Module 1: Systems Thinking: Moving Beyond Blame to Safety

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<th>PSEP – Canada Objectives</th>
<th>Related CPSI Safety Competencies</th>
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<td>The knowledge elements include an understanding of:</td>
<td>Domain: Contribute to a Culture of Patient Safety</td>
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<td>• Why we blame</td>
<td>2. Health care professionals who are able to describe the fundamental elements of patient safety, understand:</td>
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<td>• Systems thinking</td>
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<td>• The relationship between systems thinking, blame and accountability</td>
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<td>• The definition of a safety program</td>
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<td>The performance elements include the ability to:</td>
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<td>• Describe the elements of a healthcare delivery system</td>
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<td>• Explain how system elements interact to impact safety</td>
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<td>2. Health care professionals who are able to describe the fundamental elements of patient safety, understand:</td>
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<td>2.1. Core theories and terminology of patient safety and the epidemiology of unsafe practices</td>
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<td>2.2. The characteristics and capacities of organizations with respect to patient safety, namely:</td>
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<td>2.2.1. A commitment to patient safety as a major organizational or institutional goal demonstrated at the most senior levels</td>
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<td>2.2.2. The establishment and maintenance of a just culture</td>
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<td>2.2.3. The implementation of patient safety best practices</td>
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<td>2.2.4. The conduct of adverse event and incident (e.g., close call) analysis</td>
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<td>2.2.5. The involvement of patients and their families as key players in patient safety</td>
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<td>2.2.6. The provision of an environment of support and safety for health care professionals</td>
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<td>2.3. The use of evaluative strategies to promote safety</td>
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<td>2.4. The risks posed by personal and professional limitations</td>
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<td>2.5. Principles, practices and processes that have been demonstrated to promote patient safety</td>
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<td>2.6. The nature of systems and latent failures in the trajectory of adverse events</td>
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<td>2.7. The emotional impact of adverse events on patients, families and health care professionals</td>
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<td>2.8. Methods by which health care professionals can advocate for patient and health care system safety</td>
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<td>2.9. The elements of a just culture for patient safety, and the role of professional and organizational accountabilities</td>
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<td>2.10. The concept that health care is a complex adaptive system with many vulnerabilities, (e.g., space or workplace design, staffing, technology)</td>
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4. Health care professionals who demonstrate a questioning attitude as a fundamental aspect of safe professional practice and patient care:
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<tr>
<td>4.1. Recognize that continuous improvement in patient care may require them to challenge existing methods</td>
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<td>4.2. Identify existing procedures or policies that may be unsafe or are inconsistent with best practices and take action to address those concerns</td>
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<td>4.3. Re-examine simplistic explanations for adverse events to facilitate optimal changes to care</td>
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**Domain: Manage Safety Risks**

3. *Health care professionals who anticipate, identify and manage high-risk situations:*

   3.1. Recognize health care settings that may lead to high-risk situations
Leadership Standards

- Teams are supported in their efforts to partner with clients and families in all aspects of their care.
- A healthy and safe work environment is identified as a strategic priority.
- Support is provided for quality worklife and healthy and safe work environment improvement activities.
- Workplace health and safety policies that comply with relevant legislation are developed and implemented.
- Team members' fatigue and stress levels are monitored and work is done to reduce safety risks associated with fatigue and stress.
- REQUIRED ORGANIZATIONAL PRACTICE: A documented and coordinated approach to prevent workplace violence is implemented.
- The organization's leaders promote and support the consistent use of standardized processes, decision-support tools, or best practice guidelines to reduce variation in and between services, where appropriate.
- Roles and responsibilities for patient safety are defined in writing.
- REQUIRED ORGANIZATIONAL PRACTICE: Patient safety training and education that addresses specific patient safety focus areas are provided at least annually to leaders, team members, and volunteers.
- The organization's leaders implement an integrated risk management approach to mitigate and manage risk.
- REQUIRED ORGANIZATIONAL PRACTICE: A patient safety plan is developed and implemented for the organization.
- Responsibility for implementing and monitoring the patient safety plan and for leading patient safety improvement activities is assigned to a council, committee, group, or individual.
• REQUIRED ORGANIZATIONAL PRACTICE: A patient safety incident management system that supports reporting and learning is implemented.

• The organization's leaders support a just culture and provide opportunities for team members to learn from patient safety incidents.

