes was $250,000 between the years 1977 and 1987 (Agostini, 2001).

- The cost of specialized beds and mattresses to prevent pressure ulcer development can be high, ranging from $40 to $85 per day for low air-loss beds. Specialized beds and intensive nursing interventions all carry clear resource implications. Inman and colleagues have demonstrated the cost-effectiveness of an air suspension bed compared to a standard intensive care unit bed. Yet cost-effectiveness studies of the many different pressure-relieving devices have not been formally completed (Agostini, 2001).

### 7.2 Prevention of Pressure Ulcers

#### 7.2.1 Organizational-wide Coordination

Responsibility for pressure ulcer prevention is shared by physicians, nurses, enterostomal therapy nurses, physical and occupational therapist, nutritionists, pharmacists, administrators, patients, and patients' families. An interdisciplinary team is required to ensure a coordinated approach to quality improvement, with representation across departments and programs of interested and knowledgeable staff (RNAO, 2005 [3]; National Pressure Ulcer Advisory Panel, 1992 [5]).

As well, coordination is required when patients are transferred to other settings; this may require site visits, client/family conferences, and/or assessment of resources to prevent the development of pressure ulcers. Organizational policies can facilitate processes with respect to providing and requesting advance notice when transferring or admitting clients between practice settings when special needs are required (RNAO, 2005 [3]).

#### 7.2.2 Risk Assessment and Risk Management

Many studies recommend that a risk assessment be performed soon after admission to acute care or long-term care facilities and that, either at fixed intervals or when conditions change, a reassessment be conducted to prevent any stage 1 or higher ulcers (National Pressure Ulcer Advisory Panel, 1992 [5]; NHS Modernization Agency, 2003 [5]; Joint Commission, 2007 [5]). It is also important that the assessment be conducted by those who have the required specific knowledge and expertise, and access to regular updating opportunities (NHS Modernization Agency, 2003 [5]).
**Core Public Health Functions for BC: Evidence Review**

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**Risk Assessment**

Assessment of risk for developing pressure ulcers is generally determined by a combination of clinical judgment and the use of a validated, reliable risk assessment tool such as the Braden Scale or the Norton Scale. (RNAO, 2005 [3]; Joint Commission, 2007 [5]). There is, however, little evidence that indicates use of a risk tool or scale is better than clinical judgment, or that it improves outcomes (RCN [3], NICE [3]).

While a number of tools have been developed, many have not been fully evaluated. A number of research-based pressure ulcer assessment tools, such as the Pressure Sore Status Tool, have undergone a systematic process of development and their reliability has been assessed. However this review did not find evidence for the wide use of such tools in the UK, nor evidence that these have been tested against an agreed gold standard. As well, it remains unclear how these tools are linked to outcomes, i.e., the healing of pressure ulcers, as this is not reported in the literature. Also, there is little evidence to support the use of risk assessment scales to make decisions about allocation of devices (RCN [3], NICE [3]).

**Risk Management Plan**

On completion of risk assessment, an individualized plan of care is developed based on identified risk factors and goals for the client. The plan is developed in collaboration with the client, significant others and health care professionals, and includes measures for ongoing reassessment (RNAO, 2005 [3]; NHS Modernization Agency, 2003 [5]).

7.2.3 **Equipment**

Specialized equipment can be used as a primary prevention method although it also used in secondary prevention, or treatment, of pressure ulcers.

Foam mattresses (high-specification foam), as an alternative to the standard hospital foam mattresses, can reduce the incidence of pressure ulcers in people at risk. There is no research evidence that high-tech pressure-relieving mattresses and overlays are more effective than high-specification (low-tech) foam mattresses and overlays, however, professional consensus recommends that consideration should be given to the use of alternating pressure mattresses and other high-tech pressure relieving systems (NICE, 2003 [3]). Agostini (2003 [3]) also notes that many specialized mattresses appear to be effective in reducing the development of pressure ulcers when compared with standard mattresses, but comparison of pressure-reducing devices among themselves yields no significant differences in the prevention of pressure ulcers.

Other factors from the literature related to pressure-relieving mattresses include:

- Pressure-relieving overlays used on the operating table and in the post-operative period have been shown to reduce postoperative pressure ulcer incidence; however, it is unclear which form of pressure relief on the operating table is the most effective (NICE, 2003 [3]).

- Considerations should be given to the design and functionality of a particular bed or mattress, for example, the ability of nursing staff to move and transfer patients placed on deeper or bulkier beds (Agostini, 2001 [3]).
NICE (2003 [3]) also considers it highly important that a key part of any pressure ulcer reduction strategy should be a systematic and coordinated approach to the acquisition, allocation and management of equipment.

Agostini (2003 [3]) points out that the equipment studies generally had poor methodologic design: the trials were mostly small, true baseline comparability was hard to confirm, standardization of protocols was often unclear, and assessments were frequently unblended.

### 7.2.4 Pressure Ulcer Treatment

Many pressure ulcer treatments in the research literature are secondary prevention methods which include: nutrition assessment and management, pain control, wound cleaning, dressings, topical agents, antimicrobial agents, positioning, adjunctive therapies, and surgery (debridement). Since these are in the ambit of nursing care practices they will not be discussed in detail in this section. The treatments are in the systematic reviews conducted by the Registered Nurses Association of Ontario and the Royal College of Nursing (See Appendix on Evidence Review Quality on Prevention of Pressure Ulcers, and References).

### 7.2.5 Guidelines

Guidelines are most likely to be effective if they take into account local circumstances and are disseminated by ongoing educational and training programs. Where there are adequate planning, resources, organizational and administrative support, as well as the appropriate facilitation they can effectively identify residents and define early intervention for prevention of pressure ulcers (RNAO, 2005 [3]; Joint Commission, 2007 [5]).

### 7.2.6 Training

Appropriate educational programs that provide current research-based information should be offered at periodic intervals, and should be directed at all levels of health care providers including clients, family or caregivers. Consideration should be given to design, development, and implementation of educational programs that reflect a continuum of care. They should begin with a structured, comprehensive, and organized approach to prevention and should culminate in effective treatment protocols that promote healing as well as prevent recurrence (National Pressure Ulcer Advisory Panel, 1992 [5]; RNAO, 2002 [3]). Agostini (2001 [3]) also notes that the use of general educational interventions for hospital staff is supported by before-after studies.

Training programs must be evaluated for their effectiveness in preventing pressure ulcers through such mechanisms as quality assurance standards and audits (RNAO, 2005 [3]).
7.2.7 Information Reporting and Management

There should be an opportunity to evaluate pressure ulcer interventions by registered practitioners based on evaluations which incorporate input from patients and care providers to enable forward planning (NHS Modernisation Agency, 2003 [5]). As well, patients and/or care providers should have ongoing access to information and the opportunity to discuss individual needs with a registered practitioner (NHS Modernization Agency, 2003 [5]). Bick (n.d. [2]) notes that informing patients and carers on pressure ulcer risk assessment and prevention should be a priority, regardless of the environment in which care is provided.

There are three methods for capturing information required: recording information on the adverse incident reporting system; electronic care planning records; or patient records (Healthcare Commission, n.d. [5]). Although adverse incident reporting systems may use a number of systems (e.g., PRISM, Datex, Safecode are examples of systems – Datex is being implemented in BC); they should include a section for recording pressure ulcers. The advantages of this approach are: hospital acquired pressure ulcers are identified as adverse clinical incidents; transcription errors are avoided; and the need for a separate database is avoided. The electronic patient record is perhaps the ideal method as it enables the monitoring of pressure ulcer incidence without any additional reporting burden on clinical staff. Where routine record keeping screens are used by staff on wards, these should be designed in such a way that the data essential for incidence calculation can be accessed centrally, without further need for data entry.

In Ontario, in the long-term care and community care sector, the Minimum Data Set series of instruments has the capacity to collect information on Stage 1-4 pressure ulcers. Currently in the acute care sector, ICD-9 allows for the collection of the presence of pressure ulcers; information on different stages is not collected. With the implementation of ICD-10 the presence and stages of pressure ulcers in the acute care setting are captured (Ontario Ministry of Health and Long-Term Care, 2002 [5]).

7.3 Conclusion

Pressure ulcers create significant physical and psychological burdens for patients, families and health care providers. Once established, they are expensive and difficult to treat. Consequently, a health care facility needs to clearly establish policies and procedures to emphasize prevention strategies, including interdisciplinary coordination among health care providers, risk assessment and risk management, availability of appropriate pressure-reducing mattresses, staff training, and regular monitoring and evaluation to facilitate continuous performance improvement.
PART IV: HEALTH AND SAFETY OF HEALTH CARE EMPLOYEES

8.0 INTRODUCTION TO WORKPLACE ADVERSE EFFECTS

This section presents an overview of the major adverse events for staff employed in health care facilities as well as in home delivery of health care services. Occupational injuries in the health care workplace create a considerable burden of illness and cost, including the costs of morbidity and disability, as well as increased pressure on remaining staff members.

This introductory section emphasizes the importance of organizational factors in preventing major occupational injuries and illnesses in the health care workplace. Additional sections address the health and safety of staff members and discuss strategies targeted to minimizing or preventing specific adverse effects including:

- Musculoskeletal injuries;
- Exposure to infectious, toxic and hazardous agents;
- Harm from violent patients; and
- Psychological issues such as stress and burnout.

8.1 General Workplace Issues and Contributing Factors

8.1.1 Burden of Workplace Illness and Injury

The health care sector employs approximately 180,000 workers, about 10% of the provincial workforce (Worksafe BC, 2007). Nurses are the largest occupational group (Lowe, Discussion Paper, 2006). The data listed below includes injuries and illness that are reported to Worksafe BC (and thus may not reflect the full scope of adverse events).

<table>
<thead>
<tr>
<th>Setting</th>
<th>Injury rate 2004 (per 100 FTEs)</th>
<th>Injury rate 2005 (per 100 FTEs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Care</td>
<td>3.8</td>
<td>4.1</td>
</tr>
<tr>
<td>Community Health Support Services</td>
<td>4.5</td>
<td>4.9</td>
</tr>
<tr>
<td>Counselling or Social Services</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Long-term Care</td>
<td>8.1</td>
<td>10.0</td>
</tr>
<tr>
<td>Residential Social Service Facility</td>
<td>5.6</td>
<td>5.7</td>
</tr>
<tr>
<td>Short Term Care</td>
<td>7.0</td>
<td>8.8</td>
</tr>
</tbody>
</table>

Worksafe BC, 2007

The three most common injuries among the health care workforce in BC are (Worksafe BC, Health Care Update June 8, 2006):

- Musculoskeletal injuries (MSI) 49% of all time loss claims;
- Slips and trips, 14%; and
- Injuries resulting from violence, 9%. 
The 2007 Alamgir et al. report, *Work-related injury among direct care occupations (RNs, LPNs and Care Aides) in British Columbia*, estimated injury rates (per 100 FTEs) for direct care staff in all health care sectors:

- Injury rates for these groups:
  - Care aides (CAs) had the highest injury rates in every sector, with the highest occurring in nursing homes (37.0 per 100 FTEs).
  - Licensed practical nurses (LPNs) had the next highest injury rate, with the most injuries in acute care (30.5 per 100 FTE), followed by nursing homes (26.8).
  - Registered nurses (RNs) had the lowest injury rates, with the most injuries (21.9 per 100 FTEs) in acute care.
  - There was a trend toward lower injury rates with increasing age among RNs and CAs in acute care as well as among LPNs and CAs in nursing homes.
  - Overall, female nurses had higher injury rates than their male counterparts for all occupations and health settings with the exception of RNs in acute care.

- Musculoskeletal injuries (MSIs) comprised the highest proportion of injuries for each nursing occupation and in each sector. For RNs, the MSIs ranged from 75.9% of all injuries in the nursing homes sector, to 52.1% in acute care. Similarly for LPNs, MSIs contributed 71.2% of injuries in acute care and 69.4% in nursing homes. For CAs, MSIs represented 73% of all injuries in the nursing home and community care sectors, and 60.8% of injuries in acute care.

- RNs had a higher proportion of puncture injuries (21.3%) compared to LPNs (14.4%) and CAs (3.7%). Of note, RN puncture wounds comprised a similar proportion of all injuries in acute care and community care, and a lower proportion in long-term care.

- Irritation and allergy incidents were highest amongst RNs (11.1%) followed by LPNs (7.2%) and CAs (5.1%).

- Other injuries (the aggregate of burns, cuts, bruises, infections and psychological trauma) were highest amongst CAs (14.7%) followed by RNs (13.7%) and LPNs (7.5%).

- For RNs the majority of injuries (59.8%) occurred in general medical wards and surgery. For LPNs the majority (41.5%) of injuries occurred in general medical wards although a substantial amount occurred in rehab/extended care (18.5%), surgery/OR (15.7%) and in ‘infection control and related areas’ (12.9%). For CAs the predominant departments for injury were rehab/extended care (38.6%) and ‘infection control and related areas’ (24.4%).

- The authors note that the rates are high compared to published rates by WorkSafeBC, as they were calculated from actual productive hours for each occupation and therefore provided a more accurate measure of time-at-risk per person. WorkSafeBC uses a different denominator that is not comparable.
8.2 The Cost Burden of Workplace Illness and Injury

The Office of the Auditor General’s report, In Sickness and in Health (2004 [2]), estimated the total direct sick time cost for five health authorities in 2002/03 was $103.2 million. This did not include the cost of relief staff to replace absent workers or of overtime that may have resulted. Such indirect costs of absences are often estimated to be 2–10 times the direct costs ($206.4 to $1,032 million). Also not included was the cost of decreased productivity when staff attend work but are not feeling well. This is sometimes referred to as “presenteeism.” The cost of presenteeism is unknown, but some reports have estimated it to be two to four times the direct cost of illness and injury ($206.4 to $412.8 million) (2004). Therefore, the Office of the Auditor General estimated that the total cost of direct sick time combined with indirect costs including presenteeism, for 2002/03 ranged between $516 M and $1548 M.

8.2.1 Causes and Contributing Factors

The Health Canada-funded study, Trends in Workplace Injuries, Illnesses, and Policies in Healthcare across Canada provides an overview of the major issues in occupational health care (OHSAH, 2004):

- Health care workers face substantial occupational risks and health impacts related to infectious diseases, violence from patients/residents with dementia, allergic reactions from chemical agents, and ergonomic issues associated with patient handling;

- Important developments are changing the working environment for health care workers, including increased job complexity and increases in the number and acuity of chronic patients, in a time of cost containment and downsizing that alter the nature of work and the resources available to workers to do their work;

- These developments have resulted in fewer jobs, increased job insecurity, increased workload, longer working hours, higher patient-staff ratios, and changes in workplace structures (e.g., loss of head nurses and chief nursing offices).


- Employment relationships rest on the four pillars of trust, commitment, communication and decision-making influence. Employment relationships are fragile, easily damaged by downsizing and restructuring, which require substantial management effort and time to repair. The ingredients of a great place to work, such as respect and trust, are embedded in cultures, which are far more difficult to change than structures. This is why so many restructuring efforts fail to deliver the desired operational improvements. Workplace reorganization either changes structures while leaving the old culture intact, or changes the structure in ways that damage the fragile relationships through which culture flows.

- The most striking conclusion from this benchmarking exercise is that health professionals have the weakest employment relationships on all four dimensions—trust, commitment, communication and influence—of any occupation in Canada, including unskilled manual and service workers.
The single most powerful influence on employment relationships is a cluster of healthy and supportive work environment characteristics: good work-life balance, a healthy work environment, a safe work environment, helpful and friendly co-workers and few conflicting demands made by others.

Absenteeism is perhaps the only work environment indicator for which reliable national data are available and which all health care organizations track. It is a lagging indicator, providing an up-stream measure of the effects of poor working conditions. Statistics Canada’s Labour Force Survey documents that in 2000, nursing, technical and support staff in health care had the highest number of days lost due to personal illness or injury of any occupation, double or more the national average. Absenteeism costs include lost productivity, stress on workers who have to cover for absent colleagues and increased staff turnover given that these behaviours are highly correlated.

Other contributing factors reported in the literature include:

- Excessive overtime is reported by health care employees (Kerr, 2002 [6]; Lowe 2006 [6]) reports that in BC, 27% of hospital workers worked overtime in 2005.

- There tends to be a lack of participation in decision-making, limited social support from co-workers and colleagues, and insufficient equipment/technology to support nursing practice, including such things as the functioning and availability of lifting assists (Kerr, 2002 [6]).

- Certain aspects of organizational culture (e.g., little or no value placed on individual responsibility or in open and freely flowing communication) and climate (e.g., rigid leadership styles and poor communication channels) are associated with lower rates of worker morale, higher levels of work stress, higher accident rates, higher burnout rates, higher turnover, and higher adverse events related to patient quality of care issues (Gershon, 2004 [6]).

- Gershon (2004 [6]) also found that if aspects of the organizational culture are ill-defined, frequently shifting, poorly communicated, not reinforced, and/or poorly supported administratively, both the employees’ collective perceptions and their behaviours (i.e., delivery of care, safe work practices, and teamwork) will be inconsistent. Lowe noted that most organizations don’t have unifying cultures built around strong core values and that large multi-unit organizations—like health regions—are more likely to have weak and fragmented cultures, making it difficult for employees to see the connection between the stated values and vision, and their job (Lowe, Discussion Paper, 2006 [5]).

- A survey of nurses in Canada (BC and Ontario) and the US by Aiken (2001 [6]) identified fewer than half of the respondents reported that management is responsive to their concerns, provides opportunities to participate in decision making, and acknowledges nurses’ contributions to patient care. The proportion of nurses who have a say in scheduling was less than one third. A clear majority of US and Canadian nurses reported that the numbers of patients assigned to them increased in the past year, which is particularly troubling given the widely reported rise in patient acuity levels in both countries.
Lowe (2006 [6]) identified strong survey evidence of the relationship between the quality of the work environment and the quality of health services. Furthermore, quality and safety outcomes vary systematically across health employers rather than job classifications, suggesting that the values, policies, and practices of specific employers matter most when it comes to improving the quality of employees’ work life and the quality of patient or client services.

The BC Office of the Auditor General has recently completed two audits of the British Columbia health care workplace at the health authority. They reported:

Leadership in establishing and maintaining a healthy work environment is lagging; promoting a healthy work environment is limited by budgets and focus; and monitoring and reporting on the health of employees and the work environment is limited (OAG, 2004 [2]).

A follow-up report on the previous recommendations concluded that the six health authorities have completed implementation of many of the recommendations and are initiating action on all the rest; however, there were information gaps about what employees think of their work environment and whether current strategies and resources are addressing employee health needs and work environment conditions. In addition, it was noted that managers have been unable to devote sufficient attention to understanding and addressing employee needs (2007 [2]).

8.2.2 Current Initiatives in BC

Legislation and policy are primary prevention methods to protect health care workers from adverse events as they set out a minimum standard of behaviour. In BC, these include:

- The Ministry of Health Service Plan (2006/07 – 2009/10) includes the goal of “a sustainable, affordable, publicly funded health system” with the objective (#3) of “optimum human resource development to ensure there are enough, and the right mix of, health professionals” and a key strategy to “create safe, positive work environments that attract and retain talented people.”

- The Workers Compensation Act, Chapter 492 sets out the fundamental duties for employers (s. 115) and for employees (s. 116) to have: a safe workplace, safety policies and procedures including an occupational health and safety program and equipment; and incident reporting. The regulation describes these in some detail.

Information management has been the focus of several initiatives. The Occupational Health and Safety Agency for Healthcare (OHSAH) in BC has worked with the BC health care sector to reduce high rates of injury and illness. In collaboration with Fraser Health and Vancouver Island Health Authority, OHSAH developed a new health and safety system: the Workplace Health Indicator Tracking and Evaluation (WHITE™) Database:

- The WHITE database is a web-based system that facilitates incident tracking and case management. It centralizes information that can be used to reduce and eliminate workplace injuries, provide prompt clinical and workplace interventions to reduce disability and time loss, and evaluate the effectiveness of health and safety programs. The system links information entered into the database: for a health care organization, this
could mean determining, for example, that a specific education session had a major impact on reducing back injuries, or that introducing safer needles reduced the total cost of needle stick injuries. Similarly, the database can be used to identify immunized and non-immunized workers in the case of an infectious disease outbreak such as influenza. The Database has 5 modules: incident investigation, case management, employee health, health and safety, and Prevention and Early Active Return-to-work Safely (PEARS).

- The WHITE Database is fully operational in four BC Health Authorities: Fraser Health, Vancouver Island Health Authority, Interior Health and Northern Health. Development of the system is ongoing.

### 8.3 Organizational Strategies for Healthy Health Care Workplaces

It should be noted that many of the strategies discussed earlier in Organizational/Management Strategies to Support Quality of Health Care apply to the development of a healthy workplace (e.g., a Culture of Safety, Safety/Risk Assessment and Quality Improvement, Epidemiological Surveillance and Information Management/Reporting, and Health Promotion).

#### 8.3.1 Organizational Culture and Climate

In 2006, Lowe’s report to PHSA, *Creating Healthy Health Care Workplaces in British Columbia: Evidence for Action, A Discussion Paper*, provides the following overview and model:

- There is growing recognition among researchers of the need to develop a more comprehensive approach that moves beyond individual workers’ health outcomes to examine the underlying workplace determinants. Many workplace health researchers and practitioners now use the term “health and productivity management” to integrate health promotion into all corporate functions, from human resources, benefits, employee assistance programs, occupational health and safety, workers’ compensation, organizational development, and business operations. Comprehensive approaches to improving workplace health can take two directions. One focuses on the workplace conditions that support positive mental and physical health outcomes for employees. The other focuses on both individual and organizational outcomes, including decreased health care costs, absenteeism and performance. Both approaches use the World Health Organization’s (WHO) definition of health as complete physical, mental and social well-being, not just absence of disease or ill health.

- The emerging concept of a healthy organization, defined as “…one whose culture, climate and practices create an environment that promotes both employee health and safety and organizational effectiveness.” The figure below outlines the logic of a healthy organization, showing how work-environment characteristics influence the development and utilization of an organization’s people capacity, which is required to achieve the organization’s goals. Healthy organizations are financially successful and have healthy workforces.

- Using population health thinking, leaders must strategically link a healthy work environment, people capacity, and organizational effectiveness:
In a healthy and high-performing workplace, behaviors are guided by people-centred values that are embedded in the culture where management consistently treats staff as core assets, and behaviors are supported by human resource management policies and practices. Further, the strength of positive workplace cultures will be found within health service sites—such as an emergency department, a residential care facility, a community hospital—not at the regional level. Any attempt to improve the work environment must leverage the strengths of these local cultures, address the barriers to change that a local culture may pose or, in the worst cases, recognize that a local culture is part of the problem, contributing to an unhealthy workplace (Lowe, Discussion Paper, 2006 [5]).

When fairness (organizational justice) is present, employees experience less job stress and their productivity is higher (Lowe, Discussion Paper, 2006 [5]).

Similarly, the Office of the Auditor General report (2004 [2]) identified healthy workplace criteria as: supportive culture and values; leadership; use of a broad definition of health; participative team approach; customized plan; links to strategic goals; ongoing support; evaluation and communication. It also pointed to the National Quality Institute’s Canadian Healthy Workplace Criteria: leadership, planning, people focus, process management and a fifth section entitled “outcomes” designed to capture the results and effects of the organization’s healthy workplace effort.

### 8.3.2 Workplace Health Promotion

Workplace health promotion interventions that are comprehensive, well designed, and successfully implemented will have a Return-on-Investment (ROI) in the range of $3 to $8 for every dollar over a five-year period invested in the intervention; most ROI is achieved through reduced absenteeism with other potential cost benefits of short- and long-term disability, workers’ compensation, administrative costs, and employee productivity (Lowe, Discussion Paper, 2006 [5]).
Specific worksite health promotion programs aimed at reducing an individual’s health risks, such as modifications to diet, physical activity and other lifestyle factors, have limited to mixed results in terms of reducing health risk factors. Clinical and cost outcomes for comprehensive worksite health promotion and disease management programs are generally positive, if modest, showing the best results for individualized risk reduction for employees with the highest risk of heart disease and other chronic conditions (Lowe, Discussion Paper, 2006 [5]).

The WHO Health Promoting Hospitals initiative will be discussed as part of the design and physical aspects of the health care workplace.

8.3.3 Work-Life Balance

The CCHSA uses the following definition: “Work life provides a work atmosphere conducive to performance excellence, full participation, personal/professional and organizational growth, health, well-being and satisfaction” (Lowe, Discussion Paper, 2006).

Evidence-based strategies for achieving work-life balance for employees generally focus on providing work time and location flexibility and the development of ‘supportive managers.’ A supportive manager is a good communicator who focuses on output rather than hours, shows respect for employees, and supports their career development. The evidence suggests that the presence of formal work–family policies makes little difference unless their use is fully supported by management (Lowe, Discussion Paper [5]).

8.3.4 Data Gathering and Reporting

The issue of information gathering and under-reporting of staff injuries has been raised by Daniels (2005 [5]), who notes that a one-size-fits-all approach is unlikely to work, as it is widely postulated that such schemes ‘rarely travel well’, therefore, any incentive scheme must allow for flexible implementation. One aspect critical to the successful implementation of any reporting scheme is the need for active and visible management commitment to the scheme. Reporting rates may increase if the processes are easily accessible, efficient, and confidential (2005 [5]). (Daniels suggests that under-reporting of accidents, injuries and illness appears to be a worldwide phenomenon and suggests that this is a result of a poor safety culture and poor management commitment to ensuring a safe workplace. He further suggests that under reporting of workplace violence and bullying results from fear of blaming or reprisals, lack of an appropriate reporting system, and employer disinterest.)

The QPaSS (Quality Practice Setting Survey) is a health care measurement tool which assesses care delivery process, communication systems, facilities and equipment, leadership, organizational supports, professional development systems and response to external demands. Organizations can use QPaSS scores to measure and track progress on issues such as autonomy and control over work, leadership and management style, access to functional equipment, professional development opportunities, communication, and care delivery processes; QPaSS is currently used in British Columbia (Lowe, Making a Measurable Difference, 2006 [5]), (Lowe, Quality of Worklife Indicators, 2002 [5]).
8.3.5 Other Strategies

An example of a healthy workplace program is the Magnet Recognition Program®, an organizational program that facilitates quality care. It was developed by the American Nurses Credentialing Center to recognize health care organizations that are successful in providing the best nursing care, and also to provide a vehicle for disseminating and encouraging successful practices and strategies. The measures have been effective in retaining nurses and positively impacting nurses’ quality of work life (i.e., satisfaction, safety, psychological well-being) and have enhanced patient care. Magnet concepts, and the supporting research, provide an opportunity for organizational leaders to engage staff in improving existing programs and the work environment. The Canadian Nurses Association has adopted the Magnet hospital concepts. It has also been endorsed by researchers in Canada such as Lowe, who supports the Magnet concepts for BC health care workplaces in the PHSA report, Creating Healthy Health Care Workplaces in British Columbia: Evidence for Action. A Discussion Paper (Lowe, 2006 [5]).

Some of the characteristics of Magnet hospitals that enhance nurse leader effectiveness and support clinical nurses at the local level (Upenieks, 2002) are:

- The nurse executive is visible, influential, credible, and responsive. He or she values nursing as a profession and values the professional nurse. As a result, a greater proportion of registered nurses are incorporated into the nursing workforce.

- The administrative team listens and responds to the needs of its employees. They also recognize the worth nursing brings to the organization.

- The nurse leader not only articulates the importance of nursing to the administrative team, but also to the medical staff and community members.

- Interactions among nurses, physicians, and the administrative team are respectful and mutual. All team members work collaboratively in attaining the mutual goal of optimal patient care.

- The nurse executive, due to his or her formal and informal power structures, spreads his or her power to the directors he or she manages—displaying an optimistic, constructive, and respectful approach to matters of patient care and those related to nursing care.
delivery. The directors, in return, empower their clinical nurses, supporting an autonomous climate.

- Nurses are encouraged to do for patients what they know best how to do, in accordance with professional standards of care.

- There is freedom, there is opportunity for upward movement, there is opportunity to transfer to another nursing unit, and there are opportunities to acquire new skills or responsibilities. Nurses are encouraged to move and grow, to reach their potential. At these hospitals, nurses are fiscally supported to attend local and national conferences, in order to stay abreast of the most current nursing trends.

- Physicians work collaboratively with the clinical nurses. They value each other’s expertise and recognize the interlinked importance that each professional skill brings to patient care.

- Nurses are provided with the tools to be able to optimally perform their job—with new equipment, better staffing, and more assistive help. Nurses are paid well.

- Regardless of what may be occurring in the outside world, or whatever newest healthcare trend is prevalent, or how severe the nursing shortage—there are enough nurses, who are satisfied and empowered in their role, to provide excellence in patient care delivery.

8.4 Conclusion

It is clear that a healthy work environment is achieved by an organizational culture and climate that is committed to quality care, demonstrates trust and respect for staff members, uses a participative team approach, encourages job autonomy and decision input, has open communication, reflects fairness, and supports a good work-life balance. Healthy workplaces are strongly correlated to quality health services and reduced staff injuries and illnesses.
9.0 MUSCULOSKELETAL INJURIES IN THE WORKPLACE

The BC Occupational Health and Safety Regulation defines musculoskeletal injury or "MSI" as an injury or disorder of the muscles, tendons, ligaments, joints, nerves, blood vessels or related soft tissue including a sprain, strain and inflammation, that may be caused or aggravated by work.

Occupational Health Clinics for Ontario Workers Inc. (2005) note that work-related musculoskeletal disorders define injuries to muscles, tendons or nerves that are caused or aggravated by work: these injuries are also commonly referred to as repetitive strain disorders, cumulative trauma disorders, repetitive stress disorders and work-related upper limb disorders.

Musculoskeletal injuries are the major source of health care worker acute injury and disability. They can happen whenever patients or objects are handled or moved in such a way as to cause injuries to joint structures. They can occur in all settings, although the emphasis in the literature is on the residential care sector. Musculoskeletal injuries are complex: they are the result of, and impact on other health care worker stressors such as violence, stress/burnout, staffing, work life, and larger organizational factors discussed in following sections.

This section includes musculoskeletal injuries (MSI), slips, trips, dislocations, fractures and workplace trauma.

9.1 Key Factors and Issues

9.1.1 Prevalence and Incidence

- Musculoskeletal injuries among health care workers account for 49% of Worksafe BC time loss claims, and slips and trips 14% (Worksafe BC, June 2007).

- The annual average of MSI injuries accounted for 55% of all injuries reported by health care workers to WorksafeBC (30% were due to patient handling and 25% to material handling) (http://www2.worksafebc.com).

- MSI rate for BC health care workers has been consistently higher than the injury rate for all BC industries combined (OHSAH, 2004).

- The average MSI annual rate between 1997 and 2002 was 5.27 per 100 health care workers in BC (OHSAH, 2004).

- One study indicated the most common types of MSIs: back only, 32%; neck and/or shoulders 26%; multiple types, 10%; and wrist, elbow, hand/finger, knee, 32% (Worksafe BC, Fraser Health, 1998-2002).

- MSIs comprised the highest proportion of injuries for each nursing occupation and in each sector. For RNs, the MSIs ranged from 75.9% of all injuries in the nursing homes sector, to 52.1% in acute care. Similarly for LPNs, MSIs contributed 71.2% of injuries in acute care and 69.4% in nursing homes. For CAs, MSIs represented 73% of all injuries in the nursing home and community care sectors, and 60.8% of injuries in acute care (Alamgir, 2007).
A Health Canada funded study, *Trends in Workplace Injuries, Illnesses, and Policies in Healthcare across Canada* has the following comments on MSIs (OHSAN, 2004):

- Musculoskeletal disorders are the major source of work-related disability among healthcare workers. In recent years, researchers have directed more attention to the fact that healthcare workers, especially those working in long-term care settings, are at a high risk of MSI.

- One study found the lifetime prevalence rate of back pain in healthcare workers to be greater than 70%. The incidence of low back pain is equivalent for both male and female healthcare workers. Nurses with frequent and direct physical contact with patients have been shown to have a higher incidence of musculoskeletal back injuries than those who work with patients infrequently.

### 9.1.2 Burden of Costs for Musculoskeletal Injuries

- Worksafe BC reported on costs related to MSIs in 2000: the average cost of an MSI claim was $3020; and the average number of days lost per MSI claim was 22.3 (Worksafe BC, Fraser Health, 1998-2002).

