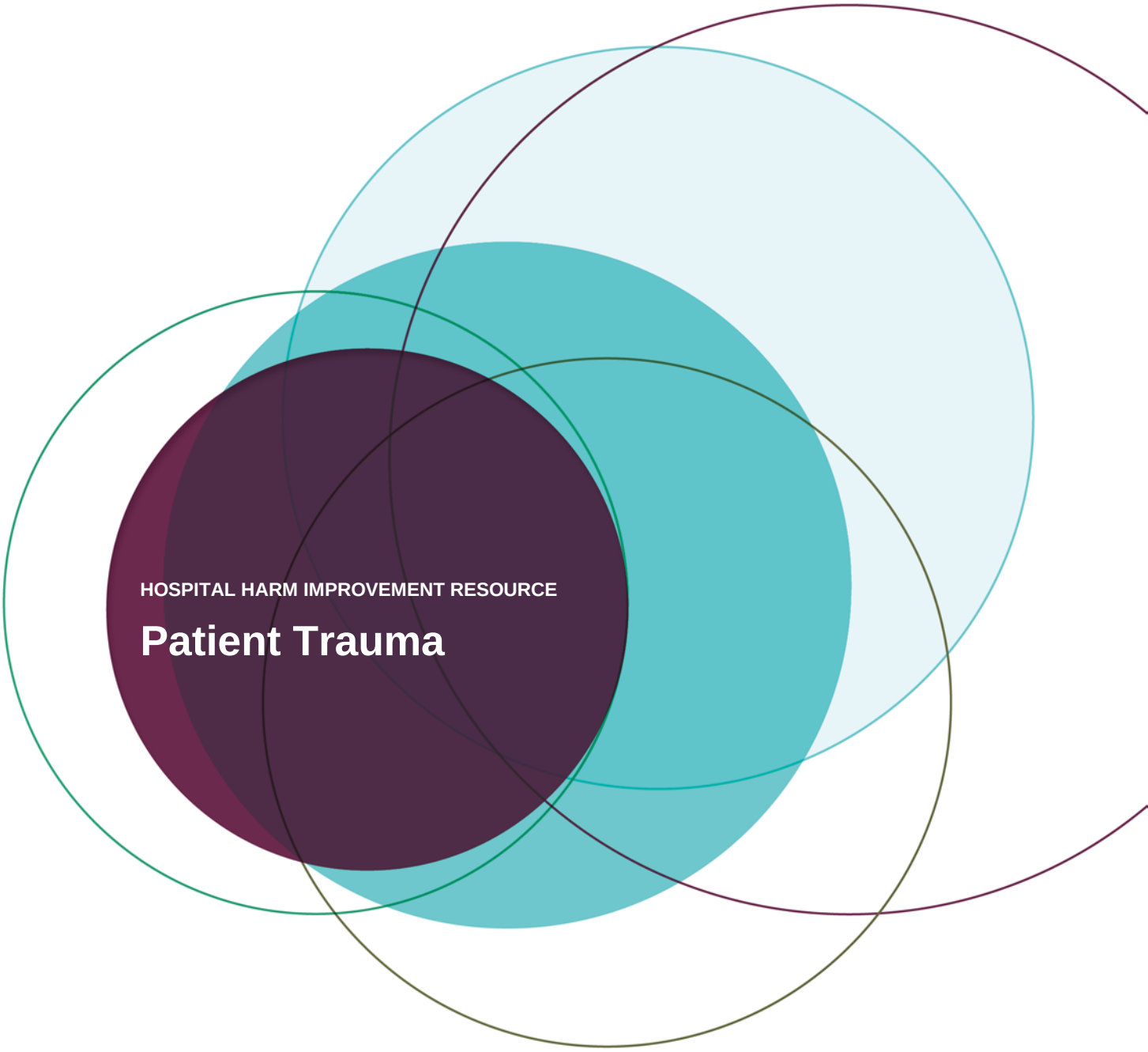

HOSPITAL HARM IMPROVEMENT RESOURCE

Patient Trauma

cpsi icsp
Canadian Patient Safety Institute
Institut canadien pour la sécurité des patients

ACKNOWLEDGEMENTS

The Canadian Institute for Health Information and the Canadian Patient Safety Institute have collaborated on a body of work to address gaps in measuring harm and to support patient safety improvement efforts in Canadian hospitals.

The Hospital Harm Improvement Resource was developed by the Canadian Patient Safety Institute to complement the Hospital Harm measure developed by the Canadian Institute for Health Information. It links measurement and improvement by providing evidence-informed resources that will support patient safety improvement efforts.

The Canadian Patient Safety Institute acknowledges and appreciates the key contributions of the Registered Nurses' Association of Ontario for the review and approval of this Improvement Resource.