• REQUIRED ORGANIZATIONAL PRACTICE: A documented and coordinated approach to disclosing patient safety incidents to clients and families, that promotes communication and a supportive response, is implemented.

• REQUIRED ORGANIZATIONAL PRACTICE: At least one patient safety related prospective analysis is carried out and appropriate improvements are implemented as a result.

Governance Standards

• The governing body fosters and supports a culture of client safety throughout the organization.

• The governing body adopts client safety as a written strategic priority for the organization.

• REQUIRED ORGANIZATIONAL PRACTICE: The governing body demonstrates accountability for the quality of care provided by the organization.

Service Excellence Standards

• Education and training on occupational health and safety regulations and organizational policies on workplace safety are provided to team members. *

• Education and training are provided on how to identify, reduce, and manage risks to client and team safety. *

• A proactive, predictive approach is used to identify risks to client and team safety, with input from clients and families. *

• Verification processes are used to mitigate high-risk activities, with input from clients and families. *

• REQUIRED ORGANIZATIONAL PRACTICE: A safety risk assessment is conducted for clients receiving services in their homes. (multiple standards sets)
Abstract

An individual physician or nurse working in a hospital can do their best in treating and caring for their patients, but that alone will not be enough to provide a safe and quality service. This is because patients depend on many people doing the right thing at the right time for them; in other words they depend on a system of care. If a physician performs an examination on a patient, makes the diagnosis and orders the treatment, unless someone acts on those orders and administers the treatment as requested, then the patient will not receive the optimal treatment and may get worse or even die.

Good healthcare requires that the people caring for the patient understand the context of that care. Health services such as hospitals are organizations made up of many interacting parts comprising individuals (health professionals, administration and management staff, patients and their family members) infrastructure (administration, governance arrangements) and technology (drugs, equipment, diagnostics). The various ways they interact with one another and how they collectively act is highly complex and variable.

Understanding the system of healthcare is as important as understanding the tasks one is required to perform at work. Understanding the nature of complexity in healthcare is essential if we are to incorporate processes that minimize adverse events. This module provides a basic understanding of complex organizations using a systems approach. It also describes the lessons from other industries and examines the characteristics of high reliability organizations. When we think in systems we are better able to understand why things break down and have a context for thinking about solutions.

Keywords

Systems theories, complexity, complex adaptive systems, workplace structures, processes, high reliability organizations, metaphors, defense against failure, adverse events, accident causation models, active failures, latent conditions, errors, violations

Teaching methods

Interactive lecture, trigger tape guided case-based teaching
The learning objectives of this module are to understand systems thinking and system engineering approaches to safety.

**Knowledge requirements**

The knowledge elements include an understanding of:

- why we blame;
- systems thinking;
- the relationship between systems thinking, blame and accountability;
- why system approaches to safety are superior to traditional approaches to safety in healthcare; and
- the definition of a safety program.

**Performance requirements**

The performance elements include the ability to:

- describe the elements of a healthcare delivery system, and
- explain how system elements interact to impact safety.
Clinical case on trigger tape

A physician is on the phone with a recently discharged patient. The patient has confused the names of her medications and accidentally taken the wrong dose of a medication. Following the phone call, the physician and her colleague discuss systemic problems with medication instructions at patient discharge and how the system could be improved.

Traditional approaches to safety in healthcare

Person approach

The traditional approach to safety in healthcare, and in all industries, is to target interventions at the person who is believed to have caused the bad outcome, such as patient harm. For example, if a patient is found to have died from an overdose, we determine which nurse gave the wrong dose and blame him/her for the death. This is typically followed by shaming the individual believed to be responsible, possibly sending him/her for remedial training, telling the individual to be more vigilant, and strengthening policy statements for how to do things correctly. In other words, the entire safety intervention is focused on one person.
Silo mentality

Another “traditional approach” is for healthcare providers to see their work as totally separate from the work of other healthcare providers and other departments. That is, there has been and remains a “silo” mentality; people do not realize how they work affects the work of their colleagues around them and in other departments.

Why do we blame?