- BC healthcare employers lost over 280,000 person-days of work and absorbed costs of over $30 million from claims made in 2000 alone (OHSAN, 2003).

### 9.1.3 Causes and Contributing Factors

- Causes of MSI have been identified as: patient handling transfers, 25%; material handling, 15%; patient repositioning, 12%; slips and falls, 10%; violence, 9%; bathing and dressing, 7%; awkward positioning, 6% (Worksafe BC, Fraser Health, 1998-2002).

- Many nurses who have been injured commonly report patient handling as a major cause of their injury. Biomechanical analyses of spinal compressive and shear forces and worker perceptions suggest that manual lifting and transferring tasks are particularly high-risk activities (OHSAN, 2004).

- Estimates of the compressive forces associated with manually handling patients usually exceed guidance on safety and physical limits (i.e., maximum allowable limit of 3400 Newtons for compressive forces on the L5/S1 disc), especially for females. The risk on the musculoskeletal system when manually patient handling is due to: the weight or required force to lift/transfer or reposition a patient/resident, the horizontal and vertical location of the patient/resident relative to the healthcare worker, the frequency, duration and orientation of lifting, stability of the patient, workplace geometry, and the physical environment (OHSAN, 2004).

- The potential for MSI when patient handling is further compounded by the patient's size, shape, deformities, level of fatigue, cognitive functioning, and cooperation, as well as the worker's physical impairments or lower limb function, balance, and coordination. Cognitively impaired patients/residents can be unpredictable and may suddenly become combative, resist efforts, or go limp during a transfer, causing a health care worker to lose
balance and/or make sudden unexpected movements. These sudden unexpected movements and muscular contractions can cause high muscular forces within the back leading to fatigue and possible failure of the muscles surrounding the lumbar spine (OHSAH, 2004).

- The age of workers and their previous injuries play significant roles in MSIs. Middle-aged workers sustain more injuries than either young or old workers: the 45-54 year-old age group makes up about 20% of the provincial workforce but, in health care, sustains about 30% of the patient MSI claims and almost 40% of the days lost (OHSAH, Report Card, 2003 [5]).

- Adverse psychosocial aspects of work such as high job demands with low decision authority and job control, and low social support at work and low job satisfaction are all deemed to contribute to MSIs (Yassi, 2005).

- Internationally, there have been many attempts to reduce injuries in health care workers but success has been limited as programs tended to focus on single factors – and because the problem has been viewed in the past as a worker issue, rather than recognizing that it relates to load. Past approaches include (ACC, 2003):
  - Back schools – trying to teach people how to lift has failed because people may be heavy or hard to grip;
  - Equipment – success is limited when carers don’t know how or when to use the equipment, don’t have time, it’s not part of standard procedures, or there is not enough space to use the equipment;
  - Lifting teams – even strong people are injured lifting, and many lifting teams have had their numbers cut because of funding shortfalls;
  - Health screening – while screening people with previous injuries is helpful, it has been legally challenged. It’s difficult to screen effectively and even people with no past history are at risk.

9.1.4 Current Initiatives in BC

In April 1997, BC Occupational Health and Safety Regulations were introduced which included, for the first time in Canada, legislated requirements for managing the risk of MSI. The 'Ergonomics (MSI) Requirements' in the Regulation specify required actions to identify, assess and control the risk of MSI through a process involving risk identification, risk assessment and risk control, as well as education and training of employees, and consultation with workers and the joint committee or worker health and safety representative. These requirements were gradually phased into the WCB compliance monitoring system over a period of several years and have been instrumental in providing incentives and guidance for establishing coordinated MSI risk management programs.

The Occupational Health and Safety Agency for Healthcare in BC (OHSAH) established several programs to assist health authorities to implement the ergonomic requirements, and to decrease injuries and their sequelae (OHSAH (2004)). Two of these OHSAH programs are: Safe Patient...
Handling and Prevention and Early Active Return-to-work Safely (PEARS). OHSAH conducted rigorous evaluation and cost benefit analysis of measures to reduce patient-handling injuries; and, based partly on the results of this research, in March 2001, the Health Employers Association of BC (HEABC) and the Association of Unions (Facilities Sub-sector) signed a Memorandum of Understanding (MOU) in which they agreed to work towards eliminating all unsafe manual lifts of patients/residents through the use of mechanical equipment, except where the use of mechanical lifting equipment may be a risk to the well-being of patients/residents, in which case adequate staff would be made available to safely handle the patient/resident (OHSAH, 2004).

To further the efforts to reduce patient handling injuries, OHSAH, the WCB, the Ministry of Health Services and others collaborated to develop a financing framework to support the purchase of necessary mechanical equipment and related training in 2001. These efforts resulted in the distribution of $15 million for the procurement of electric beds and overhead lifts by the Ministry of Health Services to support this initiative. In August 2002, the WCB of BC followed suit with the provision of $6 million from the acute care group reserve to support safe patient handling initiatives (OHSAH, 2004).

OHSAH has distributed four documents that constitute “clear industry guidelines for safe patients/residents handling” (called for in the MOU):

- Musculoskeletal Injury Prevention Program: Implementation Guide;
- Safe Patient & Resident Handling: Acute & Long Term Care Sector Handbook;
- Reference Guidelines for Safe Patient Handling; and
- Patient/Resident Ceiling Lift Program: Program Guide.

The inter-agency Provincial Ceiling Lift Program Steering Committee approved the Design Guidelines for Installation of Overhead (Ceiling-Mounted) Lift Systems for Persons developed by OSHAH. These guidelines were passed on to the Capital Planning and Programming Branch of the Ministry of Health Services in 2002.

The Auditor General’s Report In Sickness and in Health (2004) describes recent initiatives noting that the response in focus groups was very positive about the ceiling lifts in particular. The increased emphasis on preventing musculoskeletal injury, or reducing its impact when it does occur, appears to be having an effect.

### 9.2 Prevention of Musculoskeletal Injuries

It should be noted that much of the material in this section is relevant to all health care settings including acute care, residential care, and home care sectors (in many cases the specific sector and setting was not referred to in the literature). Sections on residential care and home care follow with descriptions of research that refer specifically to those sectors.
9.2.1 Risk Management

The BC Workers Compensation Act, Occupational Health and Safety Regulation requires:

- Risk identification: the employer must identify factors in the workplace that may expose workers to a risk of musculoskeletal injury (MSI).

- Risk assessment: when factors that may expose workers to a risk of MSI have been identified, the employer must ensure that the risk to workers is assessed.

- Risk factors: the following factors must be considered, where applicable, in the identification and assessment of the risk of MSI:
  
  (a) the physical demands of work activities, including: (i) force required, (ii) repetition, (iii) duration, (iv) work postures, and (v) local contact stresses;

  (b) aspects of the layout and condition of the workplace or workstation, including: (i) working reaches, (ii) working heights, (iii) seating, and (iv) floor surfaces;

  (c) the characteristics of objects handled, including: (i) size and shape, (ii) load condition and weight distribution, and (iii) container, tool and equipment handles;

  (d) the environmental conditions, including cold temperature;

  (e) the following characteristics of the organization of work: (i) work-recovery cycles; (ii) task variability; (iii) work rate.

- Risk control:

  (1) The employer must eliminate or, if that is not practicable, minimize the risk of MSI to workers.

  (2) Personal protective equipment may only be used as a substitute for engineering or administrative controls if it is used in circumstances in which those controls are not practicable.

  (3) The employer must, without delay, implement interim control measures when the introduction of permanent control measures will be delayed.

Worksafe BC analyzed the results of 120 completed risk assessments, completed before and after a project to assess and control risk factors for MSI at Langley Memorial Hospital. The study found: although there was an increase in the frequency of MSIs (up 6%) and lost time MSIs (up 2%), there was a corresponding decrease in severity (down 43%) including a decrease in days lost and in WCB costs (down 44%). The average cost of MSI WCB claims decreased by $1200 and the average days lost decreased 10.2 days (Worksafe BC, Ergonomic, 2002 [5]).
9.2.2 Ergonomic Interventions

Cole’s (2005) [3] systematic review for the Ontario Institute of Work and Health stated that there is evidence that poor ergonomics—the inappropriate design of workplaces and work processes—contributes significantly to the development and chronicity of common musculoskeletal diseases. By improving ergonomic aspects of work and workplaces, it may be possible to prevent or reduce these disorders and increase productivity (2005).

Cole used Wilson’s definition of participatory ergonomics (PE), “the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goals.” A distinctive feature of a workplace PE interventions is the formation of an ergonomics “team” which guides the intervention process. This group usually includes employees, managers, ergonomists, health and safety personnel, and research experts. The team typically undergoes training by ergonomists or researchers aimed at familiarizing them with ergonomic principles. Combining this outside expertise with the organization’s unique experience makes it possible to devise ergonomic interventions tailored to the needs of that particular workplace. This may increase the chance that interventions will be successful (Cole, 2005 [3]).

Cole concluded, based on the systematic review (2005 [3]), that current studies provide partial evidence that PE interventions have: a small, positive impact on musculoskeletal symptoms; a positive impact in reducing injuries and workers’ compensation claims; a positive impact on lost days from work or sickness absence although the magnitude of the effect requires more precise definition.

According to OHSAH’s report Success Factors for Ergonomic Interventions, an ergonomic intervention is defined as “a change process initiated and implemented by a stakeholder with the aim of introducing measures that influence occupational mechanical exposures and/or acute responses in order to promote musculoskeletal health”. Three levels of interventions have been identified: primary intervention targeted to the presumed cause of a risk factor; secondary intervention designed to alleviate the symptoms or strengthen a worker’s resistance to harmful exposures; and tertiary, rehabilitative intervention aimed at bringing the worker back to work.

The BC Occupational Health and Safety Regulation stipulates that:

1. A health care employer must consult with the joint committee or the worker health and safety representative, as applicable, with respect to the following: (a) risk identification, assessment and control; (b) the content and provision of worker education and training; (c) the evaluation of the compliance measures taken.
2. The employer must, when performing a risk assessment, consult with (a) workers with signs or symptoms of MSI, and (b) a representative sample of the workers who are required to carry out the work being assessed.
Ergonomics has also been applied to the design of computer work stations. Van Eard et al. (2006 [2]) found in a systematic review for the Toronto Institute for Work and Health:

- There was no strong evidence that any specific office ergonomic intervention categories had positive effects on either musculoskeletal or visual health;
- There was moderate evidence that rest breaks together with exercise during the breaks had no effect on musculoskeletal outcomes;
- There was moderate evidence that alternative pointing devices have a positive effect on musculoskeletal outcomes;

9.2.3 Patient Handling Policies and Practices

Worksafe BC, *Handle with care* (2003) supports a comprehensive “no-lift” policy to eliminate or minimize unsafe or hazardous manual lifting of patients and materials in all but emergency situations.

The Occupational Health Clinics for Ontario Workers *Healthcare Workers Patient Handling* (2005) describe a “minimal-lift” program as reducing the unnecessary risk of injury for clients and staff through the reduction of manual lifting. The goal of a minimal lift program is to provide employees with a policy that will promote an environment where the usage of assistive equipment is encouraged and expected. These goals can be achieved by providing staff with access to an appropriate number of assistive devices for patient handling (e.g., walking belts, total lifts, sit stand lifts, shower chairs, transfer boards and slide sheets).

Amick et al. (2006 [3]) conducted a systematic review of interventions to protect musculoskeletal health for the Toronto Institute of Work and Health. They concluded that “multi-component patient handling” involving policy change, equipment purchase, and staff training (equipment usage and patient handling) had a positive effect on musculoskeletal health. Three studies of medium-high quality evaluated interventions that included all three components. Two showed positive effects, therefore, the team concluded there was moderate evidence that a multi-component patient handling intervention was effective. They noted that overseas experience demonstrates that the most successful patient handling programs use an integrated systems approach. They:

- Have a clear patient handling policy statement;
- Define and communicate roles and responsibilities for everyone;
- Are based on safe legal responsibilities;
- Are based on safe biomechanical principles;
- Use data collection tools for ongoing evaluation;
- Use a risk assessment methodology;
- Use handling equipment and safe techniques;
- Describe and eliminate unsafe techniques;
- Differentiate between patient care and therapeutic handling;
- Put theory into practice; and
- Have full support at all levels of the organization (Amick et al., 2006 [3]).

Other studies revealed positive effects of cognitive behaviour training, broad-based musculoskeletal injury prevention, participatory ergonomics, equipment and equipment training; however the number of studies on these single interventions were limited and researchers therefore did not form conclusions. They also noted that studies on back schools, patient handling training, and education alone did not demonstrate a positive effect on musculoskeletal outcomes.

The UK and Australia have successfully reduced injuries through a combination of legislation and numerical guidelines regarding load thresholds. The UK introduced manual handling regulations in 1992, following EEC directives. Patient handling guidelines then evolved over several years, with The Guide to the Handling of Patients 4th edition, released in 1999. Australia introduced a ‘no lift’ policy in 1998. The Australian Nursing Federation’s ‘no lift’ policy is based on the UK approach. The 2002 evaluation report of the Victorian Nurses Back Injury Prevention Project states that in the year following implementation of its patient handling program, WorkCover, claims were reduced by 48%: the largest reduction was in sprains and strains, but back injuries were down 40%. A follow-up survey conducted at 18 months showed days lost due to injury had been reduced by 74% and claim costs were down 54% (Amick et al., 2006 [3]).

The US Veterans Health Administration and Department of Defense (October 2001, rev 8/31/05 [5]) identified elements of a comprehensive safe patient handling and movement program as: ergonomic workplace assessments of patient care areas; patient assessment criteria; algorithms for safe patient handling and movement; equipment selection, storage, and maintenance; peer-safety leaders (back injury resource nurses); lifting teams; after action reviews; and a no-lift policy.

9.2.4 Equipment

Ceiling lifts have demonstrated effectiveness, bordering on statistical significance, in reducing patient handling MSIs in BC’s health care facilities. The 20 facilities with high ceiling lift coverage experienced, on average, less than 1 day lost per bed due to patient handling MSI in 2001/02, significantly less than the average of 3 days lost per bed in all facilities. Only 2 of the 12 facilities that experienced more than 10 days lost per bed had ceiling lifts and those 2 facilities had covered only a small proportion of their beds. As more ceiling lifts penetrate into more health care facilities, this association should grow stronger (OHSAS, 2003 [5]).

Most of BC’s facilities with full ceiling lift coverage are trying to consciously and formally eliminate manual lifts. Few, however, have succeeded in this. At least one health authority reported that, in facilities with complete ceiling lift coverage, occasional manual lifts in transfers
occur in what their staff called “emergency situations” in which lifting equipment was not immediately available. Another facility with complete ceiling lift coverage reports that up to 20% of their lifts are still manual lifts, as workers try to save time. One facility with full lift coverage allows occasional manual lifts on the grounds of “compassion and patient comfort.” It is clear that the necessary apparatus for safe manual lifting—risk assessments, procedures, resources and training—will have to be maintained by most facilities for the foreseeable future (OHSAH, 2003 [5]).

Other research studies have noted:

- The use of an overhead lift method was associated with lower peak compressive forces at the lumbar spine than the slider sheet method, but took longer and resulted in a greater cumulative load (Yassi, 2005 [5]).

- The use of mechanical lifting devices has reduced the injuries associated with patient transfers but has not had the same impact on repositioning tasks (Yassi, 2005 [5]).

- Workers find the floor lifts to be of limited use in the repositioning of patients, where they report ceiling lifts to be significantly more effective (OHSAH, Report Card, 2003 [5]).

- Findings suggest that it would be beneficial to install a repositioning sling or slider sheet as a component of bed linen replacement for patients who are dependent on a caregiver for repositioning in bed (Yassi, 2005 [5]).

- A “best practices” musculoskeletal injury prevention program consists of mechanical lifts and repositioning aids, a zero lift policy, and employee training on lift usage (Collins, 2004 [1]).

9.2.5 Education and Training

The BC Occupational and Safety Regulation stipulates that staff education and training must be provided:

1. The employer must ensure that a worker who may be exposed to a risk of MSI is educated in risk identification related to the work, including the recognition of early signs and symptoms of MSIs and their potential health effects.
2. The employer must ensure that a worker to be assigned to work which requires specific measures to control the risk of MSI is trained in the use of those measures, including, where applicable, work procedures, mechanical aids and personal protective equipment.

Researchers have found:

- Training must be contextual with an emphasis on competencies and problem solving in the work setting. Recommendations are based on principles of change management and participatory ergonomics, where the traditional concept of training has moved forward to encompass three aspects: education (for core competencies); supervision of daily practice; and facilitation of problem solving (Hignett, 2005 [5]).
Compliance with the Royal College of Nursing competencies was found to reflect a higher level of problem solving, this is likely to be due to a greater level of supervision and support in the workplace, rather than training away from the work place. The problem solving ability provides an indication that training and education is being transferred into working practice, with the staff using the information to guide their manual handling decisions (Hignett, 2005 [5]).

With respect to training on manual handling interventions for health care staff, Fleming and Lardner (2002) summarized the evidence by saying that behavioural change is not brought about by changing the person, but by changing their environment. This was confirmed by Hignett et al. (2003) in an evidence-based review that encompassed the impact of manual handling training interventions; they found strong evidence from 12 studies that these training interventions have no impact on working practices or injury rates (Hignett, 2005 [5]).

Amick (2006 [3]) found six studies which evaluated exercise training. Two were high quality and four were medium-high quality. Four described “physical fitness” or “calisthenics” while two described exercises that specifically improved strength and/or endurance. Two high quality and four medium-high quality studies showed positive effects on musculoskeletal outcomes.

9.2.6 Return-to-Work Programs

Return-to-work programs appear to be successful in facilitating and supporting injured employee's return to work especially where they integrate primary and secondary prevention practices (OHSAH, 2004). The goals of preventing workplace MSIs are unlikely to be met solely through primary prevention strategies, therefore secondary intervention are required to minimize the impact of injury and ill health on productive activity, and facilitate an early and sustainable return to work (Hanson, 2006 [2]).

Prevention and Early Active Return-to-work Safely (PEARS)

PEARS is referred to as a secondary prevention method as Davis et al. (2004 [4]) found in an evaluation of a pilot project at Vancouver General Hospital, that PEARs did not decrease the incidence of musculoskeletal injury but did reduce the duration of associated time loss. It was effective in returning injured registered nurses and health science professionals (therapists and technicians) to work more quickly. It did not reduce time loss of MSIs among facility support staff.

The OHSAH describes PEARs as follows:

- The Prevention and Early Active Return-to-work Safely (PEARS) program was developed by OHSAH to address concerns about rising injuries and disability. The stakeholder-driven program was established with extensive input from health care employers and unions. As musculoskeletal injuries (MSI) were amenable to prevention and early intervention, and the cost of these injuries high, acute care work-related MSI was the initial focus of the PEARs program.
• The PEARs program integrates MSI prevention, early intervention, and return-to-work processes. The overall purpose is to reduce the incidence and duration of MSI time loss and related costs. The program is based on a combination of evidence of what works locally with evidence from international scientific literature that suggested an integrated (workplace and clinical) and bipartite (employers as well as unions) approach may be the most effective means of promoting health in the workplace. Cornerstones of the program include primary prevention, workplace assessment and modification, evidence-based decision-making, and strong union involvement in all aspects of program design and implementation.

• PEARs is funded by OHSAAH with matching (or greater) funding from health authorities. With the passage of time and collaborating efforts of health authorities and unions, PEARs is now a provincial wide program. It spans five health authorities, servicing over 40,000 employees, and facilities including acute, residential, long-term, community care and home support.

Davis et al. (2004 [4]) also noted that a state-of-the-art review of the effectiveness of primary and secondary intervention measures for occupational low back pain emphasized the need for a broad “determinants of health” approach and the need to examine the roles played by social, cultural, organizational, and economic factors. A comprehensive review of the literature showed that numerous factors influenced the duration of disability and the return-to-work process. These were broadly characterized as: organizational level employer characteristics; job tasks and work organization; characteristics of the injury; characteristics of the individual worker; rehabilitation interventions; disability prevention and management programs; and society level policy, legislative, and economic factors.

Early Intervention

BC health employers must offer early intervention programs to all employees eligible for long-term disability, as part of the Collective Agreement (Nurses’ Bargaining Association and HEABC), which states “The Parties agree that the goal of an Early Intervention Program is to complement the existing disability plans by facilitating a proactive and customized service for ill and injured employees to effectively return to work in a safe and timely manner. The objectives of the Early Intervention Program are:

a) To initiate early contact with the ill/injured employee;

b) To identify and provide appropriate case management of the ill/injured employee’s health issues;

c) To facilitate the rehabilitation of ill/injured employees while expediting a safe and timely return to work through an early return to work plan;

d) To convey the message that employees are valued; and

e) To reduce the costs of sick leave and the Long-Term Disability Insurance plan.”
Early Rehabilitation Services

The Healthcare Benefit Trust (an employee group benefit provider for the health care sector in BC) administers Early Rehabilitation Services, a voluntary program that is expected to become part of the Early Intervention Program in health authorities. It intends to provide more education for supervisors and expand services so that workers stay at work.

A review by the Healthcare Benefit Trust of the Early Rehabilitation Services concludes:

- Timely referral is necessary, preferably within 30 days of disability.
- Of 70% of cases receiving Early Rehabilitation Services, the program has either prevented or shortened long-term disability claims in 90%.
- Increased employee attachment to the workplace is encouraged through a greater role for direct supervisors to refer employees to Early Rehabilitation Services and to expand work modifications.

The Langley Early Assessment and Prevention (LEAP) Program (Langley Memorial Hospital)

The goals of the LEAP program are to assist employees in returning to work or staying at work after sustaining a work related musculoskeletal injury through early intervention, graduated return to work programs, onsite rehabilitation, education and ergonomic intervention, team approach to work planning; job coaching; decrease costs associated with days lost due to work related musculoskeletal injuries; assist management and union in identifying risks or hazards relating to department, occupation and job tasks (Dawson/Workers Compensation Board, 2004).

The results of a case-control study on LEAP revealed (Dawson/Workers Compensation Board, 2004):

- There were 42 WCB claims for MSIs under the LEAP program during the study period, compared to 54 that were not in LEAP;
- The average WCB costs for claims were $1054 for those in the LEAP program, compared to $2384 non-LEAP claims;
- The average days lost for all injuries was 7.2 for those in LEAP, compared to 11.4 for non-LEAP.

Active Case Management

‘Case management’ is a goal-oriented approach to keeping employees at work and/or facilitating an early return to work. There is good scientific evidence that case management methods are cost effective through reducing both time off work and lost productivity, and thus reducing health care costs. This evidence pertains to using case managers as ‘brokers’ or ‘generalists’, but not as ‘primary therapists’; the potential for a conflict of interest when using the ‘primary therapist’ approach to case management has been widely recognized in various rehabilitation programs. The evidence also found that the skill of individual case managers is more important than their professional training or background (Hanson, 2006 [2]).
There is even stronger evidence that best-practice rehabilitation approaches have important potential to significantly reduce the burden of long-term sickness absence. The combination of case management with suitable rehabilitation principles is currently being used effectively in multiple settings throughout the UK. ‘Active case management’ focuses on achieving specific work retention and return to work outcomes. It is a strategy for supporting individuals to stay in work or return to work. In practice, case managers integrate clinical and occupational management with the needs of the individual to facilitate work retention or early return to work (Hanson et al., 2006 [2]).

Hanson (2006 [2]) also pointed to key features that should be included in a model of best practice for return-to-work practices:

- A strong business case is required;
- Employees, employers and service providers need to have shared goals in terms of rehabilitation.
- Evaluation and benchmarking is necessary with a means of recording the costs of related ill health to allow full evaluation of any rehabilitation program.
- Case Managers are needed to ensure quick response, co-ordinate treatment and liaise with stakeholders (specifically the individual, line manager, and a service provider, and HR as appropriate).
- Clarification of roles (outlining the key skills of case managers, rehabilitation specialists and GPs) may help in ensuring that service providers are competent. Those providing treatment and advice need to have knowledge of the work the individual undertakes to be able to provide appropriate treatment and action planning.
- Early referral and assessments is essential as early provision of suitable advice (e.g., what to expect, what the person should be able to do, how to manage pain/restrictions etc.).
- Flexibility is necessary to ensure individual cases are managed effectively (action based on an individual assessment rather than a standard response in terms of timescales or nature of treatment).
- Involvement of all stakeholders is necessary in managing cases, with clear guidance on the role of each stakeholder, actions required, timescales and methods of communication between them.

Worksafe BC uses a case management model; however, they have not conducted any formal reviews or studies into the cost effectiveness of returning clients with musculoskeletal disorders to work, using case management and/or work rehabilitation for those with these conditions (Graham, 2005). However, they have operated the case management model and clinical case planning to achieve “Maximal Medical Recovery” in the most optimal time. They use Disability Guidelines to target recovery dates. In addition, they have established a network of rehabilitation providers of various levels of intensity to help achieve best clinical outcomes and return-to-work. Every provider is measured in return-to-work outcomes. As a result they believe that they have reduced duration of claims, and therefore, reduced wage loss where time-loss is a factor. (They
9.3 Musculoskeletal Injuries in Residential Care

Issues and factors related to MSIs in residential care include (Cohen, 2003):

- Residents have varying degrees of mobility and many have some level of dementia. As a result, injuries among direct-care staff have less to do with resident handling (i.e., lifts and transfers) and more to do with assisting in “activities of daily living” with individuals whose capabilities and moods are in constant flux.

- In the last decade, a shortage of public residential long-term-care beds combined with the trend towards home-based care has led to a resident population with more complex and advanced needs than previously.

- Care aides (CAs) provide the majority of hands-on, direct caregiving to residents. Licensed practical nurses (LPNs) perform a range of duties including dispensing medications and other nursing procedures. CAs and LPNs work under the direction of an RN, often within a unit-based team, and are supervised by a director of care.

- Injury rates are high among staff in intermediate care facilities in BC. Between 1994 and 1998, overall injury rates were approximately 50% higher than in BC’s acute care sector and slightly higher than in long-term care as a whole. For 1998, the Workers’ Compensation Board of BC reported workers in long-term care had an injury rate of 10.5 compared to 7.0 for workers in acute care.

- On average, musculoskeletal injuries accounted for 62.1% of total time-loss injuries (ranging from 1.2% to 96.4%) and 71.2% of all time-loss days (ranging from 0.5% to 99.9%) among intermediate care workers.

- Physical and verbal abuse from residents is not uncommon in intermediate care homes. Residents may become agitated or aggressive for many reasons: physical pain, emotional distress and frustration, dementia and other mental illnesses, and sometimes a history of violent behaviour.

OHSAH (2003 [5]) has reported that the type of facility (long-term care beds were thought to generate more MSI than acute care beds) and the facility’s age (older buildings were thought to have more awkward floor layouts) had no impact on patient handling MSIs from one facility to another; nor did the mere presence or absence of MSI programs or training programs.

Prevention Strategies for Musculoskeletal Injuries in Residential Care

Many prevention strategies have already been discussed in the previous section and apply as well to residential care. These include multi-components strategies encompassing: risk management, patient handling policies and practices (particularly no-lift policies), equipment, and staff education and training. Only studies and strategies that apply specifically to residential care are presented in this section, as a supplement to the earlier discussion.
Of particular interest to residential care are the following studies:

- Collins et al. (2004 [1]) examined the use of mechanical lifting machines in nursing homes. Based on workers’ compensation claims, the following reduction in MSIs resulted from the implementation of lifting machines:
  
  o 61% injury reduction in activities involving moving residents in/out of bed, bed to chair, chair to bed (the injury rate dropped from 3.80/100 FTEs to 1.49/100);
  
  o 61% in turning/rolling residents (dropped from 2.17/100 FTEs to 0.85/100);
  
  o 41% in injuries involving toileting (0.54/100 FTEs to 0.32/100);
  
  o 41% in lifting resident off the floor (0.54 to 0.32);
  
  o 39% in breaking residents fall (1.74 to 1.07);
  
  o 36% in repositioning residents in bed (1.85 to 1.17);
  
  o 76% in resident transfer, not otherwise classified (2.61 to 0.64) (Collins, 2004 [1]).

- Collins noted that the largest reductions occurred among the more serious injuries that resulted in workers’ compensation claims. The data also suggest that the effect of mechanical lifting equipment intervention was beneficial for all nursing homes, for workers in all age groups, lengths of tenure, and for full time, part time, and per diem staff. Additionally, this study documented a decline in injuries associated with resident assaults and violent acts towards nursing staff during resident handling tasks (Collins, 2004 [1]).

- An Australian study found strong evidence for use of the O’Shea no-lift system method:
  
  o Reduction of 20% in workers compensation claims costs associated with resident handling injuries;
  
  o Reduction of 20% in days lost due to resident handling injuries;
  
  o Improved return to work rate and durability of return to work for injured staff;
  
  o Increased staff awareness of factors contributing to back injuries, the importance of hazard identification risk assessment and control;
  
  o Substantial financial returns on investment in terms of cost benefits; the average total cost of implementing ‘no lifting’ programs per facility was $75,558 or $1140 per bed.

- A "no unsafe lifts" program resulted in an 83% reduction in lost hours (Yassi, Healthcare Quarterly, 2005 [5]).
9.4 Musculoskeletal Injuries in Home Care

Health care systems around the world have experienced a shift towards an increasing number of patients staying in their homes rather than moving to a hospital or residential care setting. As a result, both physical and psychosocial demands placed on home care workers have risen dramatically over the last few years.

OHSAH (2003 [5]) noted that patient handling MSIs among home support workers rose from 5% of 1996 claims to 15% of 2002 health care sector claims (OHSAH, 2003 [5]). Issues and factors related to MSIs in home care include (OHSAH website OSHTips):

- Despite the similarity between the duties of nurses and nursing aides in hospital settings, the prevalence of MSI injury among home care workers is almost three times the rate for nursing aides. One study of over 350 female home care workers reported the following statistics with regard to MSIs over a 7-day period:

<table>
<thead>
<tr>
<th>MSI - Anatomical Area</th>
<th>% of Staff Reporting Symptoms over 7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder</td>
<td>47%</td>
</tr>
<tr>
<td>Neck</td>
<td>44%</td>
</tr>
<tr>
<td>Lower Back</td>
<td>40%</td>
</tr>
<tr>
<td>Upper Back</td>
<td>30%</td>
</tr>
</tbody>
</table>

- Home care workers can either work in clients’ homes or in an assistive living community. The degree of institutionalization has been found to relate to workload and demands of time and emotional engagement. Home care in clients’ homes had the lightest workload and less exacting demands. These workers felt more satisfied with their work hours, had more freedom in conducting duties and received more positive feedback from their clients. In comparison home care workers in a more institutionalized setting experienced heavier workloads of more time and emotion-consuming duties. Their interactions with clients were less positive due to time pressure. Although these results seem to indicate that clients’ homes are preferred to an assistive living setting, one must also consider that clients’ homes have not been designed for this purpose and therefore, many features exist that prevent the home care workers from safely carrying out their duties.

Preventive Strategies for MSIs in the home care sector

Many prevention strategies have already been discussed in the previous section and apply as well to home care. These include multi-components strategies encompassing: risk management, patient handling policies and practices (particularly no-lift policies), equipment, and staff education and training.

Although the literature presents few recommendations specific to home care workers with respect to preventing musculoskeletal injuries in clients’ homes, the following are of interest:

- There is an OHSAH Risk Assessment Tool (RAT) for performing risk assessments at Community Health Care Worker worksites (clients’ homes) (Worksafe BC, 2006 [5]).

- Research indicates that the BCIT home care lift is an improvement over the manual method of lifting and transferring, and comparable to the more expensive, automated lifts...
in terms of perceived exertion, ease of use and safety. The home care workers perceived the BHM device to be the easiest and safest device, followed by the BCIT device. The manual method of transfer was perceived to be the least easy and safe method (Heacock, 2004 [5]).

- OHSAH (n.d., Homecare [5]) notes:
  - It is important that a home care agency or organization has formalized policies and procedures for reporting employees concerns, problems and injuries. The organization must ensure that employees know the appropriate steps and complaints are responded to in an organized and prompt manner;
  - Since psychosocial factors in the workplace are related to the development or worsening of MSIs, it can be speculated that improving the psychosocial environment of home care workers will reduce the number of complaints, for example, increasing the opportunities for working in small teams.
  - Opportunities to address the excessive workload that many home care workers experience could be helped by: providing technical aids, such as patient lifts and bathroom devices; alternating working in clients’ homes and assistive living communities when possible; implementing a participatory approach which has been successful in developing work content and reducing workload.