DISCHARGE ABSTRACT DATABASE (DAD) CODES INCLUDED IN THIS CLINICAL CATEGORY:

C19: Patient Trauma		
Concept	In-hospital injuries, such as fractures, dislocations, burns, etc., not related to medical or surgical procedures.	
Notes	This group does not include injuries associated with a surgical or medical procedure (refer to D19: Patient Trauma).	
Selection criteria	M96.6 S00–T32 T71	Identified as diagnosis type (2) **not in a diagnosis cluster AND** U98.20*

D19: Patient Trauma		
Concept	Injuries, fractures, dislocations, burns, etc., associated with a medical or surgical procedure identified during the hospital stay.	
Notes	1. Refer to C19: Patient Trauma for injuries, fractures, dislocations, burns, etc., that are not related to medical or surgical procedures. 2. This clinical group excludes trauma associated with device failure, laceration or puncture, pneumothorax and retained foreign body (refer to D20: Device Failure, D21: Laceration/Puncture, D22: Pneumothorax and D24: Retained Foreign Body).	
Selection criteria	S00–T19 T71	Identified as diagnosis type (2) **AND** Y60–Y84 **in the same diagnosis cluster** **OR** Identified as diagnosis type (3) **AND** T80–T88 as diagnosis type (2) **AND** Y60–Y84 **in the same diagnosis cluster**
	M96.6 T20–T32	Identified as diagnosis type (2) **AND** Y60–Y84 **in the same diagnosis cluster**
Exclusions	Events selected from a diagnosis cluster that is also selected for D20: Device Failure, D21: Laceration/Puncture, D22: Pneumothorax, D23: Wound Disruption or D24: Retained Foreign Body	

Codes	Code descriptions
M96.6	Fracture of bone following insertion of orthopedic implant, joint prosthesis, or bone plate
S00–S09	Injuries to the head
S10–S19	Injuries to the neck
S20–S29	Injuries to the thorax

Codes	Code descriptions
S30–S39	Injuries to the abdomen, lower back, lumbar spine and pelvis
S40–S49	Injuries to the shoulder and upper arm
S50–S59	Injuries to the elbow and forearm
S60–S69	Injuries to the wrist and hand
S70–S79	Injuries to the hip and thigh
S80–S89	Injuries to the knee and lower leg
S90–S99	Injuries to the ankle and foot
T00–T07	Injuries involving multiple body regions
T08–T14	Injuries to unspecified parts of trunk, limb or body region
T15–T19	Effects of foreign body entering through natural orifice
T20–T32	Burns and corrosions
T71	Asphyxiation
Y98.20	Place of occurrence, hospital
Additional Codes	
Inclusions	
T80–T88	Complications of surgical and medical care, not elsewhere classified (refer to Appendix 6)
Y60–Y84	Complications of medical and surgical care (refer to Appendix 6)

*Applicable to DAD abstracts from fiscal year 2015-2016 onward.

For the descriptions of external cause codes of complications of medical or surgical care (Y60–Y84), please refer to the technical notes: Hospital Harm Indicator: Appendices to Indicator Library.

Overview and Implications

Evidence from the Canadian Adverse Event Study, indicates that adverse events classified as 'Other', including burns and falls was the sixth leading cause of an adverse event in Canada (Baker, Norton, et al, 2004).

Falls

A fall is defined as: *an event that results in a person coming to rest inadvertently on the ground or floor or other lower level, with or without injury*. This would include an unwitnessed fall where the client is able/unable to explain the events but there is evidence to support that a fall has occurred.

A fall injury is defined as an injury that results from a fall, which may or may not require treatment. The injury can be temporary or permanent and vary in the severity of harm (*Safer Healthcare Now!* Falls Getting Started Kit, 2013).

Falls occur due to a loss of balance or an inability to recover balance. A range of risk factors (>400) have been identified as influencing whether individuals are likely to fall. The BBSE MODEL of fall-related risk factors identifies biological (intrinsic), behavioural, social and economic and environmental (extrinsic) risk factors (for examples see *Safer Healthcare Now!* 2013, page 30). The more risk factors an individual has, the greater the risk of falling (*Safer Healthcare Now!* 2013; RNAO, 2012).

Falls may cause considerable physical harm, including fractures, soft tissue injuries, haematomas, lacerations and pressure sores due to subsequent immobility; as well as psychological distress such as fear of falling and humiliation and potentially resulting in chronic pain, loss of independence, reduced quality of life, and even death (Johal, 2009; Public Health Agency of Canada, 2014; Accreditation Canada, CIHI, CPSI, 2014). Clinical practice guidelines and systematic reviews highlight the importance of identifying a person's individual risk factors and providing multifactoral interventions to address those risk factors (AGS/BGS, 2012; Cameron et al, 2012; National Institute for Health and Care Excellence, 2013; Public Health Agency of Canada, 2014; Registered Nurses' Association of Ontario, 2012; *Safer Healthcare Now!* 2013; Royal College of Physicians, 2015).