Why is it that traditional safety efforts have been person focused? The answer may be explained by attribution theory. Attribution theory comes out of social psychology and is the study of how people come to decide on what causes events, such as patient harm, adverse drug events, needle-stick injuries, or any other type of incident. The idea is that people naturally want to make sense of the world, so when unexpected events happen, we naturally start trying to figure out why. Causal attributions are people’s beliefs about the causes of events.
When safety-related events occur, such as preventable patient harm, we naturally try to figure out why the harm occurred. But because we rarely if ever can really know the causes, we attribute the cause based on a variety of biases. For example, if administrators believe physicians are careless, then when an adverse event happens, they may be predisposed to blame the physician. If someone believes that trainees such as residents are likely to screw up, then if an adverse event happens to a patient while under the care of a resident, that person might be predisposed to attribute the event to the resident. Many factors affect how we assign causal attributions, including the severity of the outcome and our own mental models. This is particularly true if harm occurs from an inherent risk of an investigation or treatment, and the complication is severe and rare.

**Biases that lead to blame**

Interestingly, there are a number of biases that may explain why people seem to naturally believe individuals cause bad events, as opposed to believing that the cause was something more complex.

**Self-serving bias**

The self-serving bias is one in which people accept responsibility for their successes, but deny responsibility for their failures. If an adverse drug even happens on a unit, the unit manager or other responsible team member may be naturally predisposed to denying that it was their fault or the fault of the unit as a whole and therefore focus blame on one or
more individuals who interacted with the patient. Ironically, the healthcare providers who were interacting with the patient also may naturally use this bias and also deny responsibility. The result then of this bias is that everyone points their finger in the other direction.

**Fundamental attribution error**

A similar well-known bias is known as the fundamental attribution error. This bias is one in which people tend to explain the actions of others based on factors internal to the others (I think your patient was harmed because of your age, your personality, your experience, or your carelessness), but we explain our own behavior based on situation factors (I think my own patient’s harm was caused by me not having the right information, or I was interrupted, or someone didn’t give me the right medication, or we were understaffed). Like the self-serving bias, the net effect of this bias is a natural predisposition to thinking that when bad things happen to others, it is somehow their fault.

**Learned intuition**

Learned intuition is the idea that once we have learned something, no matter how complicated, it becomes intuitive to us AND we cannot remember it not being intuitive. For example, after many years of practicing at a clinic, the complicated process for ordering lab tests and finding lab tests becomes automatic and it now feels intuitive. But, when a new resident comes in and they cannot figure out how to order a test or worse, they make a mistake while ordering, we cannot believe they were so stupid to have made a mistake in such a simple process. That doesn’t mean the process really is simple, it just feels that way to us once we have learned it. The implication is, again, that we focus blame on the person, in this case the resident.

**Hindsight bias**

Another related bias is hindsight bias. This is the idea that hindsight is 20/20. Therefore, when patient harm occurs, looking back it seems so obvious why it happened and therefore it also seems obvious that it could have been easily avoided had the providers just done the obviously right thing. But, in reality, just because something seems obvious in hindsight, doesn’t make it so.

We all learn from hindsight. Looking back at what happened is essential and thus improves our knowledge. However, hindsight bias is a problem because knowing an undesirable outcome has occurred increases the belief that it was predictable and therefore preventable. This “hindsight bias” contributes to the belief that the unexpected outcome was due to carelessness or poor clinical care, rather than the context or specific conditions in which the individual provider was working.
Ultimately, the reasons we jump to blame are many and complicated, but there are a number of biases that people naturally fall victim to that may provide at least partial answers. The good news is that once you are aware of these biases and learn alternative ways of thinking, you can reduce them.

**Response to patient harm**

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*Response to patient harm …*

- Based on causal attributions and biases
- Likely to blame those at the sharp end
- People involved in direct care of patients
- Interventions focus on individuals

**Slide 11**

* … Response to patient harm*

- Types of interventions
  - Random event—no response
  - Nurse is at fault—fire or retrain the nurse (person attribution)
  - Understaffed nurses cut corners—address staffing needs (system attribution)

The biases that were reviewed therefore mean that decision makers in healthcare may be predisposed, at least without additional education, to blame the individuals involved in the direct care of patients (these are people at the sharp end) when patient harm occurs. This has significant implications for subsequent safety interventions.