9.5 Conclusion

Musculoskeletal injuries (MSIs) are a major source of health care worker acute injury and disability. They also present a major financial burden to employers as a result of added pressure on existing staff resources and the cost of lost person days and disability claims.

The prevalence and incidence of MSIs has been significantly reduced in the past decade as a result of a range of initiatives. Key interventions have been an increased emphasis on ‘no lifting’ policies and practices combined with the introduction of automated lifting devices. Related initiatives have also proven to be effective: BC regulations requiring employers to engage in a number of risk management and risk control practices; staff education and training; consultation and collaboration with staff members; and evaluation of program outcomes.

Research has clearly indicated that a multi-component prevention strategy encompassing “no-lift” patient handling policies, introduction of lifting equipment, and staff training (on equipment usage and patient handling) has a positive effect on musculoskeletal health. Additional reductions in BC MSIs can be expected with continued and strengthened implementation of these strategies, i.e., integration of risk management practices, purchase of additional lifting equipment, strengthened no-lift policies, and regular education and training for health care workers in all health care settings.
10.0 PREVENTION OF OCCUPATIONAL INJURIES FROM INFECTIOUS, TOXIC AND HAZARDOUS AGENTS

This section includes:

- Occupational exposure to infectious diseases including those transmitted through body and blood fluids (e.g., Hepatitis B virus, Hepatitis C virus and the HIV virus) and through air-borne particle (e.g., Severe Acute Respiratory Syndrome virus and Tuberculosis).

- Occupational exposure to chemicals and other toxic and hazardous agents such as chemotherapy drugs, radiation, disinfectants and sterilants, formaldehyde, and rubber latex.

The focus is on institutional settings, primarily acute care. Secondary prevention protocols such as post exposure prophylaxis are not included. It is important to note that hospital associated infections, discussed in a previous section, include important parallel and supplemental strategies for preventing infectious diseases among health care workers. Conversely, this section also supplements HAI practices to support enhanced protection of patients.

10.1 Occupational Injuries from Infectious Diseases

10.1.1 Prevalence/Incidence and Key Issues

The Health Canada-funded, Trends in Workplace Injurie, Illnesses, and Policies in Healthcare Across Canada (OHSAAH, 2004) states:

- Hepatitis B virus (HBV), Hepatitis C virus (HCV) and HIV are risks to health care workers, although with the widespread adoption of preventive immunization, adherence to universal precautions and use of personal protective equipment, the number of cases has declined considerably (OHSAAH, 2004).

- The global outbreak of atypical pneumonia or Severe Acute Respiratory Syndrome (SARS) was marked by high levels of both occupational transmission as well as nosocomial spread in hospitals. In the nosocomial outbreak of SARS in Toronto, 17 individuals died, 3 of whom were health care workers. A retrospective case review of 144 patients with suspect or probable SARS in the Greater Toronto area revealed that 51% of the cases were health care workers (OHSAAH, 2002). With respect to exposure and transmission of the SARS virus, research indicates:
  
  o Both Seto et al. in a study on Hong Kong health care workers, and Loeb et al., in a study conducted in Toronto, found that not consistently wearing either a surgical mask or an N95 respirator was associated with developing SARS (Gamage, 2005 [5]).
  
  o Even when appropriate policies are in place, they are often not applied. In a U.S. study of 66 health care workers exposed to coughing patients who were later diagnosed as having had SARS, 40% had not been using a respirator at the time of exposure (Yassi, 2005 [6]).
Researchers have also found that having an inadequate amount of infection control training was associated with a higher risk of SARS infection (Gamage, 2005 [5]).

- Tuberculosis is expected to substantially increase world-wide during the next decade because of the interaction between TB and HIV, the development of multi-drug resistant TB, the decline of public health services and the increase in immigration of people from countries with a high prevalence of TB (OHSAH, 2002).

- Many pathogens have emerged in recent years including HIV/AIDS, Hantavirus pulmonary syndrome, monkeypox, West Nile virus, and hemolytic uremic syndrome (certain E.coli strains). It has been estimated that some 30 novel pathogens have emerged in the past two decades, many in recent years. Well-known pathogens, such as influenza, measles, and Varicella zoster also can cause morbidity to health care workers and place patients at risk (OHSAH, 2004).

Needlestick Injuries

- Rates of transmission following a needle-stick exposure, based on a meta-analysis of studies in the field, revealed (Tarantola, 2006 [5]):

  - The HBV seroconversion rate in nonimmunized health care workers is estimated at approximately 10% and as high as 30% in case of Ag-Hbe carriage in the source patient.

  - Risk of transmission of HCV is 1.5% to 2.0%. (Studies were conducted following exposure to blood and body fluids in Japan; however, rates varied according to polymerase chain reaction (PCR) results in the source patient (0% in case of negative HCV-PCR; 10% in case of positive PCR).

  - Transmission rates for HIV to exposed health care workers were estimated at 0.29%.

- Although most needle-stick injuries do not lead to transmission of infection, the uncertainty about the outcome can cause considerable distress and anxiety. Needle-stick and related exposures remain a significant health concern for health care workers. Each year, thousands of health care workers are affected by, not only psychological trauma during months of waiting for serological results, but also other health consequences such as postponing childbearing, discontinuing breast feeding, and if infected, experiencing side effects of prophylactic drugs, chronic disabilities, loss of employment, liver transplants and premature death.

- The PHAC (2002) Infection Control Guidelines provides information from the Canadian Needlestick Surveillance Network which monitored exposures to blood and body fluids in 12 hospitals across Canada in 2000/01.

  - Based on 1,436 reported occupational exposures in the 12 participating sites, the overall rates of exposure to infectious diseases were 4.24 per 100 FTEs, 16.83 per 100 beds, or 0.06 per 100 patient-days.
Rates were markedly higher in teaching hospitals as compared to non-teaching hospitals (e.g., 4.41 compared to 3.45 per 100 FTEs, and 21.76 compared to 7.03 per 100 beds).

Figure 1 illustrates that 84% of the exposures were percutaneous and 16% were mucocutaneous. Needle stick injuries accounted for 78% of the percutaneous exposures, while splashes accounted for 88% of the mucocutaneous exposures.

In all exposures (both percutaneous and mucocutaneous) the body fluids most frequently involved in exposures were blood, serum or plasma (85%), followed by saliva stained with blood (4%).

59% of exposures occurred in the following places: operating rooms (19%), medical wards (17%), emergency rooms (9%), surgical wards (7%) or intensive care units (7%).

Nurses accounted for 52% of all exposures. However, the nurse’s exposure rate per 100 FTEs was only 4.88, a rate much lower than that observed among phlebotomists (42.78), medical residents (20.97), nuclear medical technicians (13.59), sterilization attendants (12.14), or medical specialists (10.06).

Exposure rates among health care workers:

Distribution of percutaneous exposures (both reported and non-reported incidents) to be: medical technicians (phlebotomists, dialysis technicians and nuclear medicine), 10.2%; support service staff (laundry, housekeeping and sterile processing staff), 12.1%; and nursing and direct patient care staff, 77.7% (VIHA 12-month survey (2003/04) found on the OHSAH website).
In a BC study, RNs incurred most of the blood and body fluids (BBF) exposure events, but laboratory assistants had the highest rates of needlestick and splash injuries among the health care workforce, albeit a small absolute number of incidents (laboratory assistants had 3.41 times the relative risk of needlestick injuries compared with RNs) (Alamgir, 2007).

Physicians may have a higher rate of exposure than nurses, but the exposure is seldom reported. 76% of Canadian surgeons who responded to a survey had had an exposure to blood or body fluids in the previous year (PHAC, Infection Control Guidelines, 2003 [3]).

Factors related to percutaneous exposures (PHAC, Occupational Exposure, 2002 [5]):

- 62% of exposures were caused by five categories of devices that included: needles used for drawing arterial/venous blood (14%) or inserting intravenous/arterial lines (7%), needles for percutaneous injection (23%), suture needles (12%), or scalpel blades (7%).

- About 43% of the 1,196 reported injuries occurred during use of the device, 33% after its use (but, before its disposal) and 12% were related to disposal.

Factors related to mucocutaneous exposures (PHAC, Occupational Exposures, 2002 [5]):

- 71% of exposures occurred on mucous membranes; they were characterized as a splash/projection directly from patients (46%) or leaking/breaking intravenous lines/tubes (24%).

- The most common exposure areas for the 156 mucous membrane exposures were to eyes (62%) or mouths (10%).

- At the time of exposure, 31% of health care workers were not wearing any protective apparel, and 65% were not wearing protective eyewear or face shields/surgical masks.

Reporting Issues

- Marked differences in incident reporting compliance were found among health care workers: 42.8% of doctors, 75.5% of nurses, and 87.5% of the auxiliary staff complied with the duty to report. The perception of the efficacy of compliance was significantly higher among those who complied and reported needlestick injuries than among those who did not. Many research studies support this finding. Non-compliers perceived more disadvantages to reporting than compliers (Tabak, 2006 [6]).

- A VIHA (2003/04) survey found that respondents reported a total of 460 percutaneous exposures in the past 12 months; of these, 358 (or 77.8%) were not reported (OHASH website).

- The reasons for lack of reporting by health care workers include: the injury was considered to be low-risk; the patient was healthy; self-blame; perceived loss of status in
the workplace; and concern about job security. A number of the reasons related to doubts about the helpfulness of the institution, including: problems with confidentiality; disciplinary action; a negative clinical evaluation; a critical, unsupportive attitude by direct management; and dissatisfaction with follow-up procedures. Additional reporting difficulties related to: lack of awareness about post-exposure protocols, lack of knowledge on how to report, lack of time, etc (PHAC, 2002).

**Burden of Cost**

- The average cost of a needlestick injury in 1995 in the U.S. when the source was found to be negative for hepatitis B, hepatitis C, and HIV was $200. This estimate included laboratory costs, immunization costs, and OH staff and employee time. If the source was positive for all three bloodborne pathogens, the cost ranged from $860 (no zidovudine) to $2,000 (including zidovudine). Another estimate was $1,440 U.S. for triple therapy for HIV, including laboratory work for both the source and employee, and OH staff and employee time (PHAC, 2002).

- In 1999 in Canada, the cost for a 28-day course of a triple-drug post exposure prophylaxis regimen for HIV was $1,100, including blood test costs (PHAC, 2002).

10.1.2 Prevention Strategies to Reduce Occupational Transmission of Infectious Diseases

A number of interventions in this section involve organization-wide strategies that have been discussed in detail in Section 2, including: establishing a culture of safety; epidemiological surveillance, information management and reporting; risk/safety assessment, risk management and quality improvement, and health promotion. Rather than duplicate this information, the focus here will be to highlight additional specific factors and strategies that are unique to preventing the transmission of infectious diseases to staff members.

It should be noted that the BC Occupational Health and Safety Regulation addresses chemical and biological substances and provides direction for employers and employees on reducing and controlling exposure to infectious diseases.

**Risk Assessment and Risk Management**

Risk assessment and risk management involves:

- Information Gathering and Reporting
  - Workplace surveillance is necessary, including systematic collection, analysis and dissemination of information on the incidence of disease, injury, and/or hazards in the workplace. The more complete the policies and procedures are for post-exposure follow-up, the more injuries are reported. In Montreal, hospitals with the best post-exposure measures had the lowest rates of underreporting (PHAC, 2002 [3]).
Standardization of post-exposure procedures may increase satisfaction and decrease waiting times, so that staff report injuries even if they are busy. Increased education may highlight the need to report injuries as a result of a better understanding of the risk (PHAC, 2002 [3]).

It is highly recommended (OHSAH, 2004 [5]) that health care jurisdictions in Canada use needle-stick injury tracking methods to ensure data are captured consistently and accurately. Two widely known needle-stick injury tracking systems, WINSises and EPINet, are used by many facilities. WINSises is an integrated surveillance system for occupational exposures to body fluids and seroconversions to HBV, HCV, and/or HIV. It provides a standardized method for the compilation of information on exposures and the subsequent analysis of the data generated. EPINet (Exposure Prevention Information Network) is also a standardized surveillance system for tracking sharp-object injuries, body and blood fluid (BBF) exposures, and post-exposure follow-up (OHSAH, 2004). (Health Canada is in the process of using EPINet as a national standardized program to collect exposures to BBF and bloodborne pathogens. A pilot study is being conducted by OHSAH on the EPINet system in BC. EPINet data are also being captured in an innovative new injury tracking and claims management system (WHITE) designed by OHSAH. WHITE is currently being tested by BC health authorities (p. 29). The US Needlestick Safety and Prevention Act of 2000 and the 2001 revised OSHA Bloodborne Pathogens Standard require health care facilities to maintain a sharps injury log. The log must include, at a minimum, the type and brand of device involved in the exposure incident, the department where the exposure occurred, and an explanation of how it occurred (EPINet website).

- Risk assessment – Risk assessment requires knowledge of: the clinical manifestations and significance of the infectious agent, epidemiological characteristics (i.e., mode of transmission, incubation period, period of communicability), and transmission factors such as type of exposure and susceptibility to infection. (PHAC, 2002 [3]).

- Risk control or risk management – The risk control measures to prevent or reduce exposure to infectious disease may use the hierarchy (listed in descending order according to their effectiveness in reducing the risk of exposure to infectious diseases): hazard elimination, engineering controls, administrative controls (e.g., policies and training), work practices controls, and personal protective equipment. Each of these measures is the focus of specific interventions listed in the sections below (PHAC, 2002 [3]).

**Hazard Elimination**

This strategy involves developing alternatives to the use of hazardous devices or procedures. For example, rather than needle injections, a hazard may be eliminated by administering medications in another way, such as by using tablets, inhalers, or transdermal patches. Needleless intravenous systems, such as jet injectors, can be substituted for syringes and needles. If injections are used, the number can be minimized by eliminating all unnecessary injections (Rapiti et al., 2005).
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Engineering Controls

Engineering controls may also involve a decrease or elimination of the hazard. For example, substitute needles that retract, sheathe, or blunt immediately after use - the technology of these devices has improved over the last decade, and they are widely available in North America and Europe. They are required by law in the USA (Rapiti et al., 2005). A model based on a 15-month study of blunt suture needles showed that the estimated odds of a percutaneous injury were reduced by 87% when 50% of the suture needles used were blunt (PHAC, 2002 [3]). Four prospective randomized trials have demonstrated notable benefits from use of blunt suture needles. There is compelling published evidence to support routine use of blunt suture needles to minimize sharps injuries during closure of fascia and muscle (Berguer, 2004 [5]).

An analysis of EPINet data showed that shielded-stylet safety intravenous catheters reduced intravenous catheter related needlestick injuries by 83% (PHAC, 2002 [3]).

Studies at the University of Virginia suggest that the redesign of hollowbore needle devices incorporating safety features that eliminate unnecessary needles or that shield hands from used needles might prevent over 85% of needlestick injuries from these devices (PHAC, 2002 [3]).

Investigators have identified factors that could affect the success of safety engineered devices including whether health care workers were involved in device selection, the acceptance of safety devices by health care workers, and the compatibility of the devices with existing equipment and/or the ease of use (Tuma, 2006 [3]).

The high percentage of percutaneous injuries caused by needle sticks raises the need for needleless systems as one component of a prevention program (PHAC, 2002 [5]). A causal association between an increased risk of bloodstream infection and use of needleless systems has not been established when devices are used as recommended (according to manufacturers’ directions, with rigorous aseptic technique; however, potential risk factors for bloodstream infection with the use of needleless systems have been identified (Tuma, 2006 [3]).

Administrative Controls

These include policies and training programs aimed at limiting exposure to the hazard, such as Universal Precautions, allocating resources in such a way as to demonstrate a commitment to the safety of health care workers, instituting a needle-stick prevention committee, formulating an exposure control plan, and having consistent training programs (Rapiti et al., 2005).

Alamgir (2007 [5]) suggests that the increased privatization of services by BC health regions in areas such as cleaners, laundry and food services raises an ongoing need for close coordination between the health and safety departments of the health regions and their contractors. The high exposure rates of cleaners/laundry workers for needlestick and sharps events suggest that these workers should be targeted for prevention strategies.
Work Practice Controls

Work practice controls reduce the likelihood of occupational exposure to bio-hazardous material by altering the way a task is performed. Work practice controls include, but are not limited to washing hands with a suitable, non-abrasive agent and running water immediately after removal of gloves and as soon as possible after skin contact with blood or other potential infectious material, disposing of contaminated needles immediately after use in a readily available sharps container specially designed for such use, applying the “hands-free” method of passing scalpels during a surgical procedure, such as using a small hand tray to transfer scalpels and other sharps to and from the surgeon’s hand (BC Occupational Health and Safety Regulation).

Additional examples include rules that prohibit the recapping of needles; placing sharps containers at eye-level and at arms reach; checking sharps disposal containers on a schedule and emptying them before they become full; and establishing the means for safely handling and disposing of sharps devices before beginning a procedure (Rapiti et al., 2005 [5]).

Compliance with safe work practices was most strongly associated with cleanliness and orderliness of the work. Health care workers who reported that the work site was clean and orderly were more than 3 times more likely to report adherence to safe work practices. Compliance was also significantly associated with several demographic factors: women and younger employees were more likely to comply, as were employees with fewer than 14 years of education. Safety climate and demographic factors accounted for 14% of all compliance behaviours, a relatively large and significant finding (Gershon, 2000 [6]).

Personal Protective Equipment

Personal protective equipment creates a barrier or filter between the worker and the hazard. Examples include eye goggles, face shields, gloves, masks and gowns. At least, one third of mucous-membrane exposures may have been prevented by use of protective eyewear or face shields (PHAC, 2002 [5] Occupational exposures). Face shields that attach from the top of a mask rather than those that rest on the forehead and are open below provide more protection and improved visibility (PHAC, Infection Control Guidelines, 2002 [3]).

Perforation of gloves during surgery has been a problem with rates as high as 61% for thoracic surgeons and 40% for scrub nurses. Initial intra-operative glove perforation occurs an average of 40 minutes into a procedure and is not detected by the surgeon in as many as 83% of cases. Double gloving reduces risk of exposure to patient blood by as much as 87% when the outer glove is punctured. Despite a large body of data supporting double gloving, a major drawback of this intervention is the lack of surgeons’ acceptance (Berguer, 20 [5]).

Tanner (2006 [1]) notes that wearing two pairs of latex surgical gloves is associated with significantly fewer inner glove perforations. This evidence comes from trials undertaken in 'low risk' surgical specialties (there were none in orthopaedic joint surgery for example). There does not appear to be an increase in the number of perforations to outermost gloves when two pairs of gloves are worn, suggesting that wearing two pairs of gloves does not reduce dexterity to the extent that the glove wearer sustains more perforations. Also, wearing one pair of orthopaedic gloves (thicker than standard latex) is as effective as wearing two pairs of standard latex gloves in reducing the number of perforations to innermost gloves (Tanner, 2006 [1]).
Training

Often, educational efforts have not been evaluated, and others show ambivalent results. Some recent theories on changing behaviours indicate that the information used by the learner depends on the stage of readiness to change. Therefore, it may not be learning the information that is the difficulty but the ability of the learner to put the information into practice. Hands-on training may enhance the worker’s ability to apply procedures that have been taught (PHAC, 2002 [3]).

In Australia, an educational program combined with testing of new safety programs increased reporting: unreported needlestick injuries were reduced from 64% at the start of the program to 26%. The importance of repetition of the educational program was also stressed (PHAC, Infection Control Guidelines, 2002 [3]).

OHSAH, Trends (2004) suggests that education of health care workers is an essential component of an occupational health program:

- Education about infectious disease hazards is required to increase understanding and to encourage prompt reporting, evaluation, and treatment of injuries and timely notification to the provincial/territorial workers’ compensation agency.

- Reports indicate that education may positively influence behavioural activities, including increasing the uptake of vaccines.

- Important education topics include the use of Routine Practices in infection control (which incorporate practices formerly known as blood-borne pathogen precautions or Universal Precautions and includes hand hygiene). Additional Precautions to prevent and control airborne, contact, and droplet transmission are equally important.

Other research notes:

- Training should emphasize that patients may carry blood-borne infection that the health care worker would not predict, and while the risk may be low, it is not zero (Ferguson, 2004 [6]).

- One study examining predictors of nurses’ acceptance of an intravenous catheter safety device in one hospital found that both high-quality training and a positive institutional safety climate, were required (Beekman, 2005 [5]).

- Employees who perceived strong senior management support for safety and who received high levels of safety-related feedback and training were half as likely to experience blood or body fluid exposure incidents (Gershon, 2000 [6]).

Secondary Prevention Methods for Blood-Borne Pathogens

Testing for blood borne pathogens is voluntary and requires informed consent. Empowering health care workers with a role in obtaining consent may improve the timeliness and proportion of source blood that may be tested following an exposure (PHAC, Infection Control Guidelines, 2002 [3]). In most Canadian hospitals (87.6%), it is a physician’s responsibility to obtain consent for all HIV testing. A Calgary study carried out from 1989 to 1993 to assess an alternative
system indicated that infection control practitioners’ follow-up of known source patients, with follow-up by employees, could increase consent and testing for HIV and HBV from 67.9% and 87.6% of low-risk patients, and 82.3% and 92.2% of high-risk patients. Backup teams can successfully cover off-hours or areas where access to infection control practitioners is a problem. This practice helps the employee to receive effective follow-up after a potential exposure to blood borne pathogens (PHAC, Infection Control Guidelines, 2002 [3]).

Post-exposure prophylaxis (PEP) remains the second line of defense in instances in which primary prevention fails to prevent occupational exposures (Beekman, 2005 [5]).

In a UK study, only 45% (49/109) of health care workers exposed to an HCV positive source patient received the correct type of tests at the correct time. 22% (65/298) did not initiate HIV post-exposure prophylaxis despite being exposed to an HIV positive source patient, including high risk exposures. Reported reasons for not initiating HIV post-exposure prophylaxis included: the exposure was perceived to be low-risk by the managing clinician or health care worker; the health care worker refused HIV post-exposure prophylaxis; and the interval since exposure was too great for HIV post-exposure prophylaxis to be of benefit (Health Protection Agency, 2006 [2]).

Additional Strategies to Prevent Transmission of Air-borne Infectious Diseases

Additional prevention interventions and strategies to those discussed above, are included to address exposure to infectious diseases that are transmitted through air-borne particles, such as SARS, TB and influenza. The report, Protecting the Faces of Health Care Workers: Knowledge Gaps and Research Priorities for Effective Protection Against Occupationally-Acquired Respiratory Infectious Diseases, prepared for the Ontario Change Foundation, discusses a systems approach as likely the most effective for ensuring personal protective equipment (PPE) compliance in respiratory outbreaks (Yassie et al., 2004 [6]):

- In order for infection control guidelines to be successful in protecting health care workers and patients from SARS, a good understanding is required of what procedures, and specifically personal protective equipment (PPE), are most effective. In addition, it is necessary to understand organizational and environmental factors, and worker characteristics that influence the ability and willingness to comply with the procedures.

- A theoretical approach which can account for these factors, stems from the PRECEDE (Predisposing, Reinforcing and Enabling Factors in Educational Diagnosis and Evaluation) model developed by Green and colleagues. It was modified by DeJoy for application to SARS self-protective behaviour:
  - Predisposing factors are individual characteristics (beliefs, attitudes, values) that facilitate self-protective behaviour.
  - Enabling factors are environmental factors that block or promote self-protective behaviour, including the skills, knowledge, as well as availability and accessibility of PPE and other resources.
Reinforcing factors involve organizational factors such as communication, training, performance feedback, social approval or disapproval from coworkers or management and other safety climate dimensions.

- “Compliance” cannot be fully understood by examining each of these factors in isolation, but rather how they relate to each other.

- Bero and colleagues have characterized components of interventions that are likely to be successful or unsuccessful. Those that are consistently effective are: educational outreach visits; reminders; interactive educational meetings; multi faceted interventions (Yassi et al., 2004 [6]).

- The factors that predicted adherence included whether compliance was seen as a job hindrance, the availability and accessibility of PPE, and whether feedback on compliance was given (Yassi et al., 2004 [6]).

- An intervention that was found to improve compliance with barrier precautions (use of cap, gown, mask, gloves, protective eyewear) was pre-notification of emergency room staff which resulted in an increase in compliance with barrier precautions from 63% to 92% (Yassi et al., 2004 [6]).

- A study of 451 nurses employed in a large US hospital centre found that organizational factors were the best predictors of adherence. Specifically, there is growing evidence to indicate that it is both incorrect and unfair to assume that health care workers have total control over their own compliance behaviour. Senior management support was found to be especially significant with regard to both compliance and exposure incidents (Yassi et al., 2004 [6]).

- Similarly, although the precise nature of the safety climate requires clarification, there is general agreement that the safety-related attitudes and actions of management play an important role in creating a good or bad safety climate. Research found that health care workers are influenced by the subjective norm, i.e., the perception of social expectation...
to adopt a given behaviour. This suggests that if they believe key persons in their work and social environment expect them to be compliant with the use of PPE, they are more likely to do so (Yassi et al., 2004 [6]).

- The few studies which have looked at the effectiveness of eye protection have found mixed results. Despite this lack of evidence for the efficacy of eye protection, this has been included in formal recommendations to protect health care workers from SARS. Given the documented ability for viruses in the size range of the SARS-CoV to be transmitted via hand to eye contact, this would seem reasonable (Yassi et al., 2004 [6]).

- Training:
  - Studies that demonstrate the importance of checking personal protective equipment for “fit” each and every time to ensure a good seal, suggests that regular fit testing is less important than ongoing assessment of the ability of health care workers to achieve an effective seal through fit checking (Gamage, 2005 [5]).
  - Unfortunately, most studies have found that formal education sessions may have effects on compliance levels, but these improvements are found to be short lived. Improvements in compliance may come from informal point-of-use prompts or more formal safety performance feedback, rather than official policy statements (Yassi, 2005 [6]; Yassi et al., 2004 [6]).
  - Training programs must focus less on knowledge-based training and more on helping workers overcome or reduce the barriers associated with compliance (Yassi et al., 2004 [6]).

Benefits that accrue in negative-pressure rooms, above that of having adequate ventilation throughout the hospital, is not clear; however, in a study conducted in 17 hospitals in Canada, inadequate ventilation systems (those providing less than two air-exchanges per hour) in general patient areas were associated with an increased risk of TB infection in health care workers (Yassi, 2005 [6]).

10.2 Occupational Infectious Disease Exposure in Home Care

10.2.1 Factors and Issues Unique to Home Care

- Health care workers who provide care in a client’s home face hazards similar to those experienced in hospital and other institutional health care settings. However, the home-based work environment is likely to be less controllable, visible, standardized and predictable (NZ Occupational Safety & Health Service, 2002 [5]).

- A non-hospital study in community service centres and home care, conducted in Montreal from 1992 to 1993, indicated that 80% of all exposures to blood and body fluids were to nurses, and 92% of all needlestick injuries were to nurses (PHAC, Infection Control Guidelines, 2002 [3]).
Community nurses may be at increased risk for injury when compared with hospital workers, as they are less able to control the work environment. Poor lighting, furniture that cannot be adjusted, cluttered work areas, and working alone with clients who may be confused enhances the likelihood of sharps injuries in the home (PHAC, *Infection Control Guidelines*, 2002 [3]).

Examples of biological hazards that may result in infection: hepatitis A, B, C; human immunodeficiency virus (HIV); tuberculosis; childhood infectious diseases including chicken pox, rubella; skin (and hair) infections such as scabies, lice; food-borne infections may occur through inadequate cooking, preparation, or unsafe storage or handling of food, e.g., *campylobacter* (NZ Occupational Safety & Health Service, 2002 [5]).

**10.2.2 Strategies to Prevent Exposure to Infectious Diseases in Home Care**

Although the strategies are the same as those discussed above, the circumstances vary. The Risk Assessment Tool (RAT) for performing risk assessments at community health care worker worksites (clients’ homes) provides guidance (Worksafe BC, 2006) *Home and community health worker handbook*[5]:

- Elimination of the hazard may involve quarantine of employees, volunteers and clients at certain times from the workplace for the safety of others. Exclusion of sick adults is an important way of preventing infection being reintroduced.

- Immunization from certain infections such as Hepatitis B helps to control risks.

- Application of safety designs, for example, replace rotating taps with lever taps that can be turned on and off with elbow or wrist and are easier to clean.

- Hand washing minimizes the risk of getting or spreading infection. This avoids contaminating eyes, nose, or mouth, common objects (e.g., phones, keyboards, and doorknobs), and others (Worksafe BC, 2006 [5]).

- Utilization of personal protective equipment (PPE) including gloves, aprons, facemasks, goggles, face shield and respirator and other equipment designed to create a physical barrier from the hazard and reduce contact with body fluids. Infectious clients should also wear surgical masks (Workcover NSW, 2004 [5]).

- Additional precautions are required for infectious diseases transmitted by airborne or droplet transmission of respiratory secretions such as tuberculosis, chickenpox, measles, rubella, pertussis and influenza. Infected clients, volunteers, or employees should be quarantined from attending workplaces or receiving home services (other than acute health care) until after the period of acute infection has passed. In some cases, such as chicken pox, clients can have continued care if employees and volunteers are immune (Workcover NSW, 2004 [5]).
10.3 Occupational Injuries from Other Toxic and Hazardous Agents

10.3.1 Key Issues and Factors

- Cleaning products used in health care facilities can impact health:
  - Sensitization to several quaternary ammonium compounds has been documented; two of these compounds are recognized as asthmagens.
  - Bleach, ammonia, and hydrochloric acid, associated with floor cleaning chemicals, may cause: respiratory, eye and skin irritation; nausea; headaches; difficulty in concentrating (Pechter, 2005).

- Ethylene oxide is used as a sterilizing agent for medical devices and equipment that are heat- and moisture-sensitive and cannot be sterilized by steam (Occupational Safety and Health Service, Guidelines, 1997), (Clapp, 2006 [5]):
  - The carcinogenic rating of ethylene oxide was upgraded in 1994 from 2A (probably carcinogenic to humans) to 1 (carcinogenic to humans) by the International Agency for Research on Cancer.
  - Ethylene oxide induces a persistent dose-related increase in the frequency of chromosomal aberrations and sister-chromatid exchanges in peripheral lymphocytes and micronuclei in bone marrow cells of exposed workers. It has been associated with malignancies of the lymphatic and hematopoietic systems in both humans and experimental animals, and is a powerful mutagenic and clastogenic at all phylogenetic levels (Vecchio, 2003).
  - The liquefied gas causes dermatitis, blisters and burns when spilt on the skin.

- Glutaraldehyde is commonly used as a cold sterilizing agent for medical, dental, and surgical instruments, particularly endoscopes and plastic materials because it is noncorrosive and relatively fast acting. It is also an ingredient in X-ray developer and is used as a tissue fixative in pathology laboratories. It is a high-level disinfectant which kills all micro-organisms except bacterial spores (Clapp, 2006 [5]; Pechter, 2005 [5]; Sattler, 2002):
  - Skin contact with glutaraldehyde solutions, aerosols and vapours can cause eye irritation and either irritant or allergic contact dermatitis. Inhalation of vapours and aerosols can cause: nose, throat and lung irritation; headaches; and nausea.
  - Respiratory sensitization can cause allergic rhinitis and asthma-like reactions. Two recent articles document new onset asthma and respiratory symptoms among radiographers exposed to X-ray processing chemicals (Rideout, 2005).
  - Outbreaks of infection continue to occur when ineffective disinfectants, including over-diluted glutaraldehyde, are used for high-level disinfection (Rutala, 2004).

- Formaldehyde used in health care as a tissue preservative and disinfectant, especially in dialysis units, is linked to:
Nasopharyngeal cancer, especially for squamous cell carcinoma among smokers exposed to formaldehyde. An re-evaluation led to its upgrade from 2B (possibly carcinogenic to humans) to 2A (probably carcinogenic to humans) based on sufficient evidence to consider it a carcinogen in animals including several epidemiologic studies that have linked formaldehyde to cancer in professionally exposed workers (IARC, 1995).

- Brain cancer and leukemia risk is increased among professional workers exposed to formaldehyde, such as embalmers and anatomists (IARC, 1995).

- Other reviews have also found that formaldehyde causes asthma, affecting roughly 30% of exposed individuals (although the Institute of Occupational Medicine in the UK determined there was inadequate or insufficient evidence to support this association) (Pechter, 2005).