Studies of hospital falls revealed that (Chari et al., 2013; Pulcins & Wan, 2004; Johal 2009; Maki et al., 2011; Deandrea et al., 2013):

- Females were almost twice as likely to sustain fractures upon falling.
- Walking increases the likelihood of a fall-related fracture as compared with falls from a static position.
- Falls that were reported as having occurred during nursing shift change were associated with increased risk of fracture.
- Patients not screened for falls risk on admission have a higher likelihood of falling.
- Advancing age is a major contributing factor to falls.

- Impaired control of gait and balance is widely recognized to be a major contributing factor.
- History of falls, use of walking aids and disability are strong predictors of future falls.

Studies in acute care settings show that fall rates range from 1.3 to 8.9 falls per 1,000 patient days, with higher rates in units that focus on geriatric care, neurology, and rehabilitation (Oliver, 2010). Most hip fractures occur in the community, but nearly one in 1,000 seniors admitted to hospital fracture a hip during their stay (Pulcins & Wan, 2004). The repercussions both, medically, and financially, following a fall in hospital are immense. Patients suffering hip fractures after falls in hospital are frailer with impaired cognitive function and more co-morbidities than those suffering a fracture in the community. These patients have increased mortality, nearing 50 per cent within one year of the fall (Johal, 2009).

Burns/Scald

Burns to skin (or other organs) is a function of both temperature and duration. Even moderate heat applied for a long duration is capable of producing burns. There are three key conditions that predispose patients to burns including insensitivity to pain/temperature, unresponsiveness, or inability to communicate. In addition, impaired ability for the vasculature to help dissipate heat from the skin may predispose a patient to a burn (Patient Safety Solutions, 2010).

A search of patient safety reporting/alert systems revealed that the potential causes of accidental burns include:

- A hot towel prepared in a plastic bag coming in contact with patient's body during bed-bath (Japan Council for Quality Health Care, 2010).
- Use of a hot water bottle (Japan Council for Quality Health Care, 2010).
- Fire and the use of Alcohol-based hand cleansers (New South Wales Department of Health, 2007).
- Water temperature too hot during bathing (Japan Council for Quality Health Care, 2007).
- Vaseline and treatment with oxygen (European Union Network for Patient Safety, 2011).
- Heat therapy such as heating pads or hot packs (Data snapshot, 2009).
- Food preparation and hot liquid spills (Data snapshot, 2009).
- Burns Caused by the Tip of a Light Source Cable during Surgery (Japan Council for Quality Health Care, 2012).
- Risk of skin-prep related fire in operating theatres (National Health Service Commissioning Board, 2012).

Fires on the operating field are rare events that should never happen, but do. They are dangerous not only to the patient but to the operating room (OR) team members as well (Clarke & Bruley, 2012).

Surgical fires that ignite in or around a patient during surgery are a real danger, and are especially devastating if open oxygen sources are present during surgery of the head, face, neck, and upper chest (ECRI, 2016).

In the fire triangle – heat, fuel and oxygen – each element must be present for a fire to start.

Hospital emergency rooms and operating rooms contain the three primary elements needed to ignite a fire:

- An oxidizer (anesthesia products such as oxygen and nitrous oxide).
- Fuel (surgical drapes, alcohol swabs, etc.).
- An ignition source (lasers, electrosurgical devices such as a cautery knife, etc.).

A host of flammable materials are found in the surgical suite, from the wide range of alcohol-based prepping agents and linens such as drapes, towels, gowns, hoods and masks; to the multiple types of dressings, ointments and equipment and supplies used during surgery. Common ignition sources found in the OR are electrosurgical or electrocautery units (ESUs, ECUs); fiber optic light sources and cables; and lasers. In addition, ESUs, lasers and high-speed drills can produce incandescent sparks that can fly off the target tissue and ignite some fuels, especially in oxygen-enriched atmospheres. The surgeon and anesthesiologist control these elements and they are trained in hospital fire safety (Joint Commission, 2003).

The Pennsylvania Patient Safety Advisory reported that in 2007 an estimated 11.9 burns occur per 100,000 admissions in Pennsylvania. Based on their incident reporting system there were 224 reports of burns, two-thirds of which were thermal in nature. More than half the submitted burns were reported to have been caused by instruments or devices used in procedures, including cautery units, light sources (e.g. pulse oximetry), and cords for these devices. Nine per cent of the reported burns were attributed to therapeutic heat sources, such as heating pads or hot packs; a further five per cent were reported following magnetic resonance imaging procedures. Almost 14 per cent of reported burns were attributed to food preparation or distribution. These reports include hot liquid spills and handling hot containers (Data snapshot, 2009).