If decision makers such as unit managers, chief medical officers, and the like blame people at the sharp end for patient harm, it means that interventions to improve safety will only focus on the people who were blamed. But these biases have even more far reaching implications. If people naturally blame those at the sharp end, it also means that people involved in reporting systems, Root Cause Analyses (RCA) or Failure Mode and Effects Analyses (FMEA) or any other safety analysis method are at risk for simply blaming or focusing on those at the sharp end. It also means that a culture that fosters blaming individuals will be reinforced. To avoid this, there is a need for a turn of focus from the individual to the system.
Thankfully, with education about an alternative way to approach safety, one known as a systems approach, we can guard against falling victim to these biases and thus guard against the cycle of blame and person-focused safety.

**What is systems thinking?**

Healthcare professionals routinely apply systems thinking to organic systems. Organic systems have much to say about systems generally. Whether the organism is a single cell, complex organism or whole population, it exists in a state of continuous exchange of information with the environment, characterized by inputs, internal transformation output, and feedback. There is a continuous interaction and mutual dependence between the environment and the internal functioning of the system. It is not difficult to apply these same principles to healthcare.

A systems thinking approach is different than the person-focused view of healthcare safety. As previously discussed, the person-focused approach focuses on individuals, such as healthcare providers. In person-focused organizations, individuals are blamed for a lack of safety and interventions to improve safety are targeted at improving the blamed individuals by imploring them to be more careful or sending them to more training. In contrast, a system-focused approach to safety starts by guarding against all of the biases that make us leap to blame. The focus is not on individuals, but on the conditions under which people work, that is, the system. Interventions to improve safety focus on redesigning the system to both make it more difficult to err in the first place and to make those adverse events that do happen easily identifiable so that their effects can be quickly mitigated before harm occurs.

By using a systems approach, we then begin to appreciate that adverse events, violations and safety problems are not “caused by people”, but rather are the result of the interaction among processes and workflows, technology designs, teamwork, staff, patients, financial restraints, training and education. An example of not using system thinking would be telling an PGY medical resident that they must attend all their educational sessions when they are the only ones working on the ward; it is not a systems approach because the training program that has not been designed taking into account other competing
demands on the residents, such as their need to be available to patients. In a person-focused tradition, the resident’s non-attendance at the educational sessions is then seen as a failure of the physician. A systems approach would look at the overall role of residents in the team and in the hospital and then a training program would be designed taking into account the availability of other more senior physicians, the timing of the educational sessions in relation to busy times on the ward, the quality of the program, and so on. Maintaining a person-focused approach stimulates a belief that it is impossible to fix problems such as low attendance. A systems approach takes into account the complexity of all the activities and seeks to understand what works and what doesn’t work.

**Why care about systems thinking?**

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**Why systems thinking? ...**

- healthcare systems characterized by:
  - multiple actors, choices, hand-offs
  - no ownership
  - no natural team
  - no one with hospital-wide authority to make changes and ensure quality

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... **Why systems thinking?**

- The design of your systems will impact
  - adverse event, safety, and risk
  - quality improvement
  - performance (including economic)
  - satisfaction and comfort
  - health
  - the quality of care provided

Systems in healthcare are highly complex and are “characterized by multiple actors, multiple choices, multiple hand-offs... no ownership, no natural team and no one with hospital-wide authority to make changes and insure quality” (Leape 1997).

Consequently, the design of the healthcare system has a far reaching impact. System design can affect:

- adverse events, safety and risk;
- quality improvement;
- performance (including economic);
- satisfaction and comfort; and
• health.

Most importantly, the design of a system will affect the quality of care provided. As will be explained, the way the components of a system interact, determines all of these different outcomes.

**What does IOM say about systems?**

The Institute of Medicine (IOM) has repeatedly emphasized a systems thinking approach to healthcare. Some examples are given below:

- “…emphasis is put on the development of a systems-oriented approach that prevents and identifies errors and minimizes patient harm from errors that do occur.” (IOM, 2000)
- “Patients should be safe from injury caused by the care system. Reducing risk and ensuring safety require greater attention to systems that help prevent and mitigate errors” (IOM, 2001)
- “Patients are injured frequently because of poor system designs.” (IOM, 2001)
- “System view of errors and error prevention is based on research findings from a variety of fields…This research has revealed that errors typically result from problems within the system in which people work – not from poor individual worker performance – and typically originate in multiple areas within and external to an organization.” (IOM, 2004)

In addition, the Royal College of Physicians and Surgeons of Canada (RCPSC) emphasizes systems thinking in the 2002 publication *Building a Safer System - A National Integrated Strategy for Improving Patient Safety in Canadian Health Care*.