- Formaldehyde gas is an irritant to the eyes and respiratory tract. As a liquid in solution, it can cause both primary irritation and sensitization dermatitis. Similar concerns exist for glutaraldehyde which has been proposed as a substitute (Clapp, 2006).

- Anaesthetic gases have been found to have an effect on reproductive outcomes and reduced fertility. These gases can be released into work areas such as the operating room, the recovery room and delivery suites. Faulty seals in equipment account for the majority of gas leaks, but other causes include poor administration techniques and exhalation by patients. Low levels of nitrous oxide, halothane, enflurane, and isoflurane may be released by any of these means (Occupational Safety and Health Service, 1997).

  - Decreased fecundity was reported among health care workers who were exposed to nitrous oxide during more than 30 deliveries a month (Ahlborg et al.).

  - Exposure to nitrous oxide was associated with a near doubling in relative risk of having a small-for-gestational age newborn (Bodin et al., 1999).

  - Researchers recommended, after evaluating hospital exposures to volatile anesthetic agents, that pregnant or lactating women not be allowed to work in post-surgery recovery rooms or mechanically ventilated intensive care units, because of exposure to patient exhaled anesthetics, which exceeded the legal limits of workplace concentrations prescribed by German maternity law (Byhahn et al., 1998).

- Natural rubber latex (NRL) in protective gloves is associated with allergic reactions:

  - The prevalence of NRL allergy has been estimated to be 5-18% in health care workers. Adverse reactions range from localized dermatitis to anaphylaxis.

  - Latex allergy is attributed to latex protein exposure from frequent glove changes, especially in operating rooms and emergency departments, as well as from airborne exposure (Pechter, 2005).
Rates of exposure to these toxic agents vary according to staff roles:

- Nurses were most affected by latex (33%), cleaning products (21%), and glutaraldehyde and formaldehyde, together (19%) (Pechter, 2005 [5]).
- It is estimated that 5%–10% of health care workers have some exposure to glutaraldehyde (Cohen, 2006).
- Office workers and aides/therapists, respectively, identified miscellaneous chemicals, paints, solvents, and glues (31%, 29%), followed by cleaning products (28%, 27%) and new carpet, dust, molds, smoke, and perfume (21%, 10%), which included dust from construction/renovation (Pechter, 2005).
- Laboratory workers and technicians reported glutaraldehyde and formaldehyde (26%) and dental workers reported latex exposures (Pechter, 2005).

Cost Burden

- Individuals with work-related asthma may become sensitive to a variety of exposures that may exacerbate breathing problems even when away from work, and in some cases, result in serious personal and economic ramifications for employees.
- Direct and indirect costs attributable to work-related asthma in the US were estimated at $1.6 billion per year (Leigh et al., 2002; Pechter, 2005).

10.3.2 Prevention Strategies to Reduce Workplace Injuries from Toxic Agents

As noted earlier, the BC Occupational Health and Safety Regulation addresses chemical and biological substances and provides direction for employers and employees on reducing and controlling harmful contact with toxic substances. In addition, exposure limits have been established and published as “threshold limit values” (TLVs) for chemical substances and physical agents or as “biological exposure indices” by the American Conference of Governmental Industrial Hygienists as a guide to good professional practice.

Work Practice Safety Controls

Adherence to occupational health and safety regulations, and to occupational exposure limits may not be sufficient to ensure constant adherence to safety practices by all employees. Additional risk management strategies and controls could include.

- **Establishing a Working Group** – A key step in making good decisions about shifting to safer products and procedures is the creation of a process that includes a wide range of people affected, e.g., a working group that includes representatives of professionals, non-professionals and support staff, managers, patients and volunteers who work in the facility (Clapp, 2006 [5]).
Examining Evidence – Three types of information are important to consider in the course of taking steps to reduce exposure to toxic and hazardous agents: evidence of potential harm; information on employee exposure to substances of concern; and the availability of alternative substances (Clapp, 2006 [5]).

Controls and Strategies – The need for controls and strategies to form an ongoing control program may include: the substitution of hazardous materials or processes with less hazardous alternatives; engineering controls to limit exposure; the use of personal protective equipment; an education and training program; and implementation of a monitoring program (Verman 2002 [5]).

Staff Education and Reporting – Staff education regarding chemical hazards along with health surveillance of exposed workers will enhance the effectiveness of a safety program.

Information Management – Studies have found that even principal investigators at university affiliated hospital research laboratories consistently underreport hazards and over report the presence of health and safety policies (Vecchio, 2003).

Reducing Injuries from Cleaning Chemicals

There are a variety of approaches to reducing injuries from the use of general cleaning chemicals (Clapp, 2006) [5], (Pechter, 2005) [5], (Sattler, 2002) [5]:

Eliminating/Reducing the Use of Cleaning Chemicals

- Use of microfiber mops and cloths may dramatically reduce the use of general cleaning chemicals in many facilities.

- Establish a schedule based on necessity to reduce the use of cleaning chemicals. A review of a number of factors can assist in determining schedules, including: the scientific literature, a survey of various areas of the hospital, and other related hospital data on disinfection needs.

- Careful planning of cleaning is important: chemical use reduction can be achieved by paying attention to when surfaces need to be cleaned. For instance, some surfaces may be cleaned daily in spite of infrequent use, improbable infection transmission and no evidence of cleaning being requiring.

- Examine preventive measures that can reduce the burden of cleaning chemicals, e.g., doormats at each entryway can reduce the amount of dirt tracked into a facility and thus reduce cleaning frequency.

- If there are frequent spills or other cleaning demands in certain areas of the hospital, a review of work practices to reduce the incidence may be effective.

Finding Chemical Substitutions – Determining which products contain hazardous ingredients and identifying substitutes.
• **Isolating Cleaning Chemicals** – If only certain individuals are sensitive to a particular cleaner, limit the use of that cleaner (if it cannot be eliminated) to areas where the sensitive individual does not work.

• **Enhancing Engineering Controls** – Improving or increasing the ventilation in areas where cleaning chemicals are used may be an option to reduce exposure of staff and patients.

• **Personal Protective Equipment (PPE)** – Adopting the use of PPE for sensitive individuals when the above options are not adequate. PPE is typically the last option recommended in the hierarchy of controls that industrial hygienists and government agencies follow.

• **Administrative Controls** – Implementing policies that limit worker exposure to hazards (appropriate allocation of resources to prioritize health and safety, rotation of staff to minimize exposure time in areas where they may be exposed, etc.).

**Reducing Injuries from Ethylene Oxide**

Effective source control measures (i.e., containment or local exhaust ventilation) and work practices must be implemented to reduce the potential for worker exposure. Because the odour of ethylene oxide cannot be detected until the concentration exceeds approximately 700 ppm, significant exposures can occur without the worker’s knowledge. This possibility emphasizes the need for an effective and reliable system of exposure control measures (Occupational Safety and Health Service, *Guidelines*, 1997 [5]).

**Reducing Injuries from Glutaraldehyde**

Strategies to control potentially harmful exposure to Glutaraldehyde include engineering controls, administrative or work practices, and personal protective equipment (Cohen, 2006 [5]; Occupational Safety and Health Service, 1997 [5]):

• Ensure areas of use are well ventilated.

• Perform annual air sampling at a peak exposure time, that is, activating and mixing new glutaraldehyde (American Health Consultants, 2001).

• Report all staff complaints to occupational health and environmental health and safety professionals.

• PPE (e.g., gloves, gowns, eyewear, and respiratory protection devices) to protect workers from exposure.

• Store glutaraldehyde in closed containers.

• Automatic endoscope disinfectors are the preferred method for disinfecting endoscopes because glutaraldehyde is contained and direct contact with the chemical is limited.

• Educate personnel about the chemical hazards present.
Consider effective and less hazardous alternatives to glutaraldehyde. The Sustainable Hospitals Program lists a number of acceptable alternatives on its Web site: www.sustainablehospitals.org (Sattler, 2002). In 1999 and 2000, two new high-level disinfectants were introduced to the market: Cidex OPAw [0.55% ortho-phthalaldehyde (OPA) solution] and Compliancee (0.23% peracetic acid/7.35% hydrogen peroxide). Both were promoted as safer alternatives to glutaraldehyde. Both glutaraldehyde alternatives appear to be safer substitutes, although both solutions are corrosive and highly irritating to the skin, eyes, mucous membranes and respiratory tract. Although OPA appears to have sensitizing potential, both respiratory and dermal, the active ingredient concentration in the currently available OPA-based high-level disinfectant is much lower than that in glutaraldehyde solutions (Rideout, 2005 [5]).

9.3.2.5 Reducing Injuries from Formaldehyde

Prevention strategies include (Occupational Health and Safety Agency for Healthcare in BC, website):

- Exposure control methods should be aimed at eliminating or reducing exposure to the lowest level reasonably attainable below the exposure limit. Safer substitutes for formaldehyde in health care can include diluted bleach solutions for disinfection, alternative sterilization methods such as autoclaving, and formaldehyde-free fixatives for histopathological procedures.

- When formaldehyde is present in the workplace, appropriate engineering controls, work practices, and personal protective equipment must be used to reduce worker exposure.

- Engineering controls are largely aimed at ensuring proper ventilation to reduce airborne concentrations, and depending on the task, may be general room ventilation or a local exhaust method such as a fume hood where the formaldehyde source is small enough to be contained.

- Work practice controls involve altering how tasks are performed, such as limiting splashing of formaldehyde solutions, keeping covers on containers which emit formaldehyde as much as possible, and cleaning formaldehyde-contaminated surfaces as quickly as possible.

- Depending on the task and workplace conditions, personal protective equipment may include chemical resistant clothing, aprons, gloves and chemical splash goggles. Respirator use may also be necessary if engineering and work practice controls do not adequately control airborne formaldehyde concentrations. Adequate training and fit testing is required prior to any respirator use.

- Gloves selected for any given task must be of the appropriate material and thickness to prevent exposure of the hands to formaldehyde.
• Butyl and nitrile rubber gloves with > 0.3mm thickness are recommended when handling 30-70% formaldehyde solutions, while natural rubber (latex) gloves, polyethylene, and polyvinyl alcohol gloves are permeated by formaldehyde in less than one hour under standard conditions and are NOT recommended when handling formaldehyde solutions.

**Reducing Exposure to Rubber Latex**

Replacing latex materials with synthetics, banning latex balloons and careful purchasing policies can reduce latex exposures (Pechter, 2005 [5]).

**Reducing Exposure to Anaesthetic gases**

Proper ventilation, gas scavenger systems for extracting waste and exhaled gases in the induction mask, and regular testing of anaesthetic equipment will enhance programs to limit exposure (Occupational Safety and Health Service, *Guidelines*, 1997).

### 10.4 Occupational Exposure to Hazardous Drugs

This section provides an overview of some of the occupational issues related to the use of cytotoxic drugs and other hazardous drug therapies.

Drugs are classified as hazardous if studies in animals or humans indicate that exposure to them has potential for causing cancer, developmental or reproductive toxicity, or harm to organs (NIOSH, 2004 [5]).

#### 10.4.1 Key Issues and Factors

• Occupational exposure to hazardous drugs is affected by: drug handling circumstances (preparation, administration, or disposal); amount of drug prepared; frequency and duration of drug handling; potential for absorption; use of ventilated cabinets; personal protective equipment; and work practices (NIOSH, 2004 [5]).

• Both clinical and nonclinical workers may be exposed to hazardous drugs when aerosols are created, when they come into contact with spills or contaminated surfaces. Pharmacy and nursing personnel likely experience the highest exposure intensity. However, the elimination of these drugs in the urine enlarges at-risk personnel to include those at lesser skill levels (acute exposure through patient urine was documented in a reported case, and a recent study demonstrated dermal exposure by cleaning personnel) (McDiarmid, 2005 [5]).

• Inhalation and skin contact/absorption are the most likely routes of exposure, but unintentional ingestion from hand to mouth contact and unintentional injection through a needlestick or sharps injury are possible (NIOSH, 2004 [5]).

• Studies from several countries have identified contamination on surfaces of biological safety cabinets, countertops, floors, equipment, and most surfaces in areas where patients are treated. Air sampling has detected little airborne contamination although a recent study reported significant concentrations of several drugs in both personal and area air
samples. Drug particulates can become airborne after the drying of contaminated areas. Vaporization of antineoplastic agents has also been reported with various drugs such as carmustine, ifosfamide, thiotepa, and cyclophosphamide (Connor, 2006 [5]).

- Factors, such as increased workload, understaffing, improper training, budgetary constraints, more complex treatment regimens, use in non-oncology specialties, can adversely affect how these drugs are handled (Connor, 2006 [5]).

- Researchers report that noncompliance with Universal Precautions (UP) is significantly correlated with several variables in the work environment. One of the strongest correlations with compliance with UP measures is the safety culture/climate of the facility. In fact, so important is this variable that workers who perceive that the hospital had a strong commitment to safety were almost three times more compliant with UP measures than those who did not perceive a strong safety commitment. Workers receiving at least 1 hour of training (safety training being one facet of safety culture/climate) each year were also more likely to be compliant, and those receiving more training had higher compliance scores (McDiarmid, 2005 [5]).

10.4.2 Prevention of Occupational Exposure to Hazardous Drugs

Adherence to recommended guidelines and procedures covering work practices, engineering controls and PPE have been shown to substantially reduce worker exposure to antineoplastic drugs (Connor, 2006 [5]). These include:

**BC Legislation and Policies**

- **BC Workers Compensation Act,** Occupational Health and Safety Regulation stipulates (in summary) with respect to cytotoxic drugs that:
  
  - An employer must maintain and make readily available to workers, information on the a) acute and chronic toxicity, including any potential reproductive hazard (b) acute exposure treatment, and (c) safe handling.
  
  - When a cytotoxic drug is received, prepared, administered, stored or disposed of, written safe work procedures must be developed and implemented.
  
  - An exposure control plan must be implemented which incorporates risk identification, assessment and control, education and training, written work procedures, hygiene facilities and decontamination procedures when required, health monitoring and documentation.
  
  - The policy and procedures must inform workers about reproductive toxins and identify ways to minimize exposure for a worker who has advised the employer of pregnancy or intent to conceive a child.
  
  - A worker involved in any aspect of handling a cytotoxic drug must receive pre-job education and on-the-job training on the handling of this substance which includes known health risks, including any potential reproductive hazards,
relevant techniques and procedures for safe handling, proper use of protective equipment and materials, and spill and waste disposal procedures.

- All mixing, preparation and priming of administration sets with a cytotoxic drug must be performed in one centralized area in a specially designated Class II Type B biological safety cabinet that (a) is exhausted to the outside atmosphere in a manner that prevents recirculation into any work area, (b) has exhaust and ventilation systems that remain in operation for a sufficient period of time to ensure that no contaminants escape from the biological safety cabinet into the workplace, and (c) is equipped with a continuous monitoring device to permit confirmation of adequate airflow and cabinet performance.

- Adequate personal protective equipment must be provided and worn whenever there is a risk of contact with a cytotoxic drug, including (a) medical gloves that are manufactured and designed for use when handling cytotoxic drugs, (b) a moisture resistant, long-sleeved gown with cuffs, (c) if there is a risk of contact with aerosols, an approved respirator, and (d) if there is a risk of eye contact, eye and face protection. (3) Used gowns and gloves must not be worn outside the preparation, administration or storage area and must be handled as hazardous waste or contaminated linen, (4) All other non-disposable personal protective equipment must be cleaned immediately after use.

Other Guidelines and Standards

- BC Cancer Agency. *BCCA Cancer Drug Manual.* (website document) which provides detailed recommendations for safe handling standards for cytotoxic agents, spill management of cytotoxic agents, management of risks related to cytotoxic agents, safe disposal of waste at home after chemotherapy (patient information), and safe disposal of sharp and contaminated medical supplies at home (patient information).

- UK standards are available in: Health & Safety Executive (HSE) (2003). *Safe handling of cytotoxic drugs* (HSE Information Sheet MISC615).
  [http://www.hse.gov.uk/pubns/misc615.pdf](http://www.hse.gov.uk/pubns/misc615.pdf)

- US guidelines include:
  - Occupational Safety & Health Administration (OSHA). Hospital eTool - Pharmacy Module. (website document).
Australian guidelines are:


### 10.5 Occupational Exposure to Radiation

This brief section describes the policy framework for occupational radiation safety in BC as there are few studies available in this field.

Radiation Protection Services (RPS) is a division of the provincial BC Centre for Disease Control. It works closely with interested parties, including employers, citizens groups, associations, and the general public, on matters of all types of radiation, such as radiofrequency, microwave, ultraviolet, laser, ultrasound, and ionizing radiation, as they pertain to public and worker safety. RPS has substantial expertise and the ability to monitor and problem-solve. It also oversees the diagnostic X-ray unit accreditation process for hospitals and other medical facilities and the "partnership programs" developed with the applicable college or association.

Professional colleges and associations are responsible for preparing and submitting documentation that outlines how they will administer their program in partnership with RPS, (the document is known as the Quality Management Plan for Health Colleges and Associations of Diagnostic X-ray Users). They also register all x-ray installations, accommodate audits by RPS, notify members when current surveys are due; follow up on any deficiencies identified; and forward reports identifying units with deficiencies to WorkSafeBC if remedial steps have not been completed in accordance with the Quality Management Plan.

The Canadian Nuclear Safety Commission (CNSC), previously known as the Atomic Energy Control Board of Canada, is a federal authority that focuses primarily on the control of the health, safety, and environmental consequences of nuclear activities.

#### 10.5.1 Prevention Strategies to Reduce Occupational Exposure to Radiation

- Three fundamental principles of radiation protection from the International Commission on Radiation Protection are: (1) the practice involving exposure to radiation is justified by the benefit obtained from the practice; (2) all exposures should be kept As Low As Reasonably Achievable (ALARA), economic and social factors being taken into account; and (3) dose limits should be applied to provide an adequate standard of protection even for the most highly exposed individuals (ICRP 60).
• The BC Workers Compensation Act, Occupational Health and Safety Regulation
  specifies:

  o Annual exposure limits for workers to ionizing radiation, non-ionizing radiation
    and ultraviolet radiation.

  o Employers must prepare an exposure control plan if a worker exceeds or may exceed
    the exposure limit for ionizing or non-ionizing radiation.

  o The preferred control measures for protecting workers from the hazards of
    radiation incorporating three key considerations: shielding, distance, and time.
    Shielding involves placing a mass (a shield) between the radiation source and the
    worker: the more mass that is placed, the less radiation the worker receives.
    Distance also protects workers: the further away a worker is from the source of
    radiation, the less radiation the worker receives. The less time the worker is
    exposed to radiation, the smaller the dose of radiation received and the lesser
    chance for radiation injury. Where these protective measures cannot be used, or
    are insufficient, personal protective equipment is the minimum requirement.

  o If a worker's level of exposure exceeds or may exceed the applicable level, the
    employer must prepare written instructions and make them available in the work
    area. The written instructions should include written work procedures (such as the
    safe use of the equipment), emergency procedures, and specifications for personal
    protective equipment. The boundaries of the (radiation) hazard area are to be
    indicated through written instructions, signage, or other effective means.

  o Employers must ensure that every worker who exceeds, or may exceed, ionizing
    radiation levels is fully informed of any potential reproductive hazards associated
    with exposure to ionizing radiation. When requested by a pregnant worker or by a
    worker intending to conceive a child, the employer must make counselling
    available with respect to the reproductive hazards associated with exposure to
    ionizing radiation.

  o Unless exempted by the Board, if a worker exceeds or may exceed the exposure
    level for ionizing radiation, the employer must ensure that the worker is provided
    with and properly uses a personal dosimeter acceptable to the Board.

  o Equipment producing ionizing or non-ionizing radiation or ultrasonic energy must
    be installed, operated and maintained in accordance with standards for: (a)
    ionizing radiation, (b) radiofrequency, (c) lasers, and (e) ultrasound.

  o Employers must conduct a radiation survey for ionizing radiation in accordance
    with the standard practice specified under the applicable Safety Code (section
    7.23, a) or regulations under the Nuclear Safety and Control Act (Canada): at the
    times required by the Safety Code or regulations; if equipment has been damaged
    or modified; or if there is an indication of an unusually high exposure of a worker
    to ionizing radiation.
• The determination of energy and direction distributions of workplace fields is not a simple matter, requiring sophisticated measurement methods and analysis. The fields will usually comprise direct and scattered components resulting in broad energy and direction distributions. The best method of choosing a suitable personal dosimeter is to base the choice on an assessment of the dosimetric and other characteristics of the available systems combined with an assessment, as far as practicable, of the main characteristics of the workplace fields in which the dosimeter is to be worn, with, if at all possible, in-situ tests (Bartlett, 2005 [6]).

• Further guidance on optimization of radiation protection of workers:
  o BC Centre for Disease Control summarizes health care worker protection in the website document, *Optimization of protection in occupational exposure*.
  o 1990 Recommendations of the International Commission on Radiological Protection (ICRP 60) and *Radiological Protection and Safety in Medicine* (ICRP 73) from the International Commission on Radiological Protection

10.6 Conclusion

It appears that a program to prevent occupational injuries from hazardous diseases/agents can only be effective it is part of a larger occupational health and safety program for the workplace. Major recurring themes identified in the literature highlight the need for, and effectiveness of, the following initiatives:

• A committed management team and the involvement of occupational health and safety committees in developing and implementing the program.

• Risk management analysis and planning;

• Personal protective equipment and engineering controls;

• Active administrative support in emphasizing safety; and

• Staff education that focuses on barriers to compliance identified within their specific institution.

Organizational commitment and support is clearly a key to successful efforts. Employees who perceived strong senior management support for safety and who received high levels of safety–related feedback and training experienced half the number of exposure incidents than other employees. Compliance with safe work practices is also strongly associated with cleanliness and orderliness of the work site.
11.0 PREVENTION OF OCCUPATIONAL INJURIES CAUSED BY VIOLENCE

Violence is the second major cause of occupational injury and illness in the health care system. It can result in both physical injury and psychological problems due to the stress of caring for patients with violent tendencies. Bullying, a form of violence against fellow staff members, is also included in this section.

11.1 Key Factors and Issues

11.1.1 Prevalence and Incidence

- There is a large burden of violence in the BC health care system. Statistics from Workplace BC (2005) reveal:
  - Approximately 40% of all violence related claims come from health care workers, although these workers only make up 5% of the provincial workforce. Health workers are among the highest risk group for becoming a victim of violence while on the job.
  - In 2004, over 500 health workers (430 females) lost time from work as the result of injuries caused by violent acts—approximately 8% of health care time-loss claims.
  - The average number of days lost by a health worker due to a violence claim in BC is 50 days.
  - The rate of violence in very similarly across health care settings: acute care 33%; complex care (long-term care) 32%; short-term/home and community care 32%.
  - Health care workers injured due to violence: nurses’ aides/LPNs 49%; community health workers 22%; registered and psychiatric nurses 18%.
  - The most common injuries due to violence: 65% involve strains to the body including the back, and 18% involve bruises and contusions. In addition, 27% are injuries to the arms (wrists, fingers and elbows); 25% to back and shoulders; and 14% injuries to the head (neck, face, eyes, ears and scalp).

- Client-initiated violence appears to be increasing. Studies note that the greatest number of aggressive incidents arises from patients/clients/residents who have psychiatric or dementia illness or those with learning disabilities, and that a relatively small number of patients are responsible for a high proportion of assaults. In addition, alcohol and drugs, particularly central nervous system stimulants such as amphetamines and cocaine, contribute to violence in the short term (Mayhew, Reporting, 2001 [5]; OHSAH/Cvitkovich, 2005 [5]; WorkCover NSW, 2001 [5]).

- Nurses, psychiatrists, psychologists, social workers, mental retardation specialists, nurses’ aides, and substance abuse counsellors are at particular risk of violence (Mayhew, Reporting, 2001 [5]).
11.1.2 Violence in Acute Care

Studies on violence in acute care organizations indicate:

- Violent and aggressive behaviour is significant in the acute care sector. A 1993 survey of 808 registered nurses in Ontario found that 59% had been physically assaulted at least once while at work, 17% had been sexually abused and 92% had been verbally abused. A study undertaken at St. Paul’s Hospital in Vancouver found that 55% of respondents had experienced physical assault within the past year (OSAH website).

- An assessment at Langley Memorial Hospital found that more than 80% of incidents due to aggressive behaviour in the acute care area of the hospital were clustered in the Emergency Department and Psychiatric units (SAH website).

- It is likely that violent and aggressive behaviour towards health care workers is a greater problem than the statistics illustrate. Under-reporting of violent incidents is a persistent problem in health care for a variety of reasons. For example, one study at Langley Memorial Hospital in BC found that more than 55% of staff reported only some, or none, of their exposure to workplace violence (OSAH website).

- A variety of causative factors have been identified as contributing to and increasing the incidence of violent and aggressive behaviour in acute care environments, including: patients refusing to follow the rules and the need for rule enforcement; staffing patterns, shortages and cuts; long waits and inability to obtain needed services; early discharge of patients with acute and chronic mental illnesses without adequate outpatient treatment and services; substance abuse and mental health issues including dementia; unrestricted movement of the public in hospitals; poor environment design including poorly lit corridors, rooms, parking lots and other areas; and staff stress/overwork and lack of training.

11.1.3 Violence in Residential Care

Violence in residential care facilities:

- Physical and verbal abuse from residents is not uncommon as they may become agitated or aggressive for many reasons: physical pain, emotional distress and frustration, dementia and other mental illnesses, and sometimes a history of violent behaviour (Cohen, 2003).

- Dementia and aggression are highly correlated. Behavioural disturbances, including physical aggression affect 70-90% of persons with dementing illnesses: in BC, half of those with dementia live in long-term care facilities (MacCourt, 2004 [5]).

- Staff who are injured or at risk of being injured are frequently under considerable stress which affects their mental health. This can have an cumulative effect and cause anxiety, depression, emotional exhaustion, and burn out.

- Aggression is under reported generally in residential care. Many forms of aggression (as defined both from clinical and OH&S perspectives) are rarely reported as there is not a requirement to do so and it may be seen as futile (MacCourt, 2004 [5]).
11.1.4 Violence in Home Care

- In 2004, over 1,300 home and community care workers (social workers, home support workers, and childcare workers) lost time from work as the result of a workplace injury (approximately 22% of all health care time-loss claims). 8% of these claims were due to acts of violence and aggressive behaviour (Worksafe BC, 2005).

- The Auditor General’s Report (2004), In Sickness and in Health, makes the following comments: especially in the evening and on nights, staff in some departments may work alone and away from easy contact with others. For staff working in the community, safety and security is an issue when they are working alone in an office or client’s home. Those are also concerns for community workers in rural areas, as is driving alone in more remote areas with no or limited means of outside contact. Other issues included lack of communication from physicians to staff about patients with behavioural problems or violent tendencies, and between staff when patients are transferred from one service to another.

11.1.5 Bullying

Bullying is another form of violence in the workplace.

- The British Columbia Occupational Health and Safety Regulation s. 4.24, defines bullying as “improper activity or behaviour” that places the worker at risk of injury. This activity or behaviour can be: the attempted or actual exercise by a worker towards another worker of any physical force so as to cause injury, and includes any threatening statement or behaviour which gives the worker reasonable cause to believe he or she is at risk of injury; and, horseplay, practical jokes, unnecessary running or jumping or similar conduct.

- WorkSafe Victoria notes that workplace bullying is repeated, unreasonable behaviour directed toward an employee, or group of employees, that creates a risk to health and safety. “Unreasonable behaviour” means behaviour that a reasonable person, having regard to all the circumstances, would expect to victimize, humiliate, undermine or threaten another person. The following behaviours, when repeated or occur as part of a pattern of behaviour, could be considered bullying: verbal abuse; excluding or isolating employees; psychological harassment; intimidation; assigning meaningless tasks unrelated to the job; giving employees impossible assignments; deliberately changing work rosters to inconvenience particular employees; deliberately withholding information that is vital for effective work performance.

Studies on bullying indicate that:

- Workers exposed persistently to bullying are more likely to suffer from stress, anxiety and depression than those who are not (Richards, 2003 [5]).

- Those subjected to high demands at work and who have a low degree of control over their work process have been reported to be at higher risk of perpetrating ‘internal’ violence. A perception of unfair treatment may also contribute to aggressive tendencies (Mayhew, ‘Internal,’ 2001 [5]).
The potential for ‘internal’ violence exists within most health care organizations: the risks are increased in more hierarchical structures and in enterprises undergoing significant organizational changes.

A core problem is the difficulty of distinguishing clearly between ‘poor management’ that contributes to a violent culture and inappropriate coercive behaviour. It is also important to distinguish between legitimate supervisory activities (for example, comments on the work performance of subordinates) and inappropriate behaviours that are motivated by non-professional factors (Mayhew, ‘Internal,’ 2001 [5]).

### 11.1.6 Definitions of Workplace Violence

There are a number of definitions of workplace violence:

- The British Columbia Occupational Health and Safety (OHS) Regulation, section 4.27, defines violence as “the attempted or actual exercise by a person, other than a worker, of any physical force so as to cause injury to a worker [and also] any threatening statement or behaviour which gives a worker reasonable cause to believe he or she is at risk of injury.”

- The Worksafe BC report, Preventing Violence in Health Care further explains, “Assault involves any act, gesture, or attempt to apply force that gives a worker reasonable cause to believe there is a risk of injury, whether or not an injury (physical or psychological) occurs”, and “Aggression describes hostile, unpleasant, or unacceptable behaviour from gestures to physical violence. Aggression may be used to describe violence.”

- The World Health Organization (WHO) defines workplace violence as “The intentional use of power, threatened or actual, against another person or against a group, in work-related circumstances, that either results in or has a high degree of likelihood of resulting in injury, death, psychological harm, maldevelopment, or deprivation” (Cooper and Swanson, n.d.).

- The definition that is adopted will influence the type of statistics that are collected and the related descriptions of prevalence and incidence. Many incidents that constitute violence are not reported because they are not considered to fall within the definition of violence against a worker.

Leather (n.d.) describes a workplace violence classification system used by the California Occupational Safety and Health Administration (CAL/OSHA):

- Type I, where the assailant has no legitimate relationship to the workplace and the main object of the attack is cash or some other valuable commodity.

- Type II, which involves some form of assault by a person who is either the recipient or the object of a service provided by the affected workplace or the victim.

- Type III, where an assault is perpetrated by another employee, a supervisor, or an acquaintance of the worker.
11.1.7 Burden of Costs

- The *ILO/ICN/WHO/PSI* Framework Guidelines for Addressing Workplace Violence in the Health Sector estimate from a number of reliable studies that stress and violence together account for approximately 30% of the overall costs of ill-health and accidents. Based on the above figures it has been suggested that stress/violence may account for approximately 0.5 – 3.5% of GDP per year (2002). Note that these costs include stress.

- A calculation by Australian experts estimated that each case of ‘internal’ bullying costs employers $16,977. There are early indicators from the US that personal economic losses may be proportionately greater for female victims because: their average wages are lower than those of males; females lose slightly more time from work to recuperate from assault-related injuries; and women are, on average, required to spend more time attending to incident-related activities that are not covered by employment benefits (e.g., court appearances) (Mayhew, 2001 [5]).

11.2 Prevention Strategies to Reduce Violence in the Workplace

11.2.1 Current BC Violence Prevention Policies and Strategies

- **BC Workers Compensation Act** and Occupational Health and Safety Regulation addresses violence against workers, and requires employers, where a risk of violence at the workplace exits, to undertake a risk assessment and establish a violence prevention plan to eliminate, or where elimination is not possible, minimize the risk. Steps are identified to prevent incidents of violence and aggression and to deal with incidents including consulting a physician, if they occur.

- Worksafe BC has established supplementary policies to support the regulation, *Preventing Violence in Health Care: a 5–step program*, which applies to workers only.

- The Ministry of Health policy communiqué (2005-01), *Prevention and Management of Aggression and Violence in the BC Health Care System*, includes protection of workers and others such as volunteers, clients, patients, visitors and other professionals on the buildings and grounds of any health care facility/program operated by a health authority and affiliated denominational or contracted organizations. It also notes that although health authorities need not provide safety and security directly to contracted facilities (e.g., private residential care) and contracted staff (e.g., security or housekeeping staff), they must develop contracts that require these organizations to provide measures to ensure the safety and security of all workers and users of the facility or program.