While exact numbers [of surgical fires] are not available, of the more than 23 million inpatient surgeries and 27 million outpatient surgeries performed each year, estimates – based on data from the US Food and Drug Administration (FDA) and ECRI, an independent non-profit health services research agency – indicate that there are approximately 100 surgical fires each year, resulting in up to 20 serious injuries and one or two patient deaths annually (Joint Commission, 2003). An oxygen-enriched atmosphere was a contributing factor in 74 per cent of all hospital fires. About 70 per cent of all surgical fires are started by electrosurgical tools that use a high-frequency electric current to cut tissue or stop bleeding. About 20 per cent of hospital fires are sparked by burrs, defibrillators, hot wires or light sources, while approximately 10 per cent are ignited by lasers (Lawyers and Settlements, 2012).

Asphyxiation

Asphyxia is severe hypoxia leading to hypoxemia and hypercapnia, loss of consciousness, and, if not corrected, death. There are many circumstances that can induce asphyxia; some of the more common causes are drowning, electrical shock, aspiration of vomitus, lodging of a foreign body in the respiratory tract, inhalation of toxic gas or smoke, and poisoning (Mosby's Medical Dictionary, 2009). A search of patient safety reporting/alert systems revealed that the potential causes of iatrogenic asphyxia include:

- Restraints (Joint Commission, 1998; Registered Nurses' Association of Ontario, 2012).
- Positional asphyxia occurs when the body's position interferes with respiration and was found to occur when individuals were placed in a position that did not allow adequate breathing. Most often a prone position or restrictive or confining position, a simple flexion of the head onto the chest, a partial or complete external airway obstruction, or neck compression (Mohr et al, 2003).
- Strangulation (Joint Commission, 1998, Registered Nurses' Association of Ontario, 2012).
- Bed rails and bed entrapment – asphyxiation was caused by one of the following: being caught between the bed rail and the mattress; being caught between the head board and the bed rail; the patient's head becoming stuck in the bed rail; or being strangulated by a vest restraint between the rails (Joint Commission, 2002).
- Accidental ingestion of fluid/food thickening powder (NHS, 2015).
- Traumatic intubation (Pazannin et al., 2008).
- Factors that may contribute to an increased risk of death from restraints, root causes for restraint-related asphyxia or bed rail related asphyxia may be accessed in the CPSI Global Safety Alerts (Healthcare related asphyxiation).

A literature search did not reveal data regarding the incidence of healthcare associated asphyxia; however, a 1998 JCAHO Sentinel Event Alert that reviewed 20 restraint-related deaths found that 40 per cent of deaths were caused by asphyxiation. The extent to which restraints can be classified as therapeutic interventions is questionable: their efficacy as therapeutic measures has not been empirically demonstrated in outcome studies (Mohr, 2003).

Although physical intervention is considered by most in healthcare security to be the method of last resort, sometimes hospital employees have no alternative but to use this approach on someone who becomes a danger to themselves or others. Awareness of restraint-related positional asphyxia and how to avoid positioning that could restrict breathing is of critical importance (Schubert, 2011). When restraint use is unavoidable, the least restrictive form of restraint is used for the shortest duration of time for avoidance of harm to self/others; restraint use is temporary and alternatives must continue to be considered (RNAO, 2012).

GOAL

To prevent in-hospital patient injury such as fractures, dislocations, burns, asphyxia etc. from occurring in patients.

IMPORTANCE TO PATIENTS AND FAMILIES

In hospitals, patient accidents may cause unintended injuries or death. With the right interventions, proper communication with patients and families, and appropriate reporting and related learning, patient accidents can be prevented over the long-term.

Patient Story

Patient Story of a hospital related fall

How did 80-year old Ambrose Wald fall out of a hospital chair specifically designed to stop patients from falls? It's a question to which his daughter Irene Wald, a nurse of almost 35 years, has never received an answer.

EVIDENCE-INFORMED PRACTICES

1. Falls Prevention and Injury Reduction from Falls

(*Safer Healthcare Now!* 2013, p. 22)

The Getting Started Kit provides a Fall Prevention/Injury Reduction Intervention Model with the following five components:

- Prevention: Universal Fall Precautions (SAFE: Safe environment, Assist with mobility, Fall risk reduction, Engage client and family).
- Multifactorial risk assessment.
- Communication and education about fall risk.
- Implementation of interventions for those at risk of falling.
- Individualize interventions for those at high risk of fall-related injury.

2. Promote Alternative Approaches to the Use of Restraints

The Registered Nurses' Association of Ontario offers a model, Promoting Safety: Alternative Approaches to the Use of Restraints (RNAO, 2012, p. 20). This outlines an approach towards a restraint free environment and includes the following three components:

- First focus: Prevention, alternative approaches and assessment.
- Second focus: Use crisis management & de-escalation Interventions.
- Last focus: Restraint use as a last resort.

3. Perform a Clinical and System Review (see details below)*

Healthcare associated accidents are both complex and multifactorial and identifying contributing factors and preventative measures requires clinical and system reviews as described below. For a list of potential contributing factors and recommended mitigation strategies refer to Appendix A for burns and Appendix B asphyxiation.