- “The [Canadian healthcare] system is complex, dynamic and characterized by many competing pressures, particularly the relationship between funding and quality of care. An unprecedented level of collaboration across all sectors must occur to ensure a co-ordinated and effective strategy for improving patient safety.”
- “Systemic identification should be carried out reactively, in response to a recognized adverse event or outcome, and more importantly, proactively, before problems have occurred. This identification must be followed by reporting and recording of these hazards (and any associated adverse events and near misses) to a network of databases.”
- “The five major components [to building a safer system] will lead to a culture of safety where words are translated into actions that reduce the risk to Canadian patients.” These are:
  1. establish a Canadian Patient Safety Institute to facilitate a national integrated strategy for improving patient safety;
  2. improve legal and regulatory processes;
  3. improve measurement and evaluation processes;
4. establish educational and professional development programs; and
5. improve information and communication processes.

Clearly, there is a strong emphasis on applying systems thinking for improving patient safety, so the rest of the module will focus on defining systems, how they function, and their implications for safety.

**What is a system?**

In general, a system is defined as a set of interrelated components working together towards a common goal. A system has a defined structure and function. Some examples of systems in healthcare include:

- operating rooms;
- medication delivery systems;
- patient care units;
- nursing homes; and
- neurosurgery clinics.

**Healthcare delivery is a complex system**

- A complex system
- Diversity of people
  - huge numbers
  - vulnerable people
- Diversity of tasks
- Implementation of new technology
- Specialization
A first step is in designing better healthcare delivery systems is to understand the complexity of our own environment and its unique features. Healthcare is complex because of:

- diversity of patients, clinicians and other staff for whom the system needs to work;
- the huge number of relationships between patients, caregivers, healthcare providers, support staff, administrators, policy-makers, economists and community members as well as the relationships among the various health and non-healthcare services;
- the vulnerability of patients;
- sick, injured or dying;
- diversity of tasks;
- the means for carrying out care (access to resources);
- the variations in care;
- variations in physical layout;
- differing, lack of or unrealistic regulations, policies and procedures;
- implementation of new technology; and
- increased specialization of healthcare professionals. While specialization allows a wider range of patient treatments and services, it also provides more opportunity for things to go wrong and adverse events to occur.

Health also differs from other industries because of the nature of the health professions. The scientific study of disease, and advances in the training of healthcare professionals have led to tremendous gains and improvements for medicine. Eric Cassell, Clinical Professor of Public Health at Cornell University Medical College, wrote while reminiscing about his early medical education in the 1950s that his training was underpinned by four assumptions. The first was that the disease explained the illness. The second assumption was that the same disease in a different person produced the same illness. The final assumptions were that to know the science of disease was to know diagnosis and treatment and to know medical science was to know medicine. As part of his reflection on this, Cassell asserts that even though these are erroneous assumptions, physicians are still trained as if they are valid.

Popper and McIntyre agree that such assumptions were never valid. They argue that because medicine mistakenly believed that knowledge grows by accumulation, by collecting more and more facts, scientific knowledge was certain knowledge which could be acquired and stored in a person’s mind. The authors assert that far more knowledge is acquired by recognizing ‘errors’ - a process which is critical for learning. Nearly 50 years ago Fox identified two types of medical uncertainty: incomplete or imperfect mastery of available knowledge and the limitations of current medical knowledge. Regardless of the expertise a clinician has in any one area it is impossible to have complete access to
information for ‘perfect’ decision making. Therefore mistakes are an inevitable part of the practice of medicine.

In 1984, Hilfiker observed that physicians are trained in a way that assumes they can always perfectly diagnose and perfectly treat patients. At the heart of the perfectibility model is the belief that if only physicians and nurses would try harder and were more knowledgeable and skilful then errors would not happen. This view does not take into account the role played by other factors such as the other components of the healthcare system.

**Healthcare delivery system model**

The University of Wisconsin-Madison Systems Engineering Initiative for Patient Safety (SEIPS) model of a healthcare delivery system combines Donabedian’s well-known structure-process-outcome model of quality with human factors engineering and systems engineering ideas. Quoting directly from the paper:

“According to the work system model, a person (the person could be a care provider, another employee of a healthcare institution such as a biomedical