- The *Tentative Agreement, Memorandum of Agreement (2006-2010)* between the Nurses’ Bargaining Association (NBA) & HEABC sets out an occupational health and safety program that defines appropriate measures to reduce and/or eliminate risks of accidents and/or occupational disease. Employees performing client visit in the community have the right to request backup where there is reasonable cause to expect a violent situation and access to appropriate communication equipment (Article 32). In addition, there is a Memorandum of Understanding establishing a violence prevention program in each health authority (NBA).
• The Occupational Health and Safety Agency for Healthcare in BC has prepared several documents including Preventing Violence and Aggressive Behaviour in Healthcare: A Literature Review (2005), Elements of a Best Practice Violence Prevention Program for BC Healthcare, and Guidelines: Code White Response. A “Code White” refers to a trained team response to de-escalate a threatening situation before an individual is injured or property is damaged. An educational guide assists in developing a Code White response program, including responsibilities, policies, and protocols for the team (OHSAH, 2004). The Auditor General notes in the report In Sickness and in Health (2004) that the Code White guidelines only work well when enough staff are available to respond. They apply only to aggressive patients—not to family members or other visitors—and do not address issues for community workers or staff working alone in departments away from mainstream activity.

11.2.2 Research on Violence Prevention Strategies in Health Care

• Two studies examined policies related to the roles and responsibilities of governments, employers and workers, and provide proactive approaches to prevention based on occupational safety and health management systems (ILO, Code of Practice, 2003 [5]; Wiskow, 2003 [5]; Mayhew, 2001 [5]; ILO/WCN/WHO/PSI, 2002 [5]):
  o Organization-wide policies and strategies are most effective in preventing occupational violence.
  o Interventions that use multiple components are more likely to be successful than are single measure efforts.
  o Off-the-shelf solutions are not appropriate as site-specific strategies have far greater preventive effectiveness. Measures that involve collaboration of the employer and workers to “design-out” violence systematically across an organization have proven to be particularly effective, including: preventive measures to improve the work environment, work organization and interpersonal relationships at the workplace.
  o Prevention must include proactive response to workplace violence with emphasis on the elimination of the causes and a long-term evaluation of each intervention.

• Mayhew notes in Prevention of Occupational Violence in the Health Workplace (2001) that:
  o Guidelines on the prevention of occupational violence have historically taken one of three approaches: reducing exposure to violence (the prevention approach); encouraging appropriate behaviour when violence occurs or appears imminent (the protection approach); and diminishing the impact following violence (the treatment approach).
  o The occupational health and safety (OHS) preventive approach is based on a hierarchy of preferred actions. Elimination of hazards through re-design of the work site is the preferred option, and should also be complimented by substitution
with a less hazardous work process. For example, isolation of workers by installing barriers and establishing administrative controls would be a higher priority than staff training.

- Re-design of the work site may include an assessment of work environment layout, job-specific exposures, a review of past events, and implementation of organization-wide controls.

- Mayhew noted that ‘crime prevention through environmental design’ (CPTED) and application of ‘situational crime prevention’ concepts can enhance those aspects of building design that discourage a range of criminal activities, including violence.

- There are many similarities between the OHS ‘hierarchy of control’ approach and a body of knowledge developed by criminologists that is generally known as ‘situational crime prevention’, ‘safer by design’, or ‘crime prevention through environmental design.’ The underlying premise is that ‘opportunities’ to commit violence can be reduced, and the ‘costs’ of violence to the perpetrator can be increased to the point where they exceed possible ‘benefits’. Specific strategies developed under ‘situational crime prevention’ include ‘target hardening’ (making violence more difficult to execute), ‘improved surveillance’ (to more easily identify perpetrators), and better cash/drugs/valuables control (to reduce the ‘benefits’).

- Training Strategies

  - The most common employer action for reducing violence against health care workers is training on how to minimize and manage violence. However, the use of training as the primary violence prevention strategy is unlikely to lead to successful outcomes. In general, training in violence management has positive, but limited, short term benefits (Cooper, n.d. [5]; Zarola, 2006 [4]).

  - Training is useful in reducing the risks of occupational violence when it is embedded in a management structure which has addressed prevention comprehensively, and, where sufficient and appropriate resources have been provided (Mayhew, 2001 [5]; Zarola, 2006 [4]).

  - Best practice in training indicates that all occupations, not only nursing, should be involved in violence/aggression management training. If violence prevention training is restricted to specific sectors of the workforce, untrained workers may be exposed to a heightened risk of violence (OHSAS/Cvitkovich, 2005 [5]; Mayhew, 2001 [5]).

- Risk assessment is the key to prevention of violence in the workplace. Preventative strategies that should be used before an incident include: environmental controls, administrative controls, consultation with workers and safety and health representatives to develop a prevention plan, manage the hazard, provide information and training, and monitor the effectiveness of action taken (OHSAS/Cvitkovich, 2005 [5]; Worksafe WA, 2006 [5]).
Evidence for the effectiveness of physical restraint in reducing violent incidents is contradictory and inadequate. Restraints may not be a good preventive measure but they are an important feature of an integrated organizational response to the threat of violence in the workplace (OHSAH/Cvitkovich, 2005 [5]).

Secondary prevention

- There is disagreement concerning the type of post-incident intervention most suitable for reducing the effects of violent incident trauma (e.g., psychological debriefing versus cognitive therapy), however, there is consensus that quick response soon after a violent incident is essential for recovery of the victim. Response to incidents involves: response planning and implementation; immediate response; recovery and review; and emergency procedures (OHSAH/Cvitkovich, 2005 [5]; Worksafe WA, 2006 [5]).

- Studies on debriefing reported mixed findings but on the whole showed no differences between those who received debriefing and those who did not: however, it was very well received by staff who received it (Richards, 2003 [5]).

### 11.2.3 Violence Prevention Strategies for Residential Care

*An Integrated Approach for Responding to Aggressive and Excessive Behaviours in Complex Care Settings* (MacCourt, 2005 for Ministry of Health) notes:

- The current biomedical model of care needs to be replaced by a person-centred care model that is more responsive to resident needs and can respond more flexibly and creatively to them.

- Clinical best practice requires a biopsychosocial approach by a multidisciplinary team. Staff approach and the environment (physical and social) need to be adapted to meet the needs of the resident.

- Effective practice demands an individualized approach to care (although this can be difficult to achieve due to lack of support staff, inadequate staff ratio, staff mix and little leadership).

- Risk identification and risk management are cornerstones of best practices in resident care and staff safety.

- Environmental controls are important from OH&S and clinical perspectives. The environment can trigger aggression (e.g., congested hallways, noise) and should be modified to meet resident need.

- Staff education and training is emphasized by both the clinical and OH&S sectors but requires standardization (in content, design and delivery) and evaluation of impact and outcomes.
• Organizational and system factors have a significant impact on resident care and staff safety (e.g., service delivery model, priorities, organization of work) and on staff mental health. Organizational support moderates the effect of physical violence, vicariously experienced violence, psychological aggression, and mental/behavioral well-being.

• Peer support, training, critical incident stress debriefing, instrumental organizational support, outreach and support groups have been identified as effective approaches to support staff mental health following an injury.

11.2.4 Violence Prevention Strategies for Home Care

• Workers Compensation Act and regulation (sections 4.21-4.23) govern “Working Alone or in Isolation.” The employer must develop and implement a written procedure for checking the well-being of a worker assigned to work alone or in isolation under conditions which present a risk of disabling injury. This includes: checks during and at the end of a shift by a designated person, emergency rescue, consultation and annual review.

• Worksafe BC has established policies including Violence in the Workplace, Working Alone or in Isolation: Meeting Your Obligations as an Employer (2006), Home and Community Health Worker Handbook (2006), and the OHSAS policies Working Alone/in the Community and Community Health Worker Handbook, which include sections on violence.

• OHSAS has also developed a Risk Assessment Tool (RAT) for performing risk assessments at Community Healthcare Worker worksites (clients’ homes). This facilitates a comprehensive evaluation of the work environment and guides implementation of practical control measures before a Community Health Worker begins client care in a home care environment. Research has found that on-site assessment is more effective than assessment by phone (OHSAS, 2005 [4]; Workcover NSW, 2004 [5]; Worksafe Victoria, 2006 [5]; NZ Occupational Safety & Health Service, 2002 [5]; Stevenson, 2006 [6]).

• In the UK, procedural measures for assessing risk related to lone-working include: positive reporting practices regarding appointments and movements; the “Buddy System”; risk assessment prior to a visit; high risk visits; lone working in relation to and transportation; and, dealing with animals in home care. Physical measures are recommended such as use of a mobile phone or alarm devices (NHS Security Management Service, 2005 [5]).

• Conflict resolution training is also recommended (NHS Security Management Service, 2005 [5]; NHS-SMS, 2005 [5]).
11.2.5 Strategies for Prevention of Bullying

Strategies to prevent bullying include:

- The Occupational Health and Safety Regulation prohibits bullying in the workplace and requires that this behaviour be investigated.

- Employers should establish whether bullying exists or whether there is the potential for it to occur in the workplace. Bullying prevention procedures should focus on bullying behaviour rather than on personalities and/or status of individuals involved (Worksafe WA, 2006 [5]). Interventions that focus on organizational rather than individual risks were shown to be more likely to succeed (Richards, 2003 [5]).

- Employers, in collaboration with workers’ representatives, should make information on workplace bullying available to all workers, supervisors and managers (Worksafe WA, 2006 [5]).

- The first and most important step in prevention appears to be unequivocal commitment from top management to a zero tolerance policy, or related strategy, which is clearly stated and enforced. This includes allocating sufficient resources for security, risk assessment and surveillance, worker and management training in violence prevention, and care for worker victims (Swanson, n.d. [5]; Mayhew, Internal,’ 2001 [5]).

- Changing the work design has been shown to be useful, in particular, increasing job/task control and autonomy, clarifying job tasks and supervisory chains of command, and improving communications about job tasks and workplace changes. Employees should play an active role in the design and implementation of any job or workplace changes (Swanson, n.d. [5]).

- Conflict resolution services can provide useful support. The facilitators should be from a different work area, have a strictly neutral role, be thoroughly trained for the task, and have the authority to propose changes/solutions where necessary (Swanson, n.d. [5]).

- Natural justice must be observed in all dealings with people accused of workplace bullying and it is important that staff are protected against false and malicious accusations (Worksafe WA, 2006 [5]).

11.3 Conclusion

It is apparent that organization-wide policies and strategies are most effective in preventing occupational violence:

- Interventions that use multiple components are more likely to be successful than are single measure efforts.

- Off-the-shelf solutions are not appropriate as site-specific strategies have far greater preventive effectiveness.

- Collaboration of the employer and workers to develop a prevention plan is a key necessary component. Measures to “design-out” violence systematically across an organization have proven to be particularly effective, for example:
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- A risk assessment of past violent events, work environment layout, work organization, and job-specific exposures.
- Proactive preventive measures to improve or re-design the work environment and work processes, often through elimination of hazards (e.g., isolation of workers by installing barriers), and other environmental and administrative controls.
- Strategies to enhance communication and interpersonal support systems in the workplace.

- Prevention must also include provision of information to staff, education and training, and monitoring to assess the effectiveness of action taken.

Risk assessment and risk management is important in all health care settings (acute care, residential care and home care). However, the issues are particularly critical for staff working alone or in isolation where the risks can be heightened. In such cases, risk assessment and safety protection plans should be established prior to the provision of care.
12.0 PREVENTION OF OCCUPATIONAL STRESS/BURNOUT

This section addresses occupational factors other than violence that can cause workers in the health care system to experience psychological problems such as depression, stress and burnout.

12.1 Key Factors and Issues

12.1.1 Prevalence and Incidence

- Mental disorders (73% of which are depression) represent the fastest growing segment of long-term disability claims in the BC health care sector. In 2003, claims for depression accounted for 13.8% of all active long-term disability (LTD) claims, exceeded only marginally by claims for back disorders. In the Community Social Services sector (which includes home care), claims for depression are the largest segment of the active LTD claims, accounting for 27.5% of all active claims as compared to back disorders at 10.2%. The average duration of an active LTD claim for depression among health care workers in BC is now 46.4 months (Bilsker, n.d. [6]; OSHAH, 2004).

- A longitudinal study on the impact of cost reduction strategies reported significant increases in staff depression, anxiety, emotional exhaustion, and job insecurity among employees (OSHAH, 2004).

- A 1999 BC study reported that 10.6% of workers in the acute care sector had a prescription for antidepressant medication. The 5-year trend in the use of antidepressant medication suggests that depression is a growing problem in the health care industry. This trend is considered significant as it is commonly believed that only half of those who suffer from depression actually seek professional help and of those who do, not all are treated with antidepressants (Bilsker et al., n.d. [6]).

- Some researchers notes that health professionals suffering from depression may be at high-risk of accidents (e.g., impairment in clinical judgment, clinical errors, unsafe behaviour during the handling of hazardous materials, problems in administering drugs, and needle injuries) (Bilsker, n.d. [6]). However, Hickam (2003 [3]) found there is insufficient evidence to conclude that stress leads directly to medical errors.

12.1.2 Definition

- Stress has been defined as a collection of physiological and endocrinological effects resulting from the experience of noxious events. It results when job demands exceed the cognitive resources available and the performance of skills may suffer (OSHAH website). Stress (in this paper) refers only to psychological or mental stress, not physical stress.

- Burnout (the end stage of work stress) has been defined as physical, emotional and mental exhaustion found in people who work intensively in emotionally demanding situations. Maslach and Jackson define it as a syndrome with three aspects that develop in parallel:
  - Emotional exhaustion: feelings of being overextended and exhausted.
• Depersonalization: lack of feeling and an impersonal response to patients.
• Reduced personal accomplishment: feelings of incompetence and underachievement.

Signs that someone is suffering from burnout include (OSHAH website): tension, anxiety or worry, depression, irritability, physical fatigue, headache, insomnia, low morale, communication difficulties, low energy, lack of motivation, negative feelings toward oneself, one’s work and other people, active withdrawal of interaction with others, aggression, and frustration.

12.1.3 Contributing Factors

• Several studies have demonstrated a relationship between job strain and onset of depressive symptoms in physicians. Similar findings have been obtained in studies of other health care workers (Bilsker, n.d. [6]).

• The key job stress factors associated with stress among health care workers, based on published studies, are work overload and pressure at work, a lack of control over work or a lack of participation in decision making, poor social support, problems with management style such as unsupportive leadership or a lack of communication/feedback, staff shortages or unpredictable staffing, scheduling or long work hours, and conflict between work and family demands (OSHAH, 2004).

• In one survey, 79% of health care workers reported that challenging or aggressive behaviours of patients were very stressful. Coworker conflict was also a concern (61%) (Smailes, 2006 [6]).

• Smailes (2006) summarized the stressors that affect BC health care workers:
  • Individual job factors: work load, autonomy in decision making, control, role clarity, role tension, interrupted tasks, shift work, physical demands such as patient lifting, difficult/challenging/non-cooperative patients, critical incidents such as trauma/death/illness, fear of catching an illness such as needle sticks/SARS/TB, environment factors such as layout or inhalation of anaesthetic gases, job injury, effort/reward.
  • Organizational factors: policies and policy changes, organizational support, communication, fairness, safety culture, education, commitment to employees, respect, value, resources, transparency in decision making.

• Another survey found that 21.7% of emergency room workers reported clinically significant post-traumatic stress symptoms. The work events most frequently cited as distressing were those involving assault or threats of assault; the second were events involving severe injuries to children. High post-traumatic stress symptom severity was also associated with a sequence of distressing events without letup (Alden, 2005 [6]).
Some researchers suggest that work-related stress plays a dominant role in the development of musculo-skeletal (MSI) injuries, while others suggest that an existing MSI causes the stress response. Twenty studies were reviewed by Johnston and all reported a relationship between injury and stress. With the increasing rates of MSIs in the workplace the focus has moved to possible psychosocial and stress factors (OSHAG website).

Researchers have developed different models to describe stress and burnout. A commonly used model was developed by Karasek who uses three variables (demand, control and support). By shifting the levels of each variable, Karasek reported that it is possible to shift the levels of stress to more favourable/unfavourable positions (Di Martino, 2003):

- Demands (psychological demands) include the pressures put on the individual by the work environment including workload, pace of work, length of working hours, time schedules, tight deadlines, etc.
- Control (decision latitude) refers to the individual’s capacity to respond to work demands and pressures, including autonomy, responsibility, skill, training, experience, etc.
- Support (social support) includes the characteristics of the social environment in which working activities are performed including organizational culture, working climate, management style, help from co-workers, involvement, participation, team-work, etc.

12.1.4 Workload and Staffing Issues

- Hickam (2003 [3]) noted that there is sufficient evidence to conclude that higher nursing workload is associated with higher rates of non-fatal adverse outcomes in both inpatient and nursing home settings and a higher incidence of medication errors. The systematic review also found organizational stress and job stress were associated with higher malpractice risk and patient falls.

- Other researchers agree that studies indicate that lower nurse-to-patient ratios were associated with higher rates of nonfatal adverse outcomes. This was true at both the hospital level and the nursing unit level. With regard to in-hospital deaths, however, the evidence does not consistently show that lower nurse staffing levels are associated with higher mortality (Stanton, 2004 [5]).

- Also, reduced nurse staffing levels have been associated with: higher levels of patient complaints, unplanned hospital readmission and failure to rescue (scarce but positive evidence); and, increased length of stay, nosocomial infection (i.e., urinary tract infection, postoperative infection, and pneumonia), and pressure ulcers (strong evidence) (Sanchez McCutcheon, 2005 [5]; Stanton, 2004 [5]; Seago, 2001 [3]; Canadian Nurses Assoc., 2005 [5]).
O’Brien-Pallas (2004 [6]) reported that adding one patient to each nurse’s caseload in acute-care hospitals is associated with increases in 30-day mortality (7%), failure-to-rescue (7%), nurse burnout (23%), and job dissatisfaction (15%). Another study demonstrated that an increase of one hour of overtime per week increases the odds of a work-related injury by 70%. Part-time and casual employment can also negatively impact continuity of care and the nurse’s ability to influence clinical and work-related decisions.

Factors that influence workload and staffing levels include:

- Health care restructuring in the 1990s across Canada, and in other countries, often: reduced bed capacity, reduced nurse staffing levels, increased workload, changed nurses role, and flattened organizational structures which resulted in a loss of nurse leadership and management, reduction in clinical support, decreased satisfaction with career opportunities, and decreased co-worker support. Within residential care in BC, the traditional model of care changed from institutional care that emphasized sickness, incapacity, and hierarchical roles to a social model that created a home-like environment (OSAH, 2004). Cost-savings were made by increasing efficiency while maintaining access and quality of services. Most of the changes included mergers of several hospitals. This newly consolidated organizational structure created dramatic changes to the work environment, including reductions in the number of clinical and management positions, particularly in nursing (Sanchez McCutcheon, 2005).

- There is increased acuity of patients in acute care settings due to several factors: the aging of the population, the application of increasingly sophisticated medical technology, and significant reductions in average length of stay of hospital patients. For example, in the US from 1980 to 2000, average length of stay decreased from 7.5 days to 4.9 hospitals days (National Center for Health Statistics, 2002).


- Workers identified workload among the top stressors and noted that in recent years that the workload of frontline workers’ has increased due to higher patient acuity and volume, rapid turnover of patients, staff shortages and poor layout of their work environment, which increased the tasks they needed to complete within a shorter period of time. The volume of work was reported to be stressful by nurses, care aides, and unit clerks in 89% (25 of 28) of the focus groups.

- Workers reported that being called on their days off to work an extra shift had the greatest negative impact on their work-life balance. About a quarter of managers and executives reported that they perceived shift work as having a negative effect on health and were concerned about an increase in errors in the latter hours of the shift. Difficulties with scheduling were seen by all groups as causing the greatest stress in work-life balance. All managers and executives were working over 45 hours per week, with some up to 65 hours per week, which suggests that they too had difficulty with home and work-life balance.
A review by Lowe (2006)[5] found that common conditions for nurses and other health professionals included: stressful jobs, hectic and heavy workloads with conflicting demands, mandatory overtime and on-call, reduced time off for education and training, and placement in areas outside of their specialty. Excessive workloads and job strain can quickly erode workers’ sense of trust and commitment in their employer, increase sick time and job dissatisfaction, and increase workplace conflict and turnover. This research also documents that downsizing and restructuring undermines workers’ health status, generating stress, insecurity, increased absenteeism, and demoralization, as well as an increased risk of morbidity.

Research on appropriate nurse-patient ratios is not strong although this area continues to be explored. There is some concern that inflexible ratios would fail to account for variables such as patient acuity, staff skill mix, and individual unit characteristics. An alternative approach is the development of formalized staffing plans as these represent a more attainable, practical approach to nurse staffing: they can be organization-specific and take into account the unique needs of the patient as well as competencies of the nurses and other care providers (Ellis, et al., 2006).

12.1.5 Organizational Issues

Smailes (2006 [6]) also found:

- Managers, executives, and union representatives were aligned with frontline workers regarding their perception that there was a lack of leadership availability. Frontline workers reported that they would like to see managers and administrators improve their responsiveness to requests, general availability, and awareness of the needs of frontline workers. Managers felt they were responding well to requests but, because of their workload, were not able to be as present on the units as they would like. Many participants expressed an interest in bringing back the head nurse who could provide better support and integration of teams.

- Frontline workers reported that disrespectful interactions were stressful. They expressed an interest in improving respectful interactions with co-workers, managers, doctors, patients, and patients’ families. In addition to a respectful work environment, frontline workers reported that being valued would improve their job satisfaction.

Jordan (2003 [6]) notes that stress in the workplace has been predominantly researched from the perspective of the individual, the purpose being to reduce its effects instead of tackling actual stressors in the workplace. Although organizations are investing substantially in stress management programs, they currently lack understanding of the sources of strain and of effective strategies to deal with specific stressors. The programs are unlikely to maintain employee health and well-being without procedures in place for reducing or preventing environmental stressors. Jordan suggests the reasons for this ‘individual’ focused approach are:

- Senior management failing to take responsibility;
- Psychologists concentrating on subjective and individual differences;
The difficulty of systematic interventions and evaluation studies within rapidly changing organizational settings; and

The lack of ‘hard’ empirical evidence concerning the costs and benefits (i.e., financial) of stress interventions.

12.2 Prevention Strategies to Reduce Occupational Stress and Burnout

12.2.1 Current Prevention and Early Intervention Programs in BC

The BC *Workers Compensation Act*, Occupational health and Safety Regulation addresses the need for workers with physical or mental impairment to inform their employer of the impairment and avoid work that may create an undue risk to the worker or anyone else.

The Provincial Collective Agreement between HEABC (Health Employers Association of BC) and Nurses’ Bargaining Association (2006-2010) provides standards for measuring nurse workload and application of nurse staffing plans in BC. The Agreement includes:

- Variables which need to be considered in developing appropriate staffing plans such as: patient/resident/client clinical acuity; nature and complexity of care provided; functionality of the capital facility; location of facility or service; workforce resources (FT/PT/Casual and scheduling options, etc).

- Workload measurement tools that can facilitate informed discussion and decision-making about safe workloads for nurses, rather than being an end in themselves. While workload measurement tools have undergone advances in recent years they are not yet fully developed outside of the acute care and residential care setting. Principles that should be met in determining appropriate workload measurement tools and nurse staffing plans should be: evidence-based; and based on patient/resident/client needs, acuity and outcomes.

- A joint Provincial Nursing Workload Committee (PNWC) will seek to develop consensus and provide advice to the Leadership Council (LC) on which indicators within a workload measurement tool should be used within the health care system.

- A Local Nursing Workload Committee will advise Health Authority management and the PNWC on appropriate implementation and tracking of the workload measurement indicators and staffing plan processes.

- Employer objectives include: staffing levels that align with the mix of patients being served; allocation of appropriate relief to account for vacancies due to vacation, union leave, leave of absence, etc.; availability of an appropriate surge capacity to deal with changes in patient load and acuity over the course of time, and accessible, empowered, skilled frontline leadership.

Worksafe BC Critical Incident Reduction (CIR) Program is a province wide early intervention program for workers and employers who have experienced a traumatic workplace event (a traumatic workplace event may include an injury, near miss or threat, being the victim of a crime, or witnessing a workplace fatality). Worksafe BC requires that employers make available
to unionized employees, critical incident response and critical incident stress debriefing that significantly reduce the chances of developing post-traumatic stress disorder if provided in a timely manner, optimally within 24-72 hours. The CIR program will contract with a mental health professional with specific training in the field, and will, in some cases provide follow up counseling (Worksafe BC, 2006).

In addition, the Nurses’ Bargaining Association and HEABC, has an Early Intervention Program to identify and provide appropriate case management to facilitate rehabilitation. The Healthcare Benefit Trust also has an Early Rehabilitation Services Project that requires employers to offer early interventions programs to all employees eligible for long-term disability

12.2.2 Multi-component Prevention Interventions – General

There is a growing consensus among researchers that further improvements in employee health and well-being and organizational performance will require changes in job design, organizational systems and structures, and work environments. Staff performance is not only dependent on their knowledge and skills, but also on a number of other factors. These include the environment in which they work, their mental and physical health, their relationship with the people around them and their ability to communicate, but also a range of additional system-related factors. (ACSQHC, Literature Review, 2003 [3]; Lowe, 2006 [5]).

Research literature on multi-component interventions notes:

- Clinical and cost outcomes for comprehensive worksite health promotion and disease management programs are generally positive, if modest, showing the best results for individualized risk reduction for employees with the highest risk of heart disease and other chronic conditions. Comprehensive health promotion programs take an integrated, ongoing approach to health risk reduction, include an evaluation component, and are linked to corporate objectives (Lowe, 2006 [5]).

- Views expressed by expert panelists indicate that the effectiveness of interventions is not dependent specifically on the type of programs implemented, but whether a need has been established for it by consulting with employees and/or employee representatives, and by identifying and assessing specific risks (Jordan, 2003 [5]).

- It is not possible at this stage to determine what kind of approach is more effective, because the number of studies is too small to compare different approaches (Mimura, 2003 [3]; Jordan, 2003 [5]).

- Comprehensive Stress Prevention and Management (CSPM) may be viewed as an all encompassing organizational philosophy that recognizes that individual and organizational health are interdependent, and the responsibility for stress prevention and stress management should lie with every member of an organization (Jordan, 2003 [5]).

- Job satisfaction increases among nurses following the introduction of autonomous clinical practice in which nurses are involved in decision-making and believe they have control. Additional organizational factors consistently linked to nurses’ job satisfaction include the value placed on nursing throughout the facility by administrators and by physicians. Also important are supportive relationships with peers, physicians, and
management, based on mutual respect and mutual concern for providing quality care. Empowerment is achieved through work redesign, specifically through teams that enable learning and professional development, access to information, adequate support and resources, and control over decisions affecting care delivery (Lowe, 2006 [5]).

- It is important to recognize that empowerment, or employee involvement, are not stand-alone programs. Lasting impact on employee commitment, performance and job satisfaction interventions requires a total approach to human resource management that fosters an employee-centred culture (Lowe, 2006 [5]).

- Effective implementation of a worksite stress prevention program is facilitated by the presence of a culture whereby employers and employees are all involved in the instigation of the intervention process and are willing to continually communicate, analyze and revise their plans and to learn from interventions that do not produce expected results. Such activities assist organizations to confront future challenges through the development of communication, culture, participation and negotiation (Jordan, 2003 [5]).

12.2.3 Multi-Component Prevention Interventions – Models and Frameworks

There are a range of models and frameworks in the research literature that are used as a basis to describe, define and develop multi-component interventions:

- Graham Lowe’s (2006) concept of a healthy workplace categorizes factors related to reducing stress as:

  1. Trust, respect, fairness, commitment
  2. Resources
  3. Autonomy and input
  4. Effective supervision and communication
  5. Challenged but not overworked

- Bilsker (n.d. [6]) outlined three levels of prevention for a comprehensive approach to employee mental health:

  o **Primary Prevention/Early Intervention** – This level includes health risk management, evidence-based program development, mental health promotion (e.g., resiliency training, stress management), supportive human resource policies (e.g., conflict resolution, work-life balance, recognition/reward system), supportive leadership and management/supervision, education and training, healthy workplace strategy.
Early or Secondary Intervention – Interventions include performance management, medical surveillance, Employee Assistance Program depression screening, assessment/referral, self care program, acute and chronic stress management, Early Return-to-Work program (e.g., case management, practice guidelines, modified work), employee satisfaction/perception surveys, enhanced access to mental health professionals (e.g., preferred provider network, shared care or stepped care).

Disease/Disability or Tertiary Management – Interventions include disability management (e.g., case management, practice guidelines, psychological job analysis, psychological capacity assessment, independent medical examination), task/job modification, vocational rehabilitation, preferred provider network or shared care to increase access to mental health professionals, relapse prevention, Long Term Disability depression screening, program evaluation, data harmonization, economic analysis and research.

Similarly, Jordon (2003 [6]) discusses strategic management interventions as consisting of primary, secondary and tertiary prevention strategies which include “any activity, program, or opportunity initiated by an organization which focuses on reducing the presence of work-related stressors, or on assisting individuals to minimize the negative outcomes of exposure to these stressors”. For example:

Primary interventions attempt to eliminate the sources of stress in organizations by focusing on changing the physical or socio-political environment to match individual needs and granting them with more control over their work situation. Improving communication processes, redesigning jobs or involving employees in the decision-making process are all examples of primary level interventions.

Secondary interventions tend to help individuals manage stress without trying to eliminate or modify workplace stressors. Stress management programs assist individuals to identify stress symptoms in themselves and others, and to acquire or improve their coping skills.

Tertiary prevention strategies seek to assist individuals who are experiencing ongoing problems emanating either from the work environment or their work lives. The purpose of such programs is to adapt individual behaviour and lifestyle without much reference to changing organizational practices.

In addition, OHSASH (n.d. [5]) proposes:

Physical Interventions – e.g., rescheduling techniques to spread activities more evenly during a certain time span; technical support for new and advanced technologies, ergonomically designed workplaces that may lower the workload and reduce time pressure.

Social Interventions – e.g., address organizational socialization related to the sources of stress and the quality of social relations.
Psychological Interventions – e.g., interpersonal approaches that focus on the relationship between professional caregivers and patients, coping strategies, enhancing skills levels to reduce strain, increase participation in decision-making, establish rewards.

12.2.4 Prevention Strategies Related to Workload and Staffing Levels

The Health Outcomes for Better Information and Care (HOBIC) is a joint project of the Ontario Ministry of Health and Long-term Care and Health Canada. It is examining nursing staffing and quality work environments in acute care, long-term care, complex continuing care and community care, and will later include rehabilitation, primary health care, mental health and public health in a number of phases. It includes: (www.health.gov.on.ca/english/providers/project/nursing/nursing_mn.html):

- An Expert Panel on Outcomes which developed outcome measures for collection and analysis of information on staffing indicators and health outcome measures for a range of settings. Pilot projects have been conducted, and wider implementation for testing purposes, beginning in 2006/07, is taking place (initially 24 sites) in four sectors (acute care, long-term care, complex continuing care and home care).

- Outcome measures include: functional status, therapeutic self-care, symptom status (pain, nausea, dyspnea, and fatigue), safety outcome measures (pressure ulcers, falls) and patient satisfaction with nursing care.

- Development and testing of health outcomes for three additional sectors (mental health, public health and primary care) is being planned by an Expert Panel.

In developing outcome measures to assess staffing levels and quality of care, researchers note that the number of pressure ulcers that develop while patients are in hospital is a good measure of the quality of care. Pressure ulcers are mostly (though not entirely) preventable if patients at risk are properly assessed and appropriate actions taken to prevent tissue damage. Pressure ulcers, functional status, and weight loss have proven to be the most sensitive quality indicators linked to staffing patterns, and should be measured as incidence measures (number of occurrences) if possible (Healthcare Commission, Acute hospital portfolio review, 2005 [2]; Bostick, 2006 [3]). Resident-level outcomes are more sensitive measures of quality care and are preferred over facility-level outcomes and should be conceptually linked with staffing information (Bostick, 2006 [3]).

Research on nurse staffing levels indicates:

- One of the issues central to ensuring the best patient outcomes is determining the right mix of care providers for the patient population. It appears from many of the studies that the relationship between nurse staffing and patient outcomes is associated with RN staffing levels and the proportion of RNs in the total staff mix. In acute settings, total staffing and LPN staffing tend not to demonstrate a link with improved outcomes. There is a strong body of evidence to suggest that by achieving optimal nurse staffing levels that closely match the acuity level of patients, the quality of care is improved. Some studies have shown better quality of care with higher levels of licensed staff (Canadian Nurses Assoc., 2005 [5]; Tomblin Murphy, 2005 [5]; Lankshear, 2005 [3]; Bostick, 2006 [3]).
Similarly, educational strategies that are associated with improved patient outcomes (i.e., decreased infection rates, pressure ulcer rates, and fall rates) include: promotion of the highest nursing education base required for patient needs; and supplementing education with interventions such as providing feedback data or benchmarking results (Ellis, 2006 [5]; Seago, 2001 [3]).