Clinical and System Reviews

Occurrences of harm are often complex with many contributing factors. Organizations need to:

1. Measure and monitor the types and frequency of these occurrences.
2. Use appropriate analytical methods to understand the contributing factors.
3. Identify and implement solutions or interventions that are designed to prevent recurrence and reduce the risk of harm.
4. Have mechanisms in place to mitigate consequences of harm when it occurs.

As a means to develop a more in-depth understanding of the care delivered to patients, chart audits, incident analyses and/or prospective analyses can be helpful in identifying quality improvement opportunities. Links to key resources for analysis methods are included in the section Resources for Conducting Incident and/or Prospective Analyses.

Chart audits are recommended as a means to develop a more in-depth understanding of the care delivered to patients identified in the hospital harm measure. Chart audits help identify quality improvement opportunities.

Useful resources for conducting clinical and system reviews:

- Chart Audit Review Process (see Introduction to the Improvement Resource)
- Canadian Incident Analysis Framework
- CPSI Patient Safety and Incident Management Toolkit
- Institute for Safe Medication Practices Canada Canadian Failure Mode and Effects Analysis Framework
- Institute for Healthcare Improvement Failure Mode and Effects Analysis Tool

MEASURES

Vital to quality improvement is measurement, and this applies specifically to implementation of interventions. The chosen measures will help to determine whether an impact is being made (primary outcome), whether the intervention is actually being carried out (process measures), and whether any unintended consequences ensue (balancing measures).

Below are some recommended measures to use, as appropriate, to track your progress. In selecting your measures, consider the following:

- Whenever possible, use measures you are already collecting for other programs.
- Evaluate your choice of measures in terms of the usefulness of the final results and the resources required to obtain them; try to maximize the former while minimizing the latter.
- Try to include both process and outcome measures in your measurement scheme.
- You may use different measures or modify the measures described below to make them more appropriate and/or useful to your particular setting. However, be aware that modifying measures may limit the comparability of your results to others.
- Posting your measure results within your hospital is a great way to keep your teams motivated and aware of progress. Try to include measures that your team will find meaningful and exciting (IHI, 2011).

For more information on measuring for improvement contact the Canadian Patient Safety Institute Central Measurement Team at measurement@cpsi-icsp.ca

Falls

Outcome Measures

(*Safer Healthcare Now!* 2013)

1. Falls Rate per 1000 Patient Days.
2. Fall Related INJURY Rate per 1000 Patient Days.
3. Percentage of Patients with 2 or More Falls.

Process Improvement Measures

(*Safer Healthcare Now!* 2013)

1. Percentage of Falls Causing Injury.
2. Percentage of Patients with Completed Falls Risk Assessment on Admission.
3. Percentage of Patients with Completed Falls Risk Assessment Following a Fall or Change in Medical Status.
4. Percentage of "At Risk" Patients with a Documented Falls Prevention/Injury Reduction Plan.
5. Percentage of Patients with Restraints.
6. Per cent of Patients Designated "At Risk".
7. Per cent of Patients Designated “At Risk” and Risk Status Communicated.
8. Per cent of Patients with a Medication Review Completed on Admission.
9. Patients with Completed Fall Risk Assessment Following Change in Medical Status (%).
10. Percentage of Patients Assessed for Harm on Discovery of Fall.
11. Percentage of Patients with Completed Fall Risk Assessment Following a Fall.

12. Percentage of "Fallers" with Appropriate Monitoring in Place for 24-48 Hours After Fall.
13. Fallers with Review or Revision of Falls Prevention/Injury Reduction Plan After Fall.

Standards and Required Organizational Practices

Accreditation Canada Standards

Perioperative Services and Invasive Procedures: Requires that a client be assessed for risks and safety concerns related to the surgery or invasive procedure, and that action be taken to reduce the risks.

Accreditation Canada Required Organizational Practice

Falls Prevention: Requires the implementation and evaluation of a documented and coordinated approach to the prevention of falls.

Global Patient Safety Alerts

Global Patient Safety Alerts provides access and the opportunity to learn from other organizations about specific patient safety incidents including alerts, advisories, recommendations and solutions for improving care and preventing incidents. Learning from the experience of other organizations can accelerate improvement.

Recommended search terms:

- Accident
- Asphyxiation
- Bed entrapment
- Bed rail and restraint
- Burns
- Falls
- Healthcare related asphyxiation
- Injury
- Restraint
- Suffocation
- Surgical fires

PATIENT ACCIDENT PREVENTION SUCCESS STORIES

- Preventing Falls in the Hospital – Jewish General Hospital, McGill University
- Why FallSafe? FallSafe was a quality improvement project that helped frontline staff to reliably deliver evidence based falls prevention.

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PATIENT TRAUMA RESOURCES

*(key resources recommended by clinical experts)

Professional Associations and Helpful Websites

Registered Nurses' Association of Ontario (RNAO).

- Prevention of Falls and Fall Injuries in the Older Adult
- Promoting Safety: Alternative Approaches to the Use of Restraints

Royal College of Physicians (UK).

- FallSafe Resources

Safer Healthcare Now!

- Reducing Falls and Injury from Falls

Patient Trauma / Accident Prevention Guidelines

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APPENDIX A: IATROGENIC BURNS

Prepared by the Healthcare Insurance Reciprocal of Canada (HIROC)

Involved Procedure

- Laparoscopic ovarian cystectomy and myomectomy[1]
- Double lung transplantation[2]
- Post-operative care[4,17]
- Transesophageal echocardiography[5]
- Haemorrhoidectomy[6]
- Coronary artery bypass grafting[6]
- Orthopaedic surgery[6,8]
- Caesarean section[7,19]
- Cervicomedullary exploration and decompression[9]
- Transillumination[10]
- Excision of papilloma on upper eyelid[11]
- Adhesiolysis of a digital flexion[12]
- Bunionectomy[17]

Type of Fire/Burn

- Chemical[1,5,10,22]
- Thermal[4,7,9,10,11,12,14,15,16,17,20]

Sources/Causes and Contributing Factors Associated With Fire/Burn

- Alcohol[1,3,10,12,13,19,22]
- Electro-surgical equipment[1,2,6,9,11,13,14,15,16,19]
- Drapes[1,8]
- Sponge[2]
- Endotracheal tube[2]
- Oxygen[2,13]
- Heat Pack[4]
- Anaesthetic[4,17]
- Equipment/environmental disinfectant[5,10]
- Gas system failure[7]

- Pulse lavage system[8]
- Fibre optic light[10]
- Cosmetic products[11]
- Casting[17]
- Pulse oximeter[20]
- Tourniquet[22]

Recommended Mitigation Strategies

Staff Education

- All personnel working in the operating room should have an annual fire education complemented with fire drills.[18]

Skin Preparation Solutions

- Avoid the use of 10 per cent povidone-iodine in alcohol solution, thimerosal in 50 per cent alcohol solution, 70 per cent chlorhexidine hand rub, and methanol or ethanol for skin cleaning in the operative field.[1]
- The use of undiluted isopropyl alcohol should be avoided in the care of neonatal patients; when used, isopropyl alcohol should not be left on the skin of a neonate for a prolonged period of time.[10]
- Alcohol-based skin preparation solutions should be applied using a purpose built applicator that allows the dissipation of vapour, minimizes pooling and excess application of solution, and controls the flow of solution.[3]
- When alcohol-based skin preparations have been used, wait for at least three minutes for the solution to try and wipe the skin with a cotton swab before draping the operative field.[1,3,6,12,16,19]
- Remove any materials (e.g. swabs), drapes or gowns that have been soaked with alcohol-based skin preparations prior to commencing surgical procedures.[3,8,12,19]
- Use water-soluble lubricants (e.g. K-Y Jelly) as opposed to petroleum-based ointments.[19]

Disinfectants

- Adherence to disinfection procedures and strict compliance with equipment-related technical information instructions.[5]
- The use of benzethonium chloride should be avoided in neonatal care environments.[10]
- When using disinfectant products within neonatal care environments, healthcare workers should allow adequate time for drying and appropriate ventilation of any fumes.[10]

Pre-Operative Preparation

- Surgical team communication of fire risk and prevention during the pre-surgical checklist, as well as intraoperatively (e.g. timing of the use of electrocautery with discontinuing supplemental oxygen).[13,18,21]
- Drape the patient with a clear plastic adhesive drape to prevent the collection of flammable vapours beneath the drapes.[1,6,14]
- Drapes fabricated from cellulose should be avoided.[8]
- During ophthalmic procedures involving electro-surgical equipment, measures should be taken to ensure a make-up free ophthalmic field.[11]

Intraoperative Period

- When a fire breaks out in the OR, extinguish it using fire extinguishers; surgeons must know the location of a fire extinguisher and all surgeons and members of the operating team should be well-informed regarding the fire safety procotol.[1,2,8,13,16,18,21]
- Sources of ignition (e.g. electrosurgical units, lasers, fiberoptic light sources, defibrillators) must be readily identified and controlled to optimize fire safety.[8,13,19,21]
- Surgical staff should maintain a continuous awareness about the presence and removal of potential fuels (e.g. prepping agents, dressings, linen, equipment, bodily tissues).[19,21]
- Avoid dry sponges when cauterizing near the airway.[2]

Post-Operative Period

- When providing care to post-operative, casted or splinted patients, any complaint of pain should be thoroughly investigated, with special consideration given to avoiding thermal injuries – temperature measurements of skin should be done prior to the administration of opioids and additional touch-up nerve blocks should not be done without a thorough evaluation of the plaster cast and underlying skin.[17]