Two studies reported that the relationship between increasing nursing levels and improved outcomes tailed off at higher RN levels. Such a curvilinear relationship indicating diminishing marginal returns to increased RN levels and skill mix has more face validity than the linear relationship assumed in most studies and is of considerable policy importance. At higher RN levels, staff probably increasingly carry out the work that could he equally well done by less qualified staff (O’Brien-Pallas, 2004 [6]).

Staffing above predicted levels is costly and difficult, but given the current nursing shortage, this approach offers the best results for consistent quality care, patient outcomes and patient safety. This method of staffing utilizes the principle of redundancy in staffing that is employed by high reliability organizations (Canadian Nurses Assoc, 2005 [5]; Tomblin Murphy, 2005 [5]).

12.2.5 Other Specific Prevention Strategies

Suggestions presented by BC health care workers from Smailes’ (2006 [6]) survey include:

- Many frontline workers were familiar with Critical Incident Stress Management (CISM) programs (89%), however, many had mixed views about its effectiveness. 64% were dissatisfied with the service. The most frequent complaint was that it came too late - reducing the lag time of the program was a commonly discussed solution among frontline workers (32%). Managers and executives were predominantly positive about CISM, although they too recognized the speed of delivery was too slow.

- All participants felt the Employee Family Assistance Program should remain available.

- Frontline workers showed an awareness of the importance of self help and the need to maintain their health. The top five forms of coping were: mental preparation and self reflection (57%); spending time exercising and undertaking hobbies (53%); spending time with family and friends (39%); humour (36%); and proactive action (25%).

- Frontline workers noted that orientation was very important for new and transferred employees. However, none felt it was being done well except for training in the use of new equipment. Many frontline workers (61%) would like more training including time management, stress management, and conflict management. Managers and executives also identified education in time management, stress management, and conflict management as important programs for frontline workers (Smailes, 2006 [6]).
Bilsker (n.d. [6]) noted that the research literature provides ‘strong’ support for the effectiveness of worksite programs to increase stress-coping skills in reducing depression risk. The term most often used to describe this kind of coping training is “resilience training”. Also, Hickam (2003 [3]) found that malpractice risk was reduced in a controlled trial of a stress management program. However, Lowe (2006 [5]) found that despite their popularity, stress management and other ‘superficial’ interventions aimed at increasing an individual’s coping skills are generally ineffective.

There have been calls to institute widespread screening for depression among employees in order to facilitate early identification and prompt referral for medical treatment. However, the benefit of screening for depression in the workplace has not yet been evaluated, and “we cannot assume that universal screening of employees will deliver significant benefit” (Bilsker, n.d. [6]).

Worksite health promotion programs aimed at reducing an individual’s health risks, such as modifications to diet, physical activity and other lifestyle factors, have limited to mixed results in terms of reducing health risk factors (Lowe, 2006 [5]).

Analysis of support interventions found: cognitive techniques were effective although evidence was weak; three approaches on exercise, music, and relaxation training were potentially effective; one approach on social support education was questioned but possibly effective. One auxiliary study on cognitive education and role playing allowed no conclusion (Mimura, 2003 [3]).

For workers who change from one shift to another, a forward rotation of shift work (morning shifts followed by evening shifts followed by night shifts) may lead to less fatigue on the job than backward rotation (e.g., day shift to night shift to evening shift). There is also strong evidence that therapeutic naps and maintenance naps combat the effects of fatigue and sleep loss. They can help subjects adapt better to circadian rhythm disturbances and perform better during acute sleep deprivation (observations from non-medical settings) (Jha, 2001 [3]). However, it should be noted that most studies on optimal shift length to reduce fatigue and maximize performance are in non-medical settings and present inconsistent findings; they have been limited by poor study designs or outcomes that may not correlate well with medical settings (Jha, 2001 [3]; ACSQHC, Literature Review, 2003 [3]).

The BC Healthcare Benefit Trust has published an update report, Managing depression in the workplace: complex disorder-complex systems, outlining the considerable burden of depression and the need for employers to adopt a population-based approach and employee-focused intervention strategy that will have an increased return on investment through better productivity (2007).
12.3 Conclusion

Multi-component comprehensive prevention programs are increasingly recognized as effective strategies in enhancing employee health and well-being, as well as in strengthening organizational performance. This approach requires a collaborative approach between employer and employee representatives to identify needs and risk factors and to determine the measures that are most appropriate for their organization. Key elements should include:

- A culture characterized by mutual trust, respect, fairness and commitment to quality care, in which supportive relationships exist between peers, physicians and management.
- Increased autonomous clinical practices in which nurses are involved in decision-making, and are valued by administrators and by physicians.
- Redesign of work environments and work processes by teams that enable learning and professional development, access to information, adequate support and resources, and control over decisions affecting care delivery.
- Open communication among employees combined with active participation in analysis, monitoring, evaluation and revision of prevention programs as necessary.

As well, specific prevention strategies to address occupational stress and burnout should include:

- Primary prevention including strategies aimed at both organizational factors (e.g., healthy workplace strategies, supportive leadership) and individual factors (e.g., mental health promotion, stress management/resiliency training and work-life balance).
- Early or secondary interventions such as assessment/referral, employee satisfaction surveys, an employee assistance program, acute and chronic stress case management, and an Early-Return-to-Work program.
- Tertiary prevention including case management, practice guidelines, assessment, task/job modification, vocational rehabilitation, and relapse prevention.
PART V: HEALTH CARE DESIGN AND ENVIRONMENTAL ISSUES

13.0 DESIGN OF HEALTH CARE FACILITIES AND WORKFLOW PROCESSES

This section reviews the influence of facility design on adverse events for patients and staff. The focus is on design as a primary prevention strategy that can be used to reduce medication errors, falls and health care associated infections as well as other health and safety risks for patients and staff members. The strategies address noise/sound, light, positive distractions, sleep, wandering, social interaction and wayfinding. Design models, standards, and environmental rating systems are also discussed.

13.1 Key Factors and Issues in Design of Health care Facilities

Positively appraised environments have been shown to have a beneficial effect on patient satisfaction and well-being, as well as on staff well-being (Leather, 2000 [3]). Phiri (2006) stresses the important role of the design team in creating appropriate environmental conditions. He points out that many hospital systems are not “designed” in the true sense with the result that errors are often induced simply because processes have not been considered or thought out. It is suggested that poor design of work processes and work spaces should be the focus of error prevention efforts as these are the main cause of medical errors (rather error-prone people). Design teams should (Phiri, 2006):

- Recognize or compensate for staff and patient characteristics, inadequacies, habits and daily activities.
- Recognize situations and risk factors in lighting, illumination, flooring, storage and seating.
- Eliminate or control hazards.
- Address users’ lack of specific skills, e.g., in navigating stairs, getting in and out of low chairs, etc.

Nelson (et al., 2005 [6]) notes that controversy remains regarding whether the high cost of hospital design and construction outweighs the operational savings and increased revenues that may be generated from design innovations. There is a lack of consensus regarding whether there is sufficient evidence to support the business case for better built environments or whether the evidence is sufficient but has not been presented or transferred effectively to health care executives, designers and other decision-makers.

Environmental factors that can influence health and safety in health care settings include:

- High noise levels can have a significant impact on patients including: sleep disruption and awakening; decreased oxygen saturation, elevated blood pressure, increased heart and respiration rate among neonatal intensive care patients; decreased rate of wound healing; higher incidence of re-hospitalization (Ulrick, 2007 [6]).
The impact of high noise levels on staff include: increased perceived work pressure, stress, and annoyance; increased fatigue; emotional exhaustion and burnout; difficulty in communication possibly leading to errors (Ulrick, 2007 [6]).

Insomnia or disturbed sleep is a common complaint of older people: studies show that 50% of individuals living in the community and 70% of individuals living in a long-term care setting are affected by it (Joseph, 2006). Environmental factors that contribute to sleep disturbance among the elderly in nursing homes include: limited sunlight exposure, large amounts of time spent in bed, lack of physical activity, nighttime noise, light and incontinence care routines.

Difficulty navigating hospitals is costly to patients, families and staff. A study conducted at Emory University estimated that the annual cost of supplementing a formal wayfinding system exceeded $200,000, a cost attributable largely to time spent by hospital staff in giving directions (over 4,500 staff hours annually) (Nelson et al., 2005 [6]).

Characteristics of residential care institutions that contribute to confusion and disorientation include: monotony of architectural composition and lack of reference points; long corridors with many doors; lack of windows or lack of access to windows; ad hoc signage; low lighting in public areas; and floor patterns and dark lines or surfaces which can disorient the person and cause anxiety (Joseph, 2006).

Ulrich (Center for Research Design, 2004 [6]) created a “Scorecard for evidence-based design”, to reflect the level of evidence linking environmental factors with effective interventions. The strongest evidence was for:

- Reducing patient stress through: reduced noise stress, reduced spatial disorientation, improved sleep, and increased social support.
- Reducing staff stress through reduced noise stress, and improved medication and delivery processes.
- Improving patient safety through environment strategies that reduce nosocomial infections.

13.1.1 Health Care Associated Infections

- There is evidence that the built environment does influence the incidence of infections in health care facilities. Important environmental factors include: availability of single patient rooms, the ability to isolate patients for airborne and non-airborne organisms, the location and number of sinks, the types of surfaces, the ability to separate clean and soiled equipment, and the availability of waterless hand washing stations (Office of the Auditor General, 2007 [2]).
- The confined living arrangements and group activities of nursing homes, combined with understaffing and failure of staff to comply with infection-control measures, are associated with high infection rates in nursing homes. Although there are few studies conducted in such settings, some of them have linked environmental quality factors (such
as cleanliness, odors, noises, homeliness) with high rates of hospitalization among nursing-home residents (Joseph, 2006).

- PHAC (2001) has documented reports of construction-related nosocomial infections caused by *Aspergillus* species and *Legionella*. Nosocomial aspergillosis is a cause of severe illness and mortality in immunocompromised patients. The mortality rate is high for both nosocomial aspergillosis (65%-100%) and legionnaires’ disease (24%-80%) in hospitalized populations, even when infections are recognized and treated. The majority of infections were related to construction or renovation projects within or adjacent to the health care facility. Others were associated with ventilation systems that were malfunctioning or improperly maintained when the health care facility was undergoing construction or renovation. Two documented outbreaks of pseudofungemia and one outbreak of pseudobacteremia occurred when dust particles from construction or renovation projects contaminated laboratory specimens, bronchoscopy material, and blood culture bottles.

- A study involving inoculation of 14 common building materials and finishes in the health care environment with common harmful organisms, followed by rigorous laboratory testing, confirmed previous empirical findings that resistant organisms are capable of prolonged survival, and that selection and proper use of cleaning materials are essential for disinfection (Langford, et al., 2007).

13.1.2 Medication Errors

Environmental factors associated with medication errors include frequent interruptions or distractions, inadequate space for performing work and insufficient lighting. One study found that medication errors are closely associated with daylight and darkness hours (Nelson et al., 2005 [6]).

13.1.3 Falls

- A review of studies on falls and fall prevention indicates several problems concerning the impact and relevance of environmental factors (Phiri, 2006 [6]):
  
  - Conceptualizations of environmental factors remain incomplete, and there is no generally widely accepted formulation, with the result that most studies have emphasized environmental hazards rather than environmental conditions. As a consequence, environmental impact assessments, safety checklists and guidelines focus on environmental hazards.
  
  - Expectations are not clear for hazard removal or more individualized improvement of environmental conditions that create situational risk.
  
  - The measurement of environmental conditions associated with falls has been largely qualitative and categorical rather than quantitative, making comparisons across studies and achievements difficult, e.g., characterizing light levels as “low”, “dim” or “poor”.

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Nelson et al. (2005 [6]) found that most falls in the hospital are due to slippery floors, poor placement of handrails and inappropriate door openings or furniture heights. In one study, following implementation of ergonomic elements and a hospital design that enabled staff to view all patients simultaneously, the number of falls decreased to less than 25% of previous levels. In another study, the number of patient falls per day decreased from six falls/1000 patients in 1997 to two falls/1000 in 2001 as a result of switching to single-bed rooms and incorporating decentralized nurse stations.

Two studies have assessed the impact of flooring type on incidence of falls, though the results are not consistent. Donald et al. (2000) found that elderly residents in a rehabilitation ward in a community hospital incurred fewer falls on vinyl surfaces as compared to carpet. On the other hand, elderly residents exhibited higher gait speed and step length on a carpeted surface as compared to vinyl. There is insufficient evidence to support the use of one type of surface over the other to reduce falls among the elderly (Joseph, 2006).

Phiri (2006) notes that high-risk stairs for falls include those with fewer steps, lower risers, treads less than 12 inches deep, irregular riser heights, visually rich views on one side, visually rich overhead views, and unobstructed view of the front, patterned carpets that obscure the front edge of stair treads and create visual deceptions for users.

13.1.4 Occupational Injuries

Musculoskeletal Injuries

A BC report by Cohen et al. (2003 [3]) (prepared for OHSAH and Workers' Compensation Board of BC) found:

- Restricted spaces such as small bedrooms and bathrooms increased the physical workload, a fact echoed in workers’ perceptions. Intermediate Care facilities often have room dimensions, halls, elevators, and other building features that are challenging to residents and workers alike, especially when using wheelchairs and mechanical lifts.

- A relationship between the physical environment variables and workers’ reports of pain, health, and job satisfaction was identified; however, most relationships were moderate in magnitude and not statistically significant. There was no relationship between physical environment and time-loss injury rates.

- Bedroom size and bathroom size were found to be significant in an ergonomic study. A small bedroom and bathroom were correlated with higher cumulative compression in the lower back and with more peak spinal compression and peak neck/shoulder muscle activity. Care aides in the ergonomic study confirmed this finding when they stated that delivering care in small bathrooms and bedrooms was more demanding and difficult.

- Longer halls were also problematic; this variable was moderately associated with poorer health, with more peak neck/shoulder muscle activity.

- Poorly-rated facilities faced many problems. Workers, and some managers, reported that the physical environment affects the workload, places increased pressure on staff, and increases the risk of occupational injury. Examples of poor environmental conditions
included: long corridors; insufficient elevators; a limited number of wheelchair-accessible washrooms; small or cluttered bedrooms; cramped bathrooms; insufficient room for mechanical lifts and wheelchairs; lack of electric beds, etc.).

An Australian study (Worksafe Victoria, 2002 [5]) found that:

- Poor work place design is a major contributing cause of injuries, especially in patient rooms, toilets, bathing areas and corridors. Restricted space may lead to constrained and awkward postures during handling tasks, and poor workplace design may lead to unnecessary or double handling of patients/residents.

- The main environmental influences on safe handling of patients/residents are room layout, types and location of equipment, furniture, fixtures and floor finishes.

- Floor coverings can impact staff work practices and occupational health and safety in five ways: cleaning/maintenance procedures, manoeuvrability of equipment, risks of slipping or tripping, spread of flame and the density of smoke produced, and feet and leg fatigue

### 13.2 Health Care Design - Staff Productivity and Health

Work spaces and layouts can be designed to reduce staff fatigue and increase time for care. Rather than conventional floor layouts for patient-care units which generally provide corridors organized around a central nursing station, researchers suggest (Ulrich, 2006 [5]) properly designed localized charting stations with viewing windows to improve safety by facilitating good visual access to patients. Decentralized charting stations help reduce falls by fostering direct observation and enabling nurses to provide assistance quickly when at-risk patients attempt to get out of bed. Importantly, there is good evidence that well-designed patient-care units with single rooms and decentralized charting and observation do not require higher nurse staffing levels than conventional multi-bed units.

Research on hospital layouts examined by Joseph (2006 [6]) revealed:

- Smaller units contribute to reduced stress and increased staff satisfaction. A cross-sectional survey of 1,194 employees and 1,079 relatives of residents in 107 residential-home units and health-centre bed wards, found that large unit size was related to increased time pressure among employees and reduced quality of life for residents.

- Further, even in small units, especially those designed for persons with dementia, it is important to consider how the design impacts staff ability to monitor residents.

- The presence of amenities and environmental supports reduces staff turnover.

- Physical design enhancements improve morale and satisfaction.

Ulrich et al. (2004) reviewed studies on health care design, and found that ergonomic interventions combined with careful consideration of air quality, noise and light, resulted in reduced levels of stress among staff members, a significant positive impact on staff health, and improved nurse productivity. For example:
According to one study, almost 28.9% of nursing staff time was spent walking. This was second only to patient-care activities, which accounted for 56.9% of observed behaviour.

At least four studies revealed that the type of unit layout (e.g., radial, single corridor, double corridor) influenced the amount of walking required by nursing staff, and two studies showed that time saved walking was translated into more time spent on patient-care activities and interaction with family members.

Workplace design that reflects a close alignment between work patterns and the physical setting, have been shown to improve work flow, reduce waiting times, and increase patient satisfaction with the service.

Other aspects of the environment, such as lighting levels and auditory or visual distractions, can also influence staff effectiveness, and is particularly important when performing critical tasks such as dispensing medications (Ulrich et al., 2004).

Recommendations from the US Institute for Medicine on transforming the work environment for nurses suggests the following strategies (Page et al., 2004):

- Root-cause analysis and anticipatory failure analysis are typically used to help nurses perform desirable, “value-added” nursing activities more efficiently and safely (e.g., medication administration, documentation, and patient monitoring).

- “Lean” analysis techniques (based on methodology developed at Toyota) aim to increase face-to-face time with patients, improve communication and efficiency, and reduce interruptions during medicine rounds. Practices include:
  - Visual controls – keeping work processes and indicators in view so everyone can understand the status of the work system at a glance.
  - Streamlined physical plant layout – designing facility layout to optimize the sequencing of work processes.
  - Standardized work – using prescribed methods to perform routine tasks.
  - Point-of-use storage – locating supplies, equipment, information, and procedure rules where they will be used, thus saving the time otherwise involved in locating and obtaining them.

- Several workspace design elements based on “Lean” operation and other work design principles can potentially achieve workload reductions and more efficient and safer care delivery in general patient care rooms. Similar concepts apply to the design of adult critical care units although there are special considerations for neonatal intensive care units.

- Although the US Institute of Medicine notes that little research has been conducted on the effectiveness of these measures in improving patient safety, it notes that the evidence in support of “Lean” practices, and the associated beneficial effect on patients, provides a strong basis to urge further implementation and evaluation of these interventions.
Additional information is available from the Coalition for Health Environments Research (CHER) Paper. *Reducing Nursing Errors and Increasing Efficiency Through Environmental Design* - Spring 2007. This is a comprehensive review of the empirical literature followed by interviews with nurses at seven hospitals - four in the Pacific Northwest and three that have enhanced efficiency. The study concludes with specific recommendations on environmental interventions that can reduce errors in the nursing unit.

### 13.3 Health Care Design - Patient Health and Care

#### 13.3.1 Noise/Sound

A study by Hickam et al. (2003) for the US Agency for Healthcare Research and Quality found in a review of studies on the impact of noise in health care facilities, that there is not sufficient evidence to determine whether noise levels affect patient outcomes. However, several other reviews of the literature (Joseph, 2006; Ulrich et al., 2004) found:

- The World Health Organization (WHO) guidelines for continuous background noise in hospital patient rooms are 35 dB(A) during the day and 30 dB(A) at night, with nighttime peaks in wards not to exceed 40 dB(A). Busch-Vishniac et al. (2005) examined hospital noise levels reported in thirty-five published research studies over the past forty-five years. They found that no published studies reported noise levels that complied with the WHO guidelines for hospitals.

- Hospital noise levels have been rising steadily since the 1960s. Background noise levels rose from 57 dB(A) in 1960 to 72 dB(A) today, during daytime hours, and from 42 dB(A) in 1960 to 60 dB(A) during nighttime hours. Studies also indicate that peak hospital noise levels often exceed 85 dB(A) to 90 dB(A). To illustrate, noises that exceed 90 dB(A) (e.g, alarms, portable X-ray machine, etc) are comparable to walking beside a busy highway when a motorcycle or large truck passes.

- Architectural design solutions to reduce noise and promote patient privacy/confidentiality in hospitals should include:
  - Provision of single-patient rooms.
  - Private discussion areas in admitting areas as well as on the care unit for private conferences with families and staff.
  - Patient examination rooms and treatment areas with walls that extend to the ceiling to prevent voice and noise carrying to other areas.
  - High-performance sound-absorbing acoustical ceiling tiles have shorter reverberation times and thus are able to reduce sound propagation, and improve speech intelligibility and privacy.
  - Measures to remove or reduce the sources of loud noise and educate staff about the impact of noise on patients as well as themselves.
13.3.2 Light

A review of studies on the impact of light in the health care setting (Joseph, 2006 [6]) found:

- Visual task performance improves with increased light levels. The need for light for effective visual task performance increases with age. Also, higher lighting levels are associated with fewer medication-dispensing errors in hospital pharmacies.

- Exposure to daylight is associated with:
  - Reduced depression among patients with seasonal affective disorder and bipolar depression.
  - Decreased length of stay in hospitals.
  - Improved sleep and circadian rhythms.
  - Lower agitation among dementia patients, and easing of pain.
  - Improved adjustment to night-shift work among staff.

- Better outcomes were demonstrated for patients on a unit’s bright side. For example, patients:
  - Experienced less perceived stress.
  - Experienced less pain.
  - Took 22% less analgesic medications per hour.
  - Incurred 21% reduction in medication costs.

- Effect of windows:
  - People prefer daylight to artificial sources of light for work and prefer to be close to windows.
  - Related glare and thermal discomfort may impact mood and task performance negatively.

- Based on the results of the studies, recommendations for health care settings include:
  - Provide windows for access to natural daylight in patient rooms, along with provisions for controlling glare and temperature.
  - Orient patient rooms to maximize early-morning sun exposure.
  - Assess adequacy of lighting levels in staff work areas.
  - Provide high lighting levels for complex visual tasks.
  - Provide windows in staff break rooms so staff have access to natural light.
A small body of research has been conducted to further assess whether environmental factors influence the length of patients’ hospital stays. According to a randomized controlled trial conducted at the Department of Neuropsychiatric Sciences at the University of Milan, bipolar patients assigned to rooms with more sunlight had a mean 3.67-day shorter hospital stay than patients with the same diagnosis in rooms with little or no sunlight (Nelson et al. 2005).

13.3.3 Colour and Light

A study for the UK NHS (Dalke et al., 2004) found that colour design cannot in itself heal, but it can aid the healing process, provide a sense of well-being, visual interest and distraction. It found that:

- Colour schemes should coordinate with all finishing materials (floors, walls, textiles and even noticeboards) for colour harmony.

- The colour palette should be limited: a lot of differing colours may lead to visual confusion and a feeling of unease. Blue and white tend to be preferred colours, but their overuse, and overuse of any single colour, can lead to monotonous depressing environments.

- Colour design and contrast for the visually impaired and elderly can assist patients by:
  - Marking the changes in floor grade or slope, avoiding extreme patterns, and using pale, matt floor finishes.
  - Using contrasting colours for doors, leading edges of doors, door furniture and frames.
  - Using coloured handrails attached to a wall at waist height, colour contrast at handrail height and colour-coding on floors.
  - Providing colour distinction between adjacent surfaces for enhanced visibility.

- Navigation within the facilities can be assisted by:
  - Colour-coding and the use of landmarks to help navigation.
  - Using more than one colour in long corridors to provide variety, as well as offset or indirect lighting to provide a lighter feel to the corridor and avoid glare for patients on trolleys.
  - Avoiding spill-light at night in patient care areas, using dimming or stepswitching to reduce corridor lighting.
  - Ensuring treads and risers on stairways are easy to see.
13.3.4 Wayfinding/Spatial Orientation

The informed use of colour can help people find their way around a hospital, for example (Dalke, et al., 2004 for the NHS):

- Signs can be presented in different colours for different parts of the hospital. Signage colours should be chosen for readability. Small areas of colour (e.g., in skirtings and cornices) can highlight different areas, and large areas such as walls and floors can be in different colours to differentiate main areas of the hospital.

- Consistency is vital in the design and implementation of all elements of wayfinding.

- Large areas of strong colour should be used cautiously and colour blindness should always be taken into account when planning colour schemes.

- Different tones or shades of the same colour should be avoided in colour coding, as these can be confusing.

- Colour-coding for patients and visitors should be easy to comprehend with only a few colours. Colour-coding for the benefit of hospital staff can be slightly more complicated.

- Colour-coding should not dominate the visual environment.

- Contrast is vital for legibility in signage. Clear spaces around or near signage optimizes recognition.

In addition, Ulrich et al. (2004) found that a wayfinding system includes four main components that work at different levels: administrative and procedural levels, external building cues, internal information and overall structure. There are a number of very good studies that deal with designing better signage, optimal spacing and location of signage, types of information that are most effective in wayfinding, and so on. Similarly, other studies have looked at building layouts that facilitate or impede movement. The design of new hospitals provides an opportunity to develop effective wayfinding systems at multiple levels.

13.3.5 Reduced Wandering

Design strategies that are effective in reducing wandering and exiting behaviour among dementia patients/residents include the following:

- Two-dimensional grid patterns on the floor: In a quasi experiment with eight residents, two dimensional grid patterns eliminated most attempts to exit the building. This strategy may have been effective because persons with dementia perceive two dimensional patterns on the floor as three dimensional barriers due to problems with depth perception.

- Disguised exit panels and restricted light and views through exit-door windows: Findings from several studies support the effectiveness of disguising exit doors.

- Access to safe outdoor areas: A few studies showed that an alternative to prevent exiting is to provide access to safe outdoor spaces. This generated positive outcomes such as reduced agitation among dementia residents.
13.3.6 Nature/Positive Distraction

Twenty-three articles focused on the effects of positive distractions on patient outcomes. These are defined as “environmental-social conditions marked by a capacity to improve mood and effectively promote restoration from stress”. Positive distractions may include views of nature, bright light (natural or artificial) and the arts or entertainment. Several studies evaluated patient and staff satisfaction in hospitals that have incorporated design elements such as access to nature, artwork, music and single-patient rooms (Nelson et al., 2005 [6]):

- A growing body of research focuses on nature, music and artwork in the hospital environment. A randomized controlled trial conducted by the University of Washington compared patient satisfaction and outcomes of a Planetree Model Hospital Unit (which incorporated holistic healing, nature, and artwork) with outcomes experienced in other medical-surgical units in the hospital. Planetree patients were significantly more satisfied with their hospital stay than patients in other units; they also reported more involvement in their care while hospitalized and higher satisfaction with education they received.

- Other studies have focused on the use of music in hospital settings. Playing music during stressful times has been demonstrated to lower heart rate and anxiety and increase patient comfort.

- One RCT investigated the effect of music during a bronchoscopy on patient perception of the procedure. Patients who heard music during the procedure reported significantly greater comfort and less coughing than patients that did not have music.

13.3.7 Increased Social Interaction

Designs to increase social interaction among patients while also providing appropriate privacy and control, include (Joseph, 2006):

- There is strong evidence that placement of furniture in small flexible groupings in public spaces, such as lounges and waiting areas, can support social interaction.

- A few studies in psychiatric wards and nursing homes have found that appropriate arrangement of movable seating in dining areas enhances social interaction and improves eating behaviours (such as increasing the amount of food consumed by geriatric residents).

- A homelike environment can provide residents have the opportunity to participate in activities that are familiar from their past lives (as opposed to rigid institutional routines) and in spaces that are similar in scale and form to those found in people’s homes.

13.4 Health Care Design – Prevention of Health Care Associated Infections

13.4.1 Construction and Renovation

A number of standards and guidelines ensure safe construction and renovation of health care facilities and avoidance of construction-related health care associated infections. These include:

- Canadian Standards Association


13.4.2 Optimizing Cleaning and Maintenance

Ann Noble Architects (2003 [6]) highlight the importance of design in optimizing the level and quality of cleaning:

- The quality of cleaning and maintenance throughout the building is key to minimizing the risk of infections. Having adequate space for rooms to undergo thorough and routine cleaning is essential.

- Furniture, equipment and fittings need to be thoroughly cleaned as well as surrounding spaces.

- Designing space to avoid potential sources of infection can include:
  - Detailed designs to avoid any ducts or voids which are difficult to clean including junctions between materials or surfaces where microorganisms can be harboured, and to eliminate the need to touch surfaces where appropriate (e.g., by installing automatic doors).
  - Design the layout of rooms and departments to facilitate good practice such as clinical handwashing, disposal of waste, and to avoid inappropriate crossing between different functions (e.g., clean and dirty areas).
Maintaining standards and good practice in infection control requires adequate space to carry out infection control-related activities and all clinical and non-clinical activities without undue risk of causing or spreading infection, e.g., infection control guidance requires 3.6 m for bed spacing.

The quality of construction and materials contributes significantly to cleanability—materials and detailing should be designed for long life under an appropriate cleaning regime.

**13.4.3 Other Environmental Interventions to Control Infections**

- Airborne infections can be controlled through: providing HEPA filters in key patient-care areas; using well-maintained and operated ventilation systems; providing single-bed rooms.

- Waterborne infections can be controlled by: ensuring regular maintenance and inspection of water supply systems to minimize stagnation, back flow and temperature control; using proper water treatment; regular cleaning and maintenance of faucet aerators to prevent and control Legionella; avoiding decorative water fountains in high-risk patient-care areas; and where fountains are used, water temperature should be kept cold, and fountains regularly cleaned and maintained ((Joseph, 2006).

- Avoid carpet use where spills are likely to occur and in high-risk patient-care areas. When they are used, adopt appropriate carpet-cleaning methods including vacuum cleaners fitted with HEPA filters (Joseph, 2006).

**13.4.4 Handwashing**

- Several studies examined whether handwashing is improved by increasing the number of sinks or hand-cleanser dispensers in patient wards: there was limited evidence for the benefit of increasing the number of sinks in wards (Nelson et al., 2005 [6]).

- Locating alcohol-based handwashing preparations near patients was shown to improve the frequency with which health care workers clean their hands (Pratt, 2007 [3]).

**13.4.5 Single Patient Rooms**

- A pre-/post-study of an anesthesiology department in Israel found nearly 50% reduction (3.6% to 1.9%) in nosocomial infections coinciding with a shift from multi-bed units to single-bed units in 1995 (Nelson et al., 2005 [6]).

- The overall advantages, disadvantages and cost of single rooms need careful evaluation. Implications for infection control, capital costs, running costs, staffing, effects on occupancy rates, comparison with multi-bed rooms, should be carefully and thoroughly considered (Noble, 2003 [6]).
Phiri (2003 [6]) found a strong case for single-occupancy in-patient accommodation based on a literature review, including:

- Benefits identified were higher occupancy/lower operating costs, increased flexibility in medical care, enhanced patient privacy, enhanced individual control, control of infection or cross infection and reduced rates of infection, patients’ (and physicians’) preferences and expectations were met, etc.

- Patients spent a significant amount of time away from their rooms (66% of the sample spent 1-4 hours a day away from their beds). The importance of the corridor within the single occupancy model suggests it should be designed for orientation rather than transitional space. For example, the use of alcoves, a variety of textures and scales, appropriate day lighting, views, storage, art, etc. would overcome institutional, noisy, cluttered corridors.

A literature review by Chaudhury et al. (2003 [6]) found:

- The limited number of articles exploring the relationship between capital costs and operating costs indicates that operating costs are proportionately more than the capital cost of hospitals, even within the first three years of construction.

- Operating costs are reduced in single patient rooms compared with multi-occupancy rooms, due to reduction in transfer costs, higher bed occupancy rates and reduction in labour costs. However, this cost reduction can only be achieved when conversion to single rooms is paired with other healing environment design principles.

- Even with higher capital or unit costs of construction, furniture, maintenance, housekeeping, energy (e.g., heating and ventilation) and nursing, single occupancy can match the per diem cost of multi-bed rooms because of the higher occupancy rates. In multiple-occupancy rooms, occupancy reaches an average of 80-85%, whereas in single-occupancy rooms, occupancy is often 100%. This contributes to increased savings in operating costs.

- A patient’s length of stay is associated with hospital costs. Research demonstrates that patients’ length of stay in private rooms is less, which in turn reduces costs.