Oxygen Precautions

- Lowest percentage of FiO_2 should be used while operating on the airway.[2,13,19]
- If an open O_2 source is used during the course of a head and neck procedure, the oxygen concentration should be less than 30 per cent.[16]
- Use a sealed gas delivery device, such as an endotracheal tube or laryngeal mask airway, if deep sedation is required during a procedure.[13]
- Ensure that there is no air leak from the endotracheal tube in the operative field.[2,13]
- Prevent oxygen from collecting under drapes by creating a venting system using IV poles or other attachments to tent drapes.[13]
- Colour coding of gas cylinders.[7]

- Capnography or gas analysis should be employed during procedures involving anaesthesia.[7]

Procedures Involving Electro-Surgical Instruments

Grounding Pads

- During procedures involving electro-surgical equipment, ensure that the grounding pad is adequately applied with firm contact to the skin over an adequate surface area; non-adhesive grounding pads should be secured with bandage; and the position of all pad should be re-checked if the patient's position is changed intra-operatively.[6,14,15]
- Grounds pads should not be placed on the following areas: areas with little muscle, such as bony prominences (e.g. elbow joint, lower forearm); areas with a lot of body hair (e.g. hairy forearm, unshaved thigh); areas with soft tissue (e.g. lower legs).[14,15]
- Placement of grounding pads should take into account existing indwelling hardware; avoid grounding pad placement immediately adjacent to or overlying indwelling hardware.[9]
- During craniofacial procedures involving electro-surgical equipment, the grounding pad (i.e. indifferent electrode) should ideally be placed on the following locations – the mid-sternum, thoracic spine at T6, lateral chest wall mid-way between the axilla and 12th rib, or lower anterior abdominal quadrant; placement at the sites listed previously may reduce the risk of alternate-site burns – indifferent electrode placement on the thigh and forearm should be avoided.[9]

Electro-Surgical Instrument

- When using electro-surgical equipment, minimize the time it is used and use non-flammable equipment.[1,2,19]
- Use of bipolar electrocautery to minimize the amount of leakage of current.[2,6,19]
- Effort should be taken to limit the use of electro-surgical equipment at high currents for prolonged periods of time without interruption.[15]
- Avoid close proximity of an activated electro-surgical device on tissue immediately adjacent to vulnerable tissue such as bowel, ureter, and blood vessels.[16]
- Surgical teams should inspect electro-surgical instruments prior to procedures for any defects in insulation, with particular attention to the active electrode.[16]
- Employ the use of porosity detectors in sterile processing before electrosurgical instrument sterilization to detect insulation failure.[16]
- Laparoscopic ports should be placed so that the shafts of electro-surgical instruments do not lie adjacent to vulnerable tissue.[16]
- Avoid contact of monopolar active electrodes with other conductive instruments or materials while energy is being delivered to the active electrode.[16]

- Avoid close proximity of monopolar active electrodes to instruments that do not have insulation along their shafts.[16]
- Ensure that laparoscopic port placement does not allow the shafts of instruments to touch vulnerable tissues.[16]
- Avoid the use of combined (or "hybrid") metal and plastic laparoscopic trocars when using the monopolar instruments (e.g. "bovie" instrument).[16]
- Use alternative energy-based surgical devices instead of the monopolar "bovie" instrument, such as traditional bipolar, ultrasonic instruments, and advanced bipolar devices.[16]
- Avoid inadvertent activation injuries by: (1) utilizing a "bovie" pencil holder, (2) avoid placing energy-based devices on drapes adjacent to where surgical team members might lean, and (3) have instrument activation tones loud enough to be heard by the surgical team.[16]
- Avoid electro-surgical instrument interaction with other electronic devices by: (1) decreasing generator power setting, (2) using cut mode in preference to coagulation mode, (3) employing the desiccation technique rather than the fulguration technique, and (4) orienting the active electrode cord from the patient's feet to avoid proximity of the active electrode cord to electronic devices.[16]
- Activate the electrosurgical unit only when the tip is in view and deactivate it before it leaves the surgical site.[16]
- Electro-surgical "bovie" pencils or laparascopic devices should be in holsters when not in use and rubber sleeves should never be used over electro-surgical equipment.[16,19]

Pulse Oximeters

- Standardize the makes and models of organizational pulse oximeters to avoid mixing of equipment.[20]
- Label pulse oximeter monitors and sensors with warnings regarding incompatibility; avoid reuse of disposable probes.[20]
- Engage in regular inspection of pulse oximetry equipment to exclude damaged sensors or protective covers, defective insulation, or exposed electronics.[20]
- When utilizing pulse oximetry, engage in frequent assessment of monitor sites; special attention should be paid to high-risk patient groups, such as neonates, the elderly, and the critically unwell.[20]
- Engage in frequent relocation of pulse oximetry probes during prolonged use and review the underlying skin.[20]
- Avoid taping pulse oximetry probes to an extremity; alternate extremities used.[20]