- In comparison to multi-occupancy rooms, medication errors are reduced in single-occupancy rooms, resulting in reduced costs.

- There is mixed research results on the influence of room occupancy or room-type on the use of pain medications. Some researchers discovered that patients in private rooms were more likely to use narcotics than were similar patients in semi-private rooms. This may be due to decreased environmental stimuli in private rooms. On the other hand, other research demonstrated that pain medication intake is less in single occupancy rooms.
It is claimed that health care professionals have more private and, in many cases, more thorough consultations with patients in single rooms than with patients in multi-occupancy units. Research in this area of patient confidentiality and patient consultation is limited. More research is required before providing more definitive recommendations.

Mixed results were obtained in studies and surveys of patients’ preferences for room design. A majority of patients prefer single rooms because they offer greater privacy, reduced noise, reduced embarrassment, improved quality of sleep, an opportunity for family members to stay, and less likelihood of upsetting other patients. However, some patients prefer shared rooms because they enjoy the company and sharing of experiences, as well as the potential for help from roommates, if required. Patient stress can be reduced if preoperative patients are assigned to postoperative or non-surgical roommates.

• Universal rooms or acuity adaptable rooms are a current trend in design, especially in hospitals that are promoting patient-centred care and family participation in the patient’s healing program. These rooms are single-occupancy, and their goal is to support the level of care needed by all patients. Space is also provided for family members to stay, incorporating them into patient care. Results from a limited number of studies have indicated that medication errors, patient falls and procedural problems may be reduced in acuity adaptable rooms. However, these results may be specific to the particular institutions studied. Acuity adaptable rooms are a fairly new development in the area of hospital room design and more detailed study with examples from multiple hospitals is required before drawing specific conclusions (Chaudhury et al., 2003 [6]).

13.5 Health care Design - Prevention of Violence

Several BC standards and guidelines have been developed to prevent and reduce violence in health care settings. These include:


The National Institute for Health and Clinical Excellence (NICE). (2005). Violence: the short-term management of disturbed/violent behaviour in psychiatric inpatient settings and emergency departments, explains that the physical and therapeutic environment can have a strong, mitigating effect on the short-term management of disturbed/violent behaviour. The following recommendations are the minimum requirements that should be expected within in-patient psychiatric settings:
- Safety and security: all services should provide a designated area or room that staff may consider using specifically for the purpose of reducing patient arousal and/or agitation. In services where seclusion is practiced, this area should be in addition to a seclusion room; and the internal design of the ward should be arranged to facilitate observation: sight lines should be unimpeded (for example, not obstructed by the opening of doors). Also measures should be taken to address blind spots within the facility, including consideration of the use of CCTV and parabolic mirrors.

- Activities and external areas: service users should be able to have easy access to fresh air and natural daylight.

- The environment should take into account service user needs for safety, privacy, dignity, gender- and cultural-sensitivity, sufficient physical space, social and spiritual expression.

Mayhew et al. (2001) discusses crime prevention through environmental design (CPTED), including: target hardening, improved surveillance and lighting, fittings and furniture, zero tolerance policies supported by detailed risk identification, assessment and control procedures that design out the violence risks in health workplaces as far as is possible.

Prevention for Specific Patient/Client Populations

Special patient/client populations that are at higher risk for agitated and violent reactions may benefit from Snoezelen rooms. These are multisensory environments thought to have positive effects on child and adult behaviour:

- Children and adults with disabilities, or other limiting conditions, can enjoy gentle stimulation of the primary senses. Participants experience self-control, autonomous discovery and exploration - achievements that overcome inhibitions, enhance self-esteem and reduce tension. The results often afford the participant and caregiver an opportunity to improve communications, enhance understanding of each other and build trust in their relationship (Semiahmoo House Society website).

- A study on the impact of Snoezelen rooms on dementia patients (Livingstone et al., 2005 [3]) found that the intervention ameliorated disruptive behaviour immediately after the intervention; however, the effects were apparent only for a short time after the session (based on consistent evidence from level-2 studies). Researchers noted that music therapy and Snoezelen, and possibly some types of sensory stimulation, are useful treatments for neuropsychiatric symptoms during the session but have no longer-term effects. The cost or complexity of Snoezelen for such small benefit for dementia patients may be a barrier to its use.

Other research on environmental interventions that can be effective in reducing agitated behaviours, especially among demented residents includes (Joseph, 2006):

- **Unit Size and Ambiance:** Sloane and colleagues (1998) found that higher levels of agitation among residents in dementia special-care units was associated with the following environmental features: large unit size, poor scores on a rating of homelikeness, poor scores in cleanliness of halls, poor maintenance of public areas and
bathrooms, absence of nonglare nonslip floors, odors or urine in public areas and bathrooms, and absence of a family kitchen for activities and family use.

- **Private Rooms**: There is some (limited) evidence that persons with dementia are less agitated in private rooms rather than shared rooms. When dementia residents moved from a multiple occupancy unit to a smaller unit with private rooms, residents slept better at night, there were fewer conflicts between residents, and less rummaging and loss of belongings.

- **Music (White Noise)**: Other environmental interventions that have been successful in reducing verbal agitation among dementia residents include use of music.

- **Light**: La Garce (2002) studied the impact of environmental lighting interventions (full-spectrum lighting, micro-slatted glazed windows, and electronic controls to maintain a constant level of light intensity) on agitated behaviours of Alzheimer’s patients. She found a significant drop in disruptive behaviours when residents were in the experimental setting rather than the control setting. Lovell et al. (1995) also found a reduction in agitated behaviour among institutionalized elderly subjects when exposed to bright light. Exposure to bright light was also related to decrease in depression among institutionalized older adults.

- **Access to Outdoors**: providing access to safe outdoor spaces rather than completely blocking access to the outdoors may be an efficient strategy.

### 13.6 Health Care Design – Examples of Specific Models

#### 13.6.1 Planetree Hospital Model

Planetree is a membership-based non-profit organization working with hospitals and health care centres to develop and implement patient-centred care in healing environments. It has more than 62 hospital affiliates in the US and Canada that have adopted core components of the model. The model places a focus on “putting the patient first” and strives to treat the entire human spirit, not just the disease condition (Nelson et al., 2005). It was established by a patient in 1978.

Characteristics of the Planetree model include (Scheitzer et al., 2004):

- Continuous evaluation of the hospital and hospital setting from the perspective of the patient, incorporating this perspective into both the culture of the organization and the facility over time.

- Access to information, involvement of family, and fostering positive human interactions reflect foundational principles.

- The actual design of the health care environment is one of ten core components that make up the Planetree philosophy of care, which seeks to personalize, humanize, and demystify the patient experience.

- The design deemphasizes the rigid hierarchy present in medicine among patients, families, and providers and increases patient participation and control while in the health care environment.
Decentralized nursing work station are commonly incorporated, which are small, open and located outside clusters of 4-6 patient rooms, with the main nursing station completely open to patients. The open and inclusive designs of these spaces suggest that healing is a collaborative process, and not something exclusively under the purview of professionals.

Professional staff members are both physically and emotionally closer and more accessible: they are there to collaborate with each patient and family members about the health care experience.

Solutions to hospital noises include carpeting in corridors to lessen the impact of footsteps, conversations and rolling carts; thoughtful location of storage areas, staff lounges, and utility rooms away from patient rooms; and internal corridors located between storage and utility rooms allowing clinical and support staff to conduct necessary tasks without disturbing patients. Music is used to mask distressing environmental noises that cannot be eliminated. Similarly, the use of appropriate artwork throughout the facility provides additional positive distraction and promotion of positive responses.

Examples of the impact of Planetree on hospital affiliates include:

- Following years of eroding patient satisfaction ratings and market share decreases, Griffin Hospital in Derby CT, saw a steady climb in over-all in-patient satisfaction following Planetree implementation, from 83% in 1994 to 97% in 1998, with maintenance at 97% through to 2006. In-patient volumes increased by 27.5% between 1999 and 2002, compared to a state average growth rate of 7.7%, and out-patient volume increased 76% between 1998 and 2005 (Planetree handout).

- The percentage of hip replacement patients at Stratton VA Medical Center in Albany, NY, who rated their care as excellent, rose from 61.9% to 100% following implementation of Planetree and a related redesigned “patient-centred” pathway for total hip replacement patients (Planetree handout).

- Stamford Hospital measured satisfaction during their Planetree implementation over a period of 18 months. During this interval, their employee satisfaction showed an increase from 33rd to 60th percentile, their ED patient satisfaction increased from 44th to 89th percentile, and overall in-patient satisfaction increased from 18th to 75th (based on Press Ganey scores) (Plantree handout).

13.6.2 Pebble Project®

The US Center for Health Design launched its Pebble Project to measure the effects of the built environment, and to create a ripple effect by sharing documented examples of health care facilities in which design had improved quality of care and financial performance of the health care institution. Currently, 27 providers are participating in the Pebble Project and there are two alumni. Pebble Project partners have access to information and expertise regarding current research on the built environment. Data are collected early in the planning process and after
completion of design efforts: assessment processes are used to measure the effects of the initiatives and determine interventions that enhance health (Nelson et al., 2005).

The Center for Health Design (website) notes that by providing examples of health care organizations whose facility design has made a difference in the quality of care, as well as their financial performance, the Pebble Project is already creating ripples throughout the health care community. Pebble Project partners are demonstrating that facility design can:

- Improve the quality of care for patients,
- Attract more patients,
- Recruit and retain staff,
- Increase philanthropic, community and corporate support, and
- Enhance operational efficiency and productivity.

13.6.3 Other Information Sources

Additional sources of information on design to enhance the health and safety of health care facilities include:

- Society for the Advancement of Gerontological Environments promotes networking and collaboration among individuals who are creating better environments for older adults.
- University of Wisconsin-Milwaukee, Institute on Aging & Environment promotes research, scholarship, and service concerning environments for older persons, particularly those suffering from cognitive impairments.
- The American Society for Healthcare Engineering is dedicated to optimizing the health care physical environment.
13.7 Conclusion

Improvements to the design of health care facilities, including the design of appropriate workspaces, work processes and workflow, have been shown to improve the quality of care, enhance patient outcomes, and support the health and safety of staff members.

Strategies that are particularly effective in influencing health include:

- Work spaces and layouts that increase staff time for care. For example, rather than conventional floor layouts for patient-care units, researchers propose localized charting stations with viewing windows to facilitate good visual access to patients, enabling nurses to provide assistance quickly (there is good evidence that well-designed patient-care units with single rooms and decentralized charting and observation do not require higher nurse staffing levels than conventional multi-bed units).

- Ergonomic interventions combined with careful consideration of air quality, noise and light to reduce levels of stress among staff members and improve nurse productivity.

- A reduction in noise to reduce patient stress and positively impact the rate of blood pressure, wound healing, and re-hospitalization. Noise reduction solutions include:
  - Provision of single-patient rooms.
  - Private areas in admitting and care units for private treatment and conferences.
  - High-performance sound-absorbing acoustical ceiling tiles.
  - Removal or reduction of the sources of loud noise and the use of music to mask or counteract noise that cannot be eliminated.

- Increased light levels to improve visual task performance such as medication dispensing, reduce depression among patients with seasonal affective disorder and bipolar depressions, decrease length of stay in hospitals, lower agitation among dementia patients, ease pain, and improve adjustment to night-shift work among staff.

- The use of positive distractions (e.g., views of nature, artwork, music, etc.) to increase patient satisfaction and more involvement in self-care, and playing music during stressful times to reduce heart rate and anxiety and increase patient comfort.
14.0 ENVIRONMENTAL CONSERVATION AND SUSTAINABILITY IN HEALTH CARE

Even though health care systems are dedicated to healing and the promotion of health in the community, they are at the same time, major consumers of a wide variety of both renewable and non-renewable resources, and major producers of a vast array of solid wastes, a source of pollution that contaminates air, water, soil and food chains (Hancock, 2001).

14.1 Key Environmental Impacts and Issues in Health care

The health sector is unique in that it has an explicit ethical duty to do no harm – this concept *primum non nocere*, is embodied in the Hippocratic Oath, and is a fundamental value for health care providers and thus for the health care system. There is a growing recognition that the environmental impact of healthcare must be reduced, not only because it is perceived as a “cornerstone of health in a community” (as Cambridge Memorial Hospital, the first hospital in Canada to be ISO 14001 Certified puts it), but because it will reduce exposure to liability and regulatory penalties and also reduce costs, freeing up money for patient care (Hancock, 2001).

14.1.1 Energy Consumption

- Hospitals use large amounts of energy, especially fossil fuels. Energy consumption comprises over 80% of the eco-footprint of hospitals (Germain, Capilano College, unpublished, 2002). Canadian hospitals had “an electricity consumption almost 6 times higher than Switzerland and 2.5 times higher than the average” and “thermal energy consumption approximately 4 times that of Sweden and almost twice the average of the 9 countries [studied]” (CADDDET, 1997).

- Hospitals consume a significant amount of resources. Whether these are renewable (forest products such as wood and paper, water, natural fibres and food) or non-renewable resources (plastics, metals and minerals), there are both environment impacts and related health impacts arising from their utilization. These include depletion of resources and a related impact on the health and wellbeing of populations remote from us geographically or in time (Hancock & Davies, 1997).

14.1.2 Solid Wastes

- The health care system produces a large volume of solid waste, ranging from the relatively benign (glass, cardboard, food waste, etc.) to the highly dangerous (persistent organic pollutants, heavy metals, radio-active materials, cytotoxic drugs). For example:
  
  - A US study estimated that hospitals produced 7 kg of waste per bed per day, due primarily to increased use of plastics, excessive use of disposables, inefficient waste management and lack of waste storage space. Most of this waste could go directly into landfill; however, anywhere from 75-100% is incinerated, even though only 10-15% of hospital waste is infectious and only 1-2% actually requires incineration to protect the health of the public (Health Care Without Harm, 1998).
The Ontario Ministry of the Environment noted that Ontario hospitals produce 150,000 tonnes of solid waste annually, of which 10% was handled as biomedical waste. An evaluation of biomedical waste found that 39% required no special handling as it consisted of ordinary solid waste, and only 2% was pathogenic and needed to be incinerated (Toronto Environmental Alliance, 2000).

A study of the composition of surgical waste in a tertiary teaching hospital in Michigan found that disposable linen, paper and recyclable plastic accounted for 73% by weight and 93% by volume of the total waste (Tieszen & Gruenberg, 1992).

14.1.3 Other Wastes (Liquid Wastes, Air Pollutants, Heavy Metals)

- Hospitals discharge large volumes of liquid wastes into the sewer system. Principle pollutants of concern in waste water effluents are cyanide, phenolic compounds, mercury, chromic acid, and solvents (Canadian Centre for Pollution Prevention, 1996).

- Air pollutants from hospitals are attributable to fossil fuel combustion used for heating, stream generation and hot water supply, electrical supply, transportation and other purposes. Incineration of medical wastes can contribute key toxic air emissions such as dioxins (the most potent human carcinogen), furans, and mercury (Ontario Medical Association, 2000). Indoor air pollution may also create problems such as “building-related illness” resulting from a known cause of illness such as carbon monoxide, Legionnaires disease, TB or lead poisoning, and ‘sick building syndrome” when symptoms are present but the cause is unknown (Pollution Probe, 1998).

- Hospitals are also a source of a number of potentially toxic heavy metals, including lead, cadmium and in particular, mercury, a widely known neuro-toxicant. Cleaning agents and laboratory chemicals are major sources of pollutants. Dioxins are released from incineration of hospital wastes that include PVC and other plastics. Pharmaceutical wastes may end up in the solid or liquid waste systems through secretion in urine or faeces (cytotoxic drugs are among the most toxic) (Hancock, 2001).

- A large percentage of major US hospitals have been found to use hazardous conventional pesticides to rid their facilities of pests, even though conventional pesticides may adversely affect the health of patients and staff in the hospitals (Health Care Without Harm and Beyond Pesticides, 2003).

14.2 Assessment Methods to Determine Environmental Impact

There are a number of models and frameworks that can be applied to assess the environmental impact of the Canadian health care system.

14.2.1 Ecological Footprint

The Ecological Footprint, a concept developed by Wachernagel and Rees (1996) provides an integrative method for assessing the overall impact of an activity, facility, community or nation in terms of the amount of land required to produce the resources that are consumed or to absorb...
the wastes that are produced. The methodology has been applied to a wide variety of activities and a wide range of facilities.

The first ecological footprint in Canada was conducted on the Lions Gate Hospital (LGH) in North Vancouver (Germain, Capilano College, unpublished, 2002). She found that the ecological footprint of this facility with 591 patients (280 of whom were extended care patients), was 2.841 hectares, or 4.81 hectares per patient per year. The hospital’s ecological footprint is more than 700 times its actual size. In comparison the ecological footprint of the City of Vancouver is approximately 180 times that of its “political area”.

The calculated estimates of LGH are considered to be conservative since the study did not include a number of items such as: food, building maintenance, and the environmental impact of wastes. There were some major problems in obtaining required data, in part due to the refusal of companies to provide information on composition of their products, and in part because accounting systems do not record actual resources used per year. However, some astounding numbers emerged from the study, including:

- The energy component of the hospital’s footprint was about 88%.
- Over 1.7 million pairs of gloves were used in the year studied, or 8.2 pairs per patient per day, accounting for 35 tonnes of waste.
- Plastic bags for intravenous solutions weighed over 17 tonnes, while the packaging weighed 7 tonnes.
- More than 135,000 adult disposable diapers and more than 31,000 disposable incontinence pads were used.
- Almost 220 tonnes of paper was brought into the hospital, of which 97 tonnes of paper and 67 tonnes of cardboard were recycled.

(NOTE: the average Canadian requires 7.66 hectares (or 17 acres) of biologically productive land to provide their current level of consumption. In comparison, the average American lives on a footprint of 12.22 hectares, about 60% larger, while the average Western European requires 6.28 hectares. The average Global footprint is 2.85 hectares, while it is 1.33 in Africa and 1.78 hectares in Asia and the Pacific (www.rprogress.org/programs/sustainability/ef/))

14.2.2 Economic Input-Output Life Cycle Assessment

The Economic Input-Output Life Cycle Assessment (EIOLCA) model was developed for the US economy at Carnegie Mellon University to provide a means of assessing the resource utilization and waste production of various sectors of the US economy, including health care. The impact is assessed in terms of a given level of economic activity of the sector (www.eiolca.net)

14.2.3 Mass Balance

Mass balance is a method used for tracking the flow of materials through a country, region, city or organization. The outcome provides an opportunity for a better understanding of how and where to target activities to manage material consumption and minimization. For example, the
National Health Service calculated eco-efficiency of health care in the UK based on resources consumed and resources remaining. NHS eco-efficiency was calculated at 72%: that is, for every tonne of material and product consumed, 72% is retained while 28% is wasted. This compares positively to the UK's eco-efficiency of 52% (Barrett, 2004).

14.3 Strategies to Reduce the Environmental Impact of the Health Care System

This section identifies interventions that can reduce environmental and health impacts including: reductions in energy use, reduced use of toxic materials, reduced emissions of key pollutants, reduced solid waste production, creation of healthy indoor environments, improved design for green and healthy buildings, and implementation of environmentally-responsible purchasing. Finally, it is proposed that a comprehensive, integrated environmental management approach be implemented.

14.3.1 Adoption of a Comprehensive, Integrated Strategy

The greening of health care, as with the greening of any other large enterprise, is a complicated process. Groups who are engaged extensively in this issue such as the Canadian Centre for Pollution Prevention stress the importance of adopting an environmental management strategy (EMS) which includes commitment at the highest level of an organization, coupled with the creation of an interdepartmental “green team” or environmental management team to manage the process. This team should be accountable to the executive team and include members from all relevant departments including services providers, housekeeping, physical plant operation and so on.

The adoption of an EMS and the creation of a green team is a key part of the environmental component of the accreditation standard adopted by the Canadian Council for Health Services Accreditation. It is also central to the ISO 14001, a voluntary standard put forward by the International Standards Organization and its Canadian member body, the Standards Council of Canada. ISO is intended to guide organizations towards achieving the following goals:

- Awareness of their impact on the environment,
- Acceptance of responsibility for those impacts,
- The expectation that harmful impacts will be reduced or eliminated,
- The placement of responsibility for environmental impacts upon all members of the community.

14.3.2 Reduced Energy Use

- Energy-efficient designs can include the use of natural heating and cooling, active or passive solar heating, co-generation, use of low greenhouse gas fuels or alternative energy sources. The use of advance technologies can save electricity costs for lighting, motors, and appliances: energy efficient designs can result in savings of 40-90% (Fickett et al., 1990).
Cost savings are a major consideration and catalyst for many energy efficient initiatives. The article “Greening the Bottom Line” summarizes *Greening the Building and the Bottom Line: Increasing Productivity Through Energy-efficient Design* (Romm & Browning, 1994). It includes 20 case studies that demonstrate that while energy efficient design can pay for itself in reduced energy costs alone, it can often produce even greater benefits in higher worker productivity, lower absenteeism, and fewer errors. For example:

- Pennsylvania Power and Light redesigned the lighting in a building housing its drafting engineers. In addition to the energy savings, there was a 13% increase in productivity, a 25% decline in sick days taken and a reduction in drafting errors. The return on investment was over 1,000%.

- A retrofit of the US Post Office in Reno, Nevada also addressed lighting quality and led to an increase in output at the mail sorting machines of 6% and a reduction in the error rate. The Post office calculated the productivity gains to be worth $400,000 to $500,000 a year – up to 10 times the energy/maintenance payback.

According to CADDET (1997), hospitals have a high potential for energy savings, with estimates ranging from 20% in Germany to as much as 44% in the Netherlands. Some simple measures, for which no special budget is needed, can result in around 10% of primary energy costs in a single year. More comprehensive energy savings require a dedicated budget and careful exploration of energy saving opportunities in at least eight separate areas. These include (CADDET, 1997):

- The heating system (e.g., use of thermo-static radiator values, insulation of hot water tanks and boilers).

- Combined heat and power (e.g., examine needs and most cost-effective uses).

- Building fabric and air conditioning (e.g., insulate roof, draught proof building, window shades).

- Lighting (e.g., replace incandescent tungsten lamps with compact fluorescent lamps, replace old electromagnetic ballasts with electronic, etc.).

- Mechanical ventilation (e.g., install variable speed controls on fans and large pumps, increase temperature as much as possible when cooling is required, etc.).

- Building energy management systems (e.g., explore all possibilities to make better use of systems).

- Maintenance (e.g., time schedule for inspection and maintenance, inventories of stock for critical repairs, etc.).

- Services (e.g., explore potential for heat and water savings in laundry and kitchens, etc.).

- Natural Resources Canada, through its Energy Innovators Program is working with the Canadian College of Health Service Executives to encourage energy efficiency and the reduction of greenhouse gas and other emissions.
14.3.3 Decreased Use of Toxic Materials

The use of a wide variety of toxic materials should be reduced and preferably eliminated wherever possible. For example:

- Given the availability of safer, equally effective and less expensive alternatives, the use of pesticides should be reduced, if not eliminated from healthcare facilities. The Citizens’ Environmental Coalition (2000) suggests an integrated pest management (IPM) approach be taken in hospitals, and points out a number of success stories using IPM.

- A number of disinfectants and cleaning agents, particularly, glutaraldehyde, are associated with skin allergies, contact dermatitis and asthma among staff. In response to these concerns, there is a growing interest in finding alternative, less environmentally- and health-harmful, or “green” cleaners (Tessler, 2001). For example, 5 hospitals in the UK are now glutaraldehyde-free, using alternatives such as peroxyacetic acid and other products. The Kaiser Permanente Health System in the US has developed a chemical cleaning product selection process that includes specifications that are absolutely required for companies to bid on cleaning agent contracts. These specification and criteria address individual, environmental, community and public health concerns (Taghavi, 2001). Useful resources for purchasing less toxic, “green” cleaners include the Pollution Prevention Project, and in Canada, products approved by the Canadian Environmental Choice Program.

- Of particular concern is the presence of PVC in IV bags and tubing (as DEHP can leach directly into the blood stream or other tissues) as well as in such items as urine bags, surgical sheets, oxygen tents, mattress covers, gloves, ID bracelets, and office supplies. There are moves to phase out PVC use in health care and replace it with less harmful products. Experts recommend that PVC use should be minimized and ultimately eliminated, and all unnecessary waste incineration be avoided (Health Care Without Harm, 2001).

- Hospitals should also reduce emission of toxic and hazardous materials in liquid effluents and gaseous emissions. This requires (Hancock, 2001):
  
  - Reducing the purchase and use of toxic materials, and substituting less toxic products and materials whenever possible.
  
  - Reducing emissions of dioxins by replacing PVC (see above) and other high-chlorine plastics with alternative products, and reducing the amount of solid wastes, in particular plastics and paper, going for incineration.

  - Ensuring the incinerators used for biomedical waste meet the highest possible standards for dioxin control.

  - Reduce mercury emissions by phasing out the use of mercury, and ensuring that mercury-containing products do not go to incineration and that all the mercury is recovered and appropriately recycled/disposed of.
14.3.4 Reduced Solid Waste Production

The core of solid waste reduction is to practice the “3Rs” – reduce, re-use and recycle, to which can be added “repair” (Hancock, 2001):

- The first step is to reduce the acquisition of materials in the first place, including the amount of material used (and wasted) in construction, and the amount of packaging used for materials (through agreements with suppliers).

- The second step is to re-use materials rather than discarding them after a single use. This includes:
  - Replacing single-use and disposable products with multi-use/reusable products (e.g., surgical drapes, crockery, bed linen, etc.).
  - Reusing medical equipment whenever practical and safe.

- The third step is recycling. Health care facilities should have recycling projects for paper, bottles and other glass, cans and other metals, and composting for food wastes.

14.3.5 Healthy Indoor Air Quality

A hospital must ensure that the physical environment contributes to indoor air quality. As the combination of sealed building, synthetic building materials, emissions from hospital and office equipment, and the use of multiple cleaning and disinfecting agents can all contribute to poor indoor air quality in hospitals. Hospitals need to (Hancock, 2001):

- Be at the forefront of developments in building technology that maximize natural ventilation while still conserving energy.

- Reduce indoor air pollution by using materials such as natural fabrics and ceramics rather than plastics and resins.

- Consider the use of plants and other natural methods to clean the air. An example of a creative natural form of air cleaning is the “breathing wall” which creates a natural ecosystem of plants, animals, fish and water, and then passes the building’s air through this system to remove contaminants (the Mid-Columbia Medical Centre in Oregon has a 30 foot waterfall in its atrium to which all floors open). Research on breathing walls found that they service as an alternative to current ventilations systems to remove and control contaminants such as VOCs, irritants, particulates, and odours (www.plant.uoguelph.ca/research/enweb).

14.3.6 Healthy Grounds and Gardens

Most hospitals have grounds and/or gardens for which they are responsible. The role of plants and nature in promoting healing is of growing interest. The restorative powers of nature have been known and used by health care providers for centuries. Monastic gardens, medicinal herbs and physic gardens, the rural setting of spas and sanatoria and the gardens and farms of mental asylums are all examples of this. It is only in recent years that we have forgotten and are rediscovering this important healing tradition. Growing numbers of health care facilities are
developing and using gardens (Cooper-Marcus and Barnes, 1995) while horticultural therapy, popular in the early part of this century, in enjoying a renaissance (Journal of Therapeutic Horticulture, 1996).

Guidance on the maintenance of grounds in an environmentally-responsible manner emphasizes: the use of composting and other natural approaches; the elimination of toxic materials and the use of chemical-free, organic insecticides; the elimination of wasteful packaging and recycling of materials; reduction of water consumption; planting of trees and the creation of landscapes that attract birds and beneficial insects (Canadian Pacific Hotel, n.d.).

A review by Ulrich and Parson (1992) discuss several well known studies in this area. First, matched pairs of gallbladder surgery patients who had window views of either a small stand of tress or a brick building wall were compared. “Patients with the view of trees had shorter post-operative hospital stays, required fewer potent pain drugs, and received fewer negative staff evaluations about their conditions than those with the wall view.” Similarly, a study by Moore found that among prison inmates, those who had a view of nearby farmlands and forests, were less likely to report for sick call, than those whose cells look out onto the prison yard.

The Evergreen Foundation, through its Learning Grounds program was established in 1993, to work with schools across Canada to naturalize school grounds. It identifies benefits that accrue to students, teachers and the community that range from lower exposure to toxins, creation of a sense of place, a healthier natural environment and a stronger sense of community. The same issues, approaches and benefits can also apply to hospitals (www.evergreen.ca).

14.3.7 Environmentally-Preferable Purchasing

One of the most important strategies for reducing environmental impact is to alter purchasing policies in order to purchase less environmentally harmful products. Environmentally preferable purchasing (EPP) is the act of purchasing products/services whose environmental impacts have been considered and found to be less damaging to the environment and human health when compared to competing products/services (Health Care Without Harm). Examples include (Hancock, 2001):

- The Winnipeg Health Sciences Centre was a partner in establishing the Manitoba Green Procurement Network, with support from the provincial government’s Sustainable Development Coordinating Unit. The policy developed by the Health Sciences Centre states

  Where clinical performance, safety and other factors are equal or better, HSC procurement decision-makers shall give preference for products demonstrating the highest level of environmental sustainability through: use of environmentally certified products where feasible; contribution to pollution prevention; longer service life; potential for waste minimization; contribution to HSC environmental performance targets.
In the US, several large health systems have developed green purchasing policies. At the Health Care Without Harm’s “CleanMed 2001” conference in Boston, senior executives from some of the largest health systems in the US such as Kaiser Permanente, Catholic Health East, and Catholic Health West stress above all that their systems had made a clear and strong ethical commitment to environmentally-responsible management. This commitment is incorporated in their Values and Mission Statements, in the uppermost levels of the Board and senior management team structures, and in at least one case, in the criteria used to assess compensation, incentives and bonuses for senior executives.

Some large member-driven purchasing organizations representing US hospitals are committed to increasing the stringency of their requirements for environmental responsibility in product purchasing. One of the largest, Premier, has a catalogue of PVC-free, mercury-free, and latex-free products on its website (www.premierine.com).

Purchasing decisions and planning should take into consideration a wide range of products including cleaning products, disinfectants, construction materials, and gloves that have been tested for their allergenic and irritant properties (Pechter, 2005).

14.4 Rating Systems and Standards to Reduce Environmental Impact and Increase Sustainability

14.4.1 Accreditation Standards

The Canadian Council on Health Services Accreditation has included guidelines for environmental management in its standards since 1995. In order to be accredited, organizations are required to establish an environmental management team and to manage the physical environment in a manner that ensures the safety of patient/clients and staff. The accreditation standards have an extensive section on environmental standards. The standards consist of five sections: providing a suitable environment, minimizing adverse events, respecting the environment, being a learning organization, and achieving positive outcomes.

Under the theme of providing a suitable environment (standard 1), standards address indoor air quality, the safe, efficient and effective use of equipment, supplies and medical devices, and methods of waste creation and disposal.

Standards 3 through 5 under the Environmental section, refer to minimizing potential hazards and risks, including safely operating and maintaining vehicles and the proper handling, storing and disposing of hazardous and infectious material.

The main component of the environmental standards applicable to the greening of health care are in standard 6, which states: “While providing services, the organization protects and improves the health of the environment, in partnership with the community and other organizations.” These processes and activities include:

- Reducing, reusing and recycling waste, conserving resources such as water and energy’ using products and promoting practices that are environmentally friendly;
- Testing and inspecting indoor air quality;
o Controlling emissions;
o Monitoring and disposing of hazardous gases;
o Handling, storing, using and disposing of hazardous materials and waste safely, efficiently and in accordance with the law;
o Working together with local environmental management agencies;
o Beautifying and maintaining the outdoor surrounds; and
o Advocating for healthy public policy.

14.4.2 Green Buildings BC Checklist

Green Buildings BC is a provincial initiative enabling BC’s publicly funded agencies to increase the performance of their new and existing buildings through two programs: New Buildings Program, and a Retrofit Program. Green Design encourages use of products and processes that are both cost effective and pose fewer threats to workers, consumers and the environment.

The initiative is funded by the BC Ministry of Advanced Education, Ministry of Education, Ministry of Health, Ministry of Energy Mines and Petroleum Resources, the Ministry of Environment and Shared Services BC. The Ministry of Finance has drafted a green design checklist for assessing the impact of a facility’s design, construction, operation and demolition. It is a process for ensuring that the environmental impact of a capital facility is minimized while the needs of users are met. This includes improving the facility’s economic performance both in life cycle and capital cost terms. The checklist aims to ensure facilities: are more resource efficient, require less energy to operate, make better use of materials and consume less water and at the same time: improve the comfort of building occupants, generate cost savings and, foster the growth of a strategic industry in the province.

- Website for Green buildings BC, New Buildings Program:  
- Retrofit Program:  

14.4.3 Leadership in Energy and Environmental Design (LEED®) Green Building Rating System™

The Leadership in Energy and Environmental Design (LEED®) Green Building Rating System™, developed in the US, is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings.

The Canada Green Building Council (CaGBC) supports LEED® in Canada and notes that the rating system has prerequisites and credits that are organized into five principal categories:

- Sustainable sites.
- Water efficiency.
Energy and atmosphere.
- Materials and resources.
- Indoor environmental quality.

Project ratings are certified by the CaGBC based on the total point score, following an independent review and audit of selected credits based on documentation submitted by a design and construction team. With four possible levels of certification (certified, silver, gold and platinum), LEED® is flexible enough to accommodate a wide range of green building strategies that best fit the constraints and goals of particular projects.

LEED® registered health care sites in BC (from the CAGBC website):
- Abbotsford Regional Hospital and Cancer Centre, Abbotsford
- BC Cancer Research Centre Vancouver BC (LEED Gold)
- Centre for Translational Research, Vancouver
- Child, Adolescent and Women's Mental Health Building, Vancouver
- Cottonwood Lodge - Riverview, Fraser Health's Specialized Residential Mental Health Care Facility, Coquitlam
- Czorny Alzheimer’s Centre, Surrey (LEED BC)
- Hillside Centre - Interior Adult Psychiatric Centre (LEED Gold)
- Maple Ridge Care & Office Building, Maple Ridge
- St. Paul's Hospital 9A Mental Health Unit (LEED Certified)
- Withdrawal Management Centre, Surrey
- Woodlands Assisted Living and Care Centre, New Westminster

14.4.4 Green Guide for Health Care™ Toolkit

The Green Guide for Health Care™ is an open source document that is provided at no charge for use by the health care design, construction, and facilities management communities. Houghton (2007) makes the following comments about the Guide:

- The Green Guide for Health Care™ is the health care sector’s first quantifiable toolkit for sustainable design, construction, and operations. Modeled, with permission, on the US Green Building Council’s Leadership in Energy and Environmental Design Rating System (LEED®), the Green Guide is tailored to work within the framework of specific health care regulatory requirements, such as ICRA (Infection Control Risk Assessment), that control many aspects of acute care hospitals’ physical environment and facility operations.
Two innovations encourage facilities to use the Green Guide as a continuous improvement framework that bridges the construction/operations divide:

- A prerequisite for an integrated design process.
- Cross-referencing between the Construction and Operations sections.

The Guide is not a rating system and is run as a no cost, voluntary program. The Green Guide does not provide achievement level threshold rankings such as the Certified, Silver, Gold, and Platinum levels found in LEED®.

The unique feature of the Green Guide, which is clearly geared toward the education of health care providers on the positive effects of building green facilities, is the addition of the Health Issues statement, which describes the impacts of each credit topic on human and environmental health.

Owners focusing primarily on the public relations benefits of incorporating sustainability into the design, construction, and operations of their facilities will be interested in the name brand recognition behind the LEED® Rating System. In situations where the driving force behind a health care project’s focus is primarily on sustainability, the Green Guide offers the owner both the familiar structure of LEED® and a toolkit that is customized to the challenges of health care facilities.

Owners interested in both the public relations value of LEED® and a system customized to advance sustainability in health care may be interested in using the appropriate LEED® product in conjunction with the Green Guide to customize the design process for health care. The USGBC is currently working on such a product through the development of a LEED® for Healthcare tool.

14.4.5 Other Guidelines and Information Sources

- **Canadian Centre for Pollution Prevention (C2P2)** – C2P2 is a non-profit, non-government organization supported by members and sponsors. The Board of Directors represents business, governments, trade associations and academia. It operates a website called Healthcare EnviroNet to provide the health care community with access to environmental information, products, and services that support a commitment to quality health care, protection of the environment, and sustainability. Healthcare EnviroNet delivers a unique collection of Canadian-based information including:

  - Green alternatives for health care facilities.
  - Regulatory updates and government initiatives.

Canadian case studies.

• **Canadian Coalition for Green Health Care** – The Canadian Coalition for Green Health Care is a coalition of major national health care and environmental organizations and health care facilities and institutions. The mission of the Coalition is to minimize the adverse environmental and human health impact of Canada's health care system by encouraging the adoption of resource conservation and pollution prevention principles and effective environmental management systems, without compromising patient safety and care. [http://www.greenhealthcare.ca/](http://www.greenhealthcare.ca/)

• **Environment Canada. Canadian Pollution Prevention Information Clearinghouse (CPPIC), Hospital Sector** – The CPPIC is an online database and comprehensive resource that provides Canadians with the information they need to put pollution prevention into practice. [http://www.ec.gc.ca/cppic/En/sectSearch.cfm?sectSearch=step3&category=10&sctr=316](http://www.ec.gc.ca/cppic/En/sectSearch.cfm?sectSearch=step3&category=10&sctr=316)

• **Health Care Without Harm** – Health Care Without Harm is an international coalition of hospitals and health care systems, medical professionals, community groups, health-affected constituencies, labour unions, environmental and environmental health organizations and religious groups. [http://www.noharm.org/us](http://www.noharm.org/us)

• **Hospitals for a Healthy Environment (H2E)**
  - In 1998, the American Hospital Association and the US Environmental Protection Agency signed a landmark agreement to advance pollution prevention efforts in US health care facilities. The Memorandum of Understanding is the basis of the H2E initiative and calls for: virtual elimination of mercury waste, reduction of the health care sector’s total waste volume, chemical waste minimization, and a variety of educational and information sharing activities focused on pollution prevention and toxics minimization.

  - H2E has been jointly founded by the American Hospital Association, the U.S. Environmental Protection Agency, Health Care Without Harm and the American Nurses Association. It is building a network among health professionals and educating them about pollution prevention opportunities and providing a wealth of practical tools and resources to facilitate the industry’s movement toward environmental sustainability [http://www.h2e-online.org/](http://www.h2e-online.org/)

• **International Academy for Design and Health** – The International Academy for Design and Health (Design & Health) was created by scientists at the Karolinska Institute in Stockholm in 2000 to stimulate and develop research on the interaction between design, health and culture. The Academy is multi-disciplinary and research-based. Educational and health care institutions in different countries are linked through membership in the Academy. [http://www.designandhealth.com/](http://www.designandhealth.com/)
• **NHS Environmental Assessment Tool (NEAT)** – The UK National Health Service Environmental Assessment Tool (NEAT) is a software tool designed to assess the negative impact of health care facilities on the environment. NEAT can be applied to any type of NHS health care facility and is suitable for use by NHS trusts and organizations who act on behalf of the NHS. [http://www.dh.gov.uk/assetRoot/04/11/99/63/04119963.pdf](http://www.dh.gov.uk/assetRoot/04/11/99/63/04119963.pdf)

• **Sustainable Hospitals** – Provides technical support to the health care industry for selecting products and work practices that reduce occupational and environmental hazards, maintain quality, patient care, and maintain costs. [http://sustainablehospitals.org/cgi-bin/DB_Index.cgi](http://sustainablehospitals.org/cgi-bin/DB_Index.cgi)

• Other resources include:
  - Abbotsford Regional Hospital and Cancer Centre. Resource centre. (example of a LEED® project) [http://www.abbotsfordhospitalandcancercentre.ca/files/resources.html](http://www.abbotsfordhospitalandcancercentre.ca/files/resources.html)

### 14.5 Conclusion

Strategies to reduce the environmental impact of health care require a comprehensive and integrated approach that has support and commitment from the highest level of an organization, an interdepartmental environmental management team, and an environmental plan that encompassing a wide range of interventions to address key organizational issues. Interventions should aim to:

• **Reduce Energy Consumption** – Technologically advanced energy-efficient designs and energy-saving measures such as natural heating and cooling, active or passive solar heating, and/or other alternative energy sources have reduced energy use in hospitals by 40%-90%.

• **Decrease the Use of Toxic Materials** – Reductions in the purchase, use and disposal of toxic materials can be achieved by: substituting less toxic products wherever possible; eliminating dioxin emissions by avoiding the incineration of plastics and replacing PVC and other high-chlorine plastics with alternative products; phasing out the use of mercury and ensuring it is not incinerated.

• **Enhance Indoor Air Quality** – Application of new building technologies and natural building materials can maximize natural ventilation and air quality. The use of plants, water and other elements from the natural eco-system can also provide creative ways to control air contaminants.
Healthy Grounds and Gardens – There is growing interest in the therapeutic role of green spaces and gardens on the healing process and some evidence that documents its positive impact.

Environmentally-Preferable Purchasing – Purchasing policies can establish preferences for products that are environmentally sustainable, for example, those that are certified, have longer service life, and minimize waste.

A number of rating systems and standards support reduced environmental impact by health care systems including; accreditation standards, Green Buildings BC checklist; Leadership in Energy and Environmental Design (LEED) Rating System; and Green Guide for Health Care toolkit.


Core Public Health Functions for BC: Evidence Review
Prevention of the Adverse Health Effects of the Health Care System


Canadian Council on Health Services Accreditation (CCHSA). Worklife Initiatives. (note this is no longer available on the website).


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MacCourt, P. (2004). Best practice model for the development of an aggressive behaviour prevention and management program for long term care facilities to reduce aggression by residents towards staff, and the impact on staff in long term care facilities. Victoria: Nursing Directorate, British Columbia Ministry of Health. (note this paper was supplied by OHSAH).


Article 32.03 – Safe Workplace (p. 63) and Appendix G: Addressing Workplace Violence and Respect in the Workplace (p. 170-1)

Appendix A: Intervention Program (p. 128-130)

Appendix O: Standards for Measuring Nurse Workload and Application of Nurse Staffing Plans in British Columbia (p. 175-181)


Occupational Health and Safety Agency for Healthcare in BC (OHSAH). Homecare and MSI Literature Review. (note this is no longer available on the website as of January 1, 2008).

Occupational Health and Safety Agency for Healthcare in BC (OHSAH). Stress and Burnout. (note this is no longer available on the website as of January 1, 2008).


Ontario Hospitals Association (OHA). Ontario Medication Safety Support Service. (note this is no longer available on the website as of January 1, 2008).


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APPENDIX 1: LIST OF REPORTABLE INCIDENTS – ADULT CARE REGULATIONS AND CHILD CARE LICENSING REGULATION

Section 10.6 (2) of the Adult Care Regulations and section 23 of the Child Care Licensing Regulation require that the licensee notify the care giver and the Medical Health Officer of illness or injury as specified in schedule F (reportable incidents), as follows:

- "aggressive or unusual behaviour" means aggressive or unusual behaviour by a person in care towards other persons, including another person in care, which has not been appropriately assessed in the individual's care plan;
- "attempted suicide" means an attempt by a person in care to take his or her own life;
- "death" means any death of a person in care;
- "disease outbreak or occurrence" means an outbreak or the occurrence of a disease above the incident level that is normally expected;
- "emergency restraint" means any use of a restraint that is not approved and documented in the care plan of a person in care;
- "emotional abuse" means any act, or lack of action, which may diminish the sense of well-being of a person in care, perpetrated by a person not in care, such as verbal harassment, yelling or confinement;
- "fall" means a fall of such seriousness, experienced by a person in care, as to require emergency care by a physician or transfer to a hospital;
- "financial abuse" means
  - the misuse of the funds and assets of a person in care by a person not in care, or
  - the obtaining of the property and funds of a person in care by a person not in care without the knowledge and full consent of the person in care or their substitute decision maker;
- "medication error" means an error in the administration of a medication which adversely affects a person in care or requires emergency intervention or transfer to a hospital;
- "missing or wandering person" means a person in care who is missing;
- "motor vehicle injury" means an injury to a person in care that occurs during transit by motor vehicle while the person is under the care and supervision of the licensee;
- "neglect" means the failure of a care provider to meet the needs of a person in care, including food, shelter, care or supervision;
- "other injury" means an injury to a person in care requiring emergency care by a physician or transfer to a hospital;
"physical abuse" means any physical force that is excessive for, or is inappropriate to, a situation involving a person in care and perpetrated by a person not in care;

"poisoning" means the ingestion of a poison or toxic substance by a person in care;

"service delivery problem" means any condition or event which could reasonably be expected to impair the ability of the licensee, or the employees of the licensee, to provide care or which affects the health, safety or well-being of persons in care;

"sexual abuse" means any sexual behaviour directed towards a person in care by an employee of the licensee, a volunteer or any other person in a position of trust, power or authority and includes:

any sexual exploitation, whether consensual or not, and

sexual activity between persons in care if the difference in age or power between them is so significant that the older or more powerful person in care is clearly taking sexual advantage of the younger or less powerful person in care;

“unexpected illness” means any unexpected illness of such seriousness that it requires a person in care to receive emergency care by a physician or transfer to a hospital.
**APPENDIX 2: DEFINITION OF TERMS ADOPTED BY CIHI FOR MEDICATION INCIDENT REPORTING AND PREVENTION SYSTEMS**

**Drug**
Aspden (2007): According to the FDA a drug is defined as a substance that is recognized by an official pharmacopeia or formulary; intended for use in the diagnosis, cure, mitigation, treatment or prevention of disease; intended to affect the structure or any function of the body (excluding food); and intended for use as a component of a medicine, but not a device or a component, part, or accessory of a device.

*Adverse drug event (ADE)*
An injury resulting from a medical intervention related to a drug (CIHI, 2005). This is also an iatrogenic harm related to medication including harm due to both adverse drug reactions and medication errors (Franklin, p 892). ADE, defined as any injury due to medication are common in hospitals and nursing homes. ADEs that are associated with a medication error are considered preventable (Aspden 2007).

*Adverse drug reaction*
A noxious and unintended response to a drug, which occurs at doses normally used or tested for the diagnosis, treatment or prevention of a disease or the modification of an organic function (CIHI, 2005). This is also what the CIHI 2004 Health Report calls a side effect.

The UK’s Chief Pharmaceutical Officer further describes these reactions: those which can be predicted from knowledge of a drug’s effects on the body (Type A), and adverse drug reactions which are unpredictable, unusual reactions that occur in particular individuals (Type B). Type B reactions are less common but can be more serious than type A reactions (p. 20).

*Adverse event*
An unexpected and undesired incident directly associated with the care or services provided to the patient (CIHI, 2005).

**Medication incident**
Any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Medication incidents may be related to professional practice, drug products, procedures, and systems, and may include prescribing, order communication, product labelling/packaging/nomenclature, compounding, dispensing, distribution, administration, education, monitoring and use (CIHI, 2005).

Medication incidents are also called preventable ADEs (pADEs). Preventable ADEs typically result from inappropriate care or medication errors, which include errors of commission and errors of omission. Errors of commission are defined as errors directly caused by the use of one or more drugs that could cause a toxic reaction (e.g., use of contraindicated drugs or overdoses). Errors of omission denote an indirect association between drug therapy and adverse outcomes (e.g., lack of necessary drugs or underdosages resulting in therapeutic failure). In other words, the
two types of errors differ in terms of their relationship to adverse outcomes: direct causation and drug toxicity issues are attributed to errors of commission, whereas indirect causation, lack of access, and therapeutic failure are related to errors of omission (Kanjanarat, 2003).

While a pADE always indicates patient harm (i.e., a clinically manifest adverse outcome), a medication error denotes only the process of care, which may or may not result in an adverse outcome (Kanjanarat, 2003).

*Medication error*
Any error in prescribing, dispensing or administration of medication (CIHI, 2005). A medication error may or may not result in patient harm, but is considered to be preventable. Some countries also identify an a transcribing stage, for example, handwritten medication orders which have to be entered into a computer system by pharmacy staff prior to administration, can give rise to transcribing errors (Franklin p. 892). For example, patients can receive the wrong drug or an incorrect dose; they can take the right drug improperly; or interactions between two or more drugs could cause adverse effects. This follows Reason’s model shown above. (CIHI, 2004). The events related to prescribing, dispensing, transcribing or administration are called medication errors in the literature as will be shown below.

*Near-miss*
An occurrence with potentially important safety-related effects which, in the end, was prevented from developing into actual consequences (CIHI, 2005).

*No-harm event*
An error which reaches the patient, but by chance there is no injury to the patient (CIHI, 2005).

*Sentinel event*
An unexpected occurrence involving death, serious physical or psychological injury, or risk thereof. Serious injury specifically includes loss of limb or function. The phrase “or the risk thereof” includes any process variation for which a recurrence would carry a significant chance of a serious adverse outcome (CIHI, 2005).
APPENDIX 3: EVIDENCE QUALITY ON ADVERSE HEALTH EFFECTS

Evidence Quality on Health Care Associated Infections

Of the eleven studies in this section, one is CEBM-6, qualitative research; two are CEBM-5 studies, expert opinion without explicit critical appraisal; two, CEBM-3, systematic reviews; four, CEBM-2, audit, and one, CEBM-1, a prospective cohort with good follow-up.

The prospective cohort with good follow-up is:


The audits are:


The systematic reviews are:


The qualitative study is:


The level of evidence is strong with a prospective cohort study, audits and systematic reviews. The level of evidence will be in square brackets after each reference in the evidence-based literature review.
Three studies are from BC; two, from Canada; four from the UK, one, the US and one from Switzerland. Eight studies are the acute care sector and one, acute/residential care: CDC (2006). *Management of Multidrug-Resistant Organisms In Healthcare Settings.*

**Evidence Quality on Handwashing**

Of the eight studies in this section, two are CEBM-5 studies, expert opinion without explicit critical appraisal and five, CEBM-3, systematic reviews.

The systematic reviews are:


The level of evidence is strong with five systematic reviews. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

One study is from Canada; one, WHO; two, US; one, Scotland; and three, UK.

**Evidence Quality on Residential Care and Home Care:**

Of the seven studies in this section, one was CEBM-6, qualitative research; three were CEBM-5 studies, expert opinion without explicit critical appraisal and three, CEBM-3, systematic reviews.

The systematic reviews were:

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The qualitative study was:


The level of evidence was moderate with 3/7 studies being systematic reviews.

There were two studies from Canada, three from the UK, and one each from Scotland and from the US. There were four studies on residential care and three, home care.

**Evidence Quality on Medication Errors**

Of the fifty studies in this section, one was CEBM-6, qualitative research; thirty-six were CEBM-5 studies, expert opinion without explicit critical appraisal; one, CEBM-4, cross-sectional study; six, CEBM-3, systematic reviews; 5 CEBM-2, audit, and one, CEBM-1, a randomised control trial (RCT) with >80% participation.

The RCT was:


The audits were:


The systematic reviews were:


The cross-sectional study was:


The qualitative study was:


There were 25 studies from the United States, 12 the UK, 5 from Canada, 3 Saskatchewan, 2 from Australia and 1 each from Denmark, Netherlands and Switzerland.

Most of the studies in this section concerned the acute care sector, but there were six for residential care, two for mental health and one for home care.

The level of evidence was strongest in the drug distribution chain and mental health because of the number of audits and systematic reviews. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

**Evidence Quality on the Prevention of Falls**

Of the eight studies in this section, four are CEBM-5 studies, expert opinion without explicit critical appraisal; three, CEBM-3, systematic reviews; and one, CEBM-2.

The audit is:


The systematic reviews are:

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The expert opinion without explicit critical appraisal studies are:


- Todd (2004). *What are the main risk factors for falls among older people and what are the most effective interventions to prevent these falls?*

The level of evidence will be in square brackets after each reference in the evidence-based literature review. Jurisdictions: One study is from British Columbia, one, Australia, one, the WHO, two, the UK and two, the US.

Evidence Quality on Prevention of Falls in Hospitals
Of the three studies in this section, two were CEBM-5 studies, expert opinion without explicit critical appraisal; one, CEBM-3, systematic review.

The systematic review is:


The expert opinion without explicit critical appraisal studies are:


The level of evidence is weak, however, the previous section also covers similar issues in the evidence-based review. The level of evidence will be in square brackets after each reference in the evidence-based literature review. BC and/or Canada mentioned first in a given section with other jurisdictions to follow.

Jurisdictions: There was one study from Canada, one from Australia and one from the UK.
Evidence Quality on Prevention of Falls in Residential Care Facilities
The one study is a CEBM-3, a systematic review.


The level of evidence is weak with one study, however, residential care is also covered by studies in the beginning section. The evidence quality for those studies is presented at the beginning of the section. The level of evidence is in square brackets after each reference in the evidence-based literature review. BC and/or Canada mentioned first in a given section with other jurisdictions to follow.

Jurisdictions: The one study is from British Columbia.

Evidence Quality on Prevention of Pressure Ulcers
Of the fifteen studies in this section, seven were CEBM-5 studies, expert opinion without explicit critical appraisal; five, CEBM-3, systematic reviews of level 3 or better; and two CEBM-2, audit. The proportion of CEBM-2 and -3 studies in this section suggests a stronger evidence base for the literature review.

The systematic reviews were:


The two audits were:


The level of evidence will be in square brackets after each reference in the evidence-based literature review.
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Note: no British Columbia reports were readily available; therefore, the vulnerabilities and prevention methods are entirely from other jurisdictions. The fact that there is agreement on many of the vulnerabilities and prevention methods across jurisdictions suggests that similar findings likely exist in this province.

Evidence Quality on Workplace Adverse Effects
Of the seven studies in this section, one was CEBM-6, qualitative research; three were CEBM-5 studies, expert opinion without explicit critical appraisal; one, CEBM-3, systematic review of level 3 or better evidence; and, two, CEBM-2, audit. The Appendix has a complete list of articles with jurisdiction and evidence weighting.

The level of evidence will be in square brackets after each reference in the evidence-based literature review.

The qualitative research was:
  • Kerr (2002). Monitoring the Health of Nurses in Canada.

The expert opinion studies were:

The systematic review was:

The audits were:
  • Office of the Auditor General (2004). In Sickness and in Health.

The jurisdictions were British Columbia for the two audits, Ontario, for the systematic review and the UK, Ontario and British Columbia for the remainder.
Evidence Quality on Healthy Health Care Workplaces

Of the fifteen studies in this section, four were CEBM-6, qualitative studies, seven were CEBM-5 studies, expert opinion without explicit critical appraisal; three, CEBM-3, systematic reviews of level 3 or better; and one, CEBM-2, audit. The Appendix has a complete list of articles with jurisdiction and evidence weighting.

The level of evidence will be in square brackets after each reference in the evidence-based literature review.

The qualitative research was:


The expert opinion studies were: Given the number of studies, these can be found in the appendix.

The systematic reviews were:


The audit was:


Seven of the studies were from the US and the remainder from Canada. The audit was from British Columbia.
Evidence Quality on the Prevention of Musculoskeletal Injuries
Of the thirty-six studies in this section, three were CEBM-6, qualitative research; twenty-two were CEBM-5, expert opinion without explicit critical appraisal; none, CEBM-4; four, CEBM-3, case-control (2), cohort (1); four, CEBM-2, systematic review level 2(2) and outcomes research (2); and one, CEBM-1, a prospective cohort study.

The prospective cohorts were:

The systematic reviews were:

The outcomes research was:

The case control studies were:

The cohort study was:
The qualitative studies were:

- WorkCover NSW (2001). “Utilisation of the ‘Manual Handling Competencies For Nurses’ by Health & Community Services Organizations and Education Establishments in NSW.”

There was a wide range of jurisdictions represented with British Columbia (12), Australia (8), US (6), New Zealand (4), Ontario (4) and UK (3).

No sectors were clearly given in 16 studies, residential care, 9; home care, 6. The mental health sector was not specifically mentioned in any study.

The level of evidence was balanced in most sections.

The level of evidence will be in square brackets after each reference in the evidence-based literature review.

**Evidence Quality on Occupational Exposure to Infectious Agents**

Of the three studies in this section, one was CEBM-5, expert opinion without explicit critical appraisal and two were CEBM-3, systematic reviews.

The systematic reviews were:


The expert opinion without critical appraisal was:


The level of evidence was strong with 2 systematic reviews. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

**Jurisdictions:** Two of the studies were from Canada and one from the US.

**Sectors:** One study was for the acute sector specifically.
Evidence Quality on Sharps Injuries
Of the eight studies in this section, four were CEBM-6, qualitative research; two were CEBM-5 studies, expert opinion without explicit critical appraisal; one, CEBM-3, systematic review; and, one, CEBM-2, audit.

The audit was:

The systematic review was:

The qualitative studies were:

The level of evidence was strong with one audit and one systematic review. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

Jurisdictions: There was one study from the WHO, two from the UK and five from the US.

Sectors: Four studies were from the acute sector.

Evidence Quality on Reducing Infection Risk in the Operating Room
Of the two studies in this section, one was CEBM-5 studies, expert opinion without explicit critical appraisal one, CEBM-1, a systematic review (“SR”) of randomized controlled trials.

The systematic review of randomized controlled trials was:
The expert opinion without explicit critical appraisal was:


The level of evidence was strongest for double gloving. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

Jurisdictions: One study was from the UK, one from the US.

Sectors: Both studies were the acute sector.

**Evidence Quality on Aerosol Exposure to infectious Agents**

Of the three studies in this section, two were CEBM-6, qualitative research and one was CEBM-5 studies, expert opinion without explicit critical appraisal.

The expert opinion without explicit critical appraisal was:


The level of evidence was moderate with three studies. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

Jurisdictions: All three studies were BC-based.

Sectors: All three studies were for the acute sector.
Evidence Quality on Prevention of Occupational Infectious Diseases in Home Care
Of the three studies in this section, all were CEBM-5 studies, expert opinion without explicit critical appraisal.

Jurisdictions: There was one study each from BC, Australia and New Zealand.

Sectors: Three studies were specifically for home and community care.

The level of evidence was modest with only expert opinion. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

Evidence Quality on Health Care Workplace Chemical Hazards
Of the four studies in this section all four were CEBM-5 studies, expert opinion without explicit critical appraisal. These studies were:


The level of evidence was adequate. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

Jurisdictions: There was one study from Canada (Verma); the rest were from the US.

Sectors: While the sector was not specifically mentioned, the articles seemed to focus on hospital/acute care settings.

Evidence Quality on Occupational Exposure to Disinfection and Sterilization Agents
All eight studies in this section were CEBM-5 studies, expert opinion without explicit critical appraisal. The studies were:


The level of evidence was adequate. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

BC Canada mentioned first in a given section with other jurisdictions to follow.

Jurisdictions: There was one study from BC (Rideout), one from Canada (PHAC), and the rest were from the US.

Sectors: While the sector was not specifically mentioned, the articles seemed to focus on hospital/acute care settings.

**Evidence Quality on Occupational Exposure to Hazardous Drugs**

Of the four studies in this section, all were CEBM-5 studies, expert opinion without explicit critical appraisal. The studies were:


The level of evidence was adequate. The level of evidence will be in square brackets after each reference in the evidence-based literature review.
Jurisdictions: All four of the studies were from the US.

Sectors: Although not specifically mentioned, the acute care sector was assumed given that hazardous drugs are most often given in institutional settings.

**Evidence Quality on Occupational Exposure to Radiation**

Of the two studies in this section, one was CEBM-6, qualitative research; and one, CEBM-2, audit.

The audit was:

The qualitative study was:

The level of evidence was reasonable with one audit. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

Jurisdictions: Both studies were from the UK.

Sectors: These studies are from the acute sector.

**Evidence Quality on Violence in the Workplace**

Of the fourteen studies for violence and bullying, thirteen were CEBM-5 studies, expert opinion without explicit critical appraisal and, 1; CEBM-4, poor quality cohort study.

The level of evidence will be in square brackets after each reference in the evidence-based literature review.

The expert opinion studies were: Given the number of studies, these can be found in the appendix.

The poor quality cohort study was:

There was one study from BC; six from Australia, one, the UK; and six from the ILO and WHO.
Evidence Quality of Violence in Health Care Sectors

Of the seventeen studies in this section, two were CEBM-6, qualitative studies; eleven, CEBM-5 studies, expert opinion without explicit critical appraisal; one, CEBM-4, outcome research; one, CEBM-3, systematic reviews of level 3 or better; and two CEBM-2, audit. The Appendix has a complete list of articles with jurisdiction and evidence weighting.

The level of evidence will be in square brackets after each reference in the evidence-based literature review.

The qualitative studies were:
- Yassi (2002). Caring for the Caregivers of “Alternate Level Care” (ALC) Patients.

The expert opinion studies were:
- Given the number of studies, these can be found in the appendix.

The outcome research study was:

The systematic review was:

The audit was:

There were seven studies from BC; four from the UK; three from Australia, and one each from Ontario, Canada, and New Zealand.

There were four studies for acute care; two, residential care; six; home care and seven, mental health, although there were some overlaps among the studies.

Evidence Quality on Occupational Mental Health

Of the five studies in this section, four were CEBM-6, qualitative research; and one, CEBM-3, cohort with limited population.

The cohort with limited population was:
The qualitative studies were:

- Bilsker (nd). Depression & Work Function.

There were too few studies to assess the quality of evidence accurately. Four of the studies were qualitative studies based on surveys: this is important information for capturing the attitudes, thoughts or beliefs of individuals. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

Jurisdictions: There were four studies from British Columbia, and one from the UK. There is good internal validity and poor external validity.

Sectors: One study was the acute sector. (Alden (2005). Posttraumatic Stress Disorder in hospital emergency room personnel.(website document)

Evidence Quality on Stress and Burnout
Of the ten studies in this section, two were CEBM-6, qualitative research; four were CEBM-5 studies, expert opinion without explicit critical appraisal; and three were CEBM-3, systematic review.

The systematic reviews were:


The qualitative studies were:

- Yassi (2002). Caring for the Caregivers of “Alternate Level Care.”
The level of evidence was not strong in this section with only two systematic reviews. The level of evidence will be in square brackets after each reference in the evidence-based literature review.

Jurisdictions: There were three studies from British Columbia, one from Ontario, three from the US and one each from the UK, WHO and Australia. There is thus good external validity.

Sectors: There was one study for the acute sector (Yassi (2002) Caring for the Caregivers of “Alternate Level Care”) and one for the home care sector (Zeytinoglu (2005) Satisfied Workers, Retained Workers). These studies are included with the others rather than having a separate health care sector section. The Caring for the Caregivers of “Alternate Level Care” (ALC) Patients study by Yassi and others has been discussed in the context of violence. Here the study discusses ALC impacts on staff.

Evidence Quality on Staffing Levels
Of the fourteen studies in this section, two were CEBM-6, qualitative research; seven were CEBM-5 studies, expert opinion without explicit critical appraisal; four, CEBM-3, systematic reviews; and one CEBM-2, audit.

The audit was:


The systematic reviews were:


The qualitative studies were:


The level of evidence is strong in this section with one audit and four systematic reviews.
Jurisdictions: One study was from British Columbia, seven from Ontario, five from the US and one from the UK. There is thus good external validity.

Sectors: Eleven studies did not mention a sector, four were the acute sector and two, the residential care sector.

**Evidence Quality on Safe Staffing (Fatigue and Shiftwork)**
Of the six studies in this section, three were CEBM-6, qualitative research; one was CEBM-5 studies, expert opinion without explicit critical appraisal; and two, CEBM-3, systematic reviews.

The systematic reviews were:

The expert opinion without explicit critical appraisal was:

The qualitative studies were:

**Evidence Quality on Health Care Facilities Design**
Of the thirty-nine studies in this section, five were CEBM-6, qualitative research; twenty-seven were CEBM-5 studies, expert opinion without explicit critical appraisal; three, CEBM-3, systematic reviews; and four, CEBM-2, audit.

The audits were:


The systematic reviews were:


The qualitative studies were:


There were six studies from BC, two each from Canada and Australia, one from New Zealand, twelve, the UK and sixteen from the US.
Although it was not clearly stated, the acute care sector was the basis for most of the studies, one specifically dealt with the long term care sector. The authors of the omnibus studies often covered many different topics of design as part of their review. These studies are listed separately in alphabetical order at the end of the appendix.

**Omnibus Studies**

These studies include more than one primary prevention method or facility design issue. They are listed in alphabetical order and chronology.


- Patient Safety Research Program. (nd). PS 041: The cost-effectiveness of hospital design: options to improve patient safety and well-being (Dr Peter West, University of York, April 2008).