- Engage in regular review of insensate limbs during anaesthesia where prolonged pulse oximetry may be used.[20]

Tourniquets

- When applying a tourniquet, a waterproof barrier is recommended to isolate the tourniquet to prevent pooling and impregnation of the padding.[22]
- When a tourniquet is applied, engage in routine inspection of the tourniquet after surgery, particularly after a spinal anesthetic, where sensation may be absent for several hours after surgery.[22]

Heat Packs

- Heat packs are not to be heated in microwaves and should only be warmed in warm storage cabinets (e.g. warm blanket storage units or fluid warming units).[4]
- Caution should be employed when applying a heat pack to potentially anesthetised skin.[4]

Fiber Optic Light Sources

- When utilizing fiber optic light sources in the care of neonatal patients, a filter to block out light with a wavelength less than 570nm should be employed.[10]

Transillumination

- Caution is advised when employing transillumination in the care of neonatal patients.[10]

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APPENDIX B: HEALTHCARE-ASSOCIATED ASPHYXIA, ENTRAPMENT & ENTANGLEMENT

Prepared by the Healthcare Insurance Reciprocal of Canada (HIROC)

Patient Population

- Adult[1,2]
- Geriatric[2,3]
- Paediatric[5,6,7,8,9,10,13,14]

Injury

- Asphyxia associated with restraint use[1,2,3,7,10,11,15]
- Asphyxia associated with bed-related entrapment[5,12]
- Strangulation associated with hospital equipment[5,6,8,13,14]

Equipment Contributing to Injury

- Nursing bedcover[3]
- Restraint waist belt[3]
- Patient bed/crib[4,5,12]
- Medical lines[5,6,8,9,13,14]
- Apnea monitor lead[5]

Conditions Contributing to Adverse Event

- Mental illness[1,7,10,11]
- Substance abuse[1]
- Obesity[1]
- Developmental disorders[7]
- Inadequate patient assessment[10,14]
- Inadequate care planning[10]
- Inappropriate room or unit assignment[10]
- Lack of patient observation procedures and practices[3,6,10,11]
- Staff issues in training[3,10,12,15]
- Inadequate staffing levels[10]
- Staff competency and credentialing problems[10]
- Equipment failures[10,12]

RECOMMENDED MITIGATION STRATEGIES

Restraints

- Revise organizational policies to prohibit the use of higher-risk forms of restraint, including: (1) any form of restraint that involves compression of the patient's chest; (2) prone restraint, (3) supine restraint, (4) any type of technique that obstructs airways or impairs breathing, (5) any technique that obstructs vision, and (6) any technique that restricts a patient's ability to communicate.[11]
- Restraints should be applied strictly in accordance with policies and procedures, using an approved method, and according to the patient's behavior support plan.[7,15]
- Consider age and gender in writing therapeutic hold policies.[10]
- Discontinue the use of high neck vest and waist restraints.[10]
- Mandate the recording and reporting of restraint.[2]
- Avoid restraint use by actively promoting alternative intervention and management strategies that focus on primary and secondary intervention.[2,10,15]
- Clear medical documentation of the restraint device including indication, during and method.[3,11]
- Promote staff training in alternatives to physical restraint and in the proper use of holding and restraint.[3,10,15]
- Engage in close monitoring of patients under restraints, with special attention to paediatric patients, as well as those who exhibit dementia or apractic disorders.[3,10,11]
- When restraints have been employed, monitor vital signs (pulse, respiration, blood pressure, and oxygen saturation) to help determine how the patient is responding to the restraint.[15]
- With prone restraint, ensure that the airway is unobstructed at all times and that the patient's lungs are not restricted by excessive pressure on the patient's back.[10]
- With supine restraints, allow the patient's head to rotate freely. Do not cover the patient's face with a towel, bag, etc., during therapeutic holding.[10]

Entrapment – Beds

- Ongoing monitoring and maintenance of bed rails.[4,12]
- Consider compliance with dimensional guidelines when engaging in bed procurement decision-making.[4,12]
- 'Retrofit' older bed models to eliminate gaps.[4]
- Develop guidelines on avoiding bedrail entrapment gaps; the routine measurement of gaps may be a consideration for residential care settings.[4]

- Ensure that bedrails are only used when appropriate; if bedrails are to be used, the appropriateness of the bed, rail and mattress combination for the patient should be considered.[4,12]

Entanglement and Entrapment – Medical Lines

- Children who are at risk for entanglement should be placed under continuous observation.[6,14]
- Within the paediatric setting, oral treatment or use of a heparin-locked needle should be considered in place of intravenous therapy.[6,14]
- Within a paediatric setting, if intravenous tubing is used, excess amounts should be coiled to prevent entanglement.[6]
- Implement a routine, standardized process that focuses on the prevention of entanglement of therapeutic tubing, cords and cables.[8,14]

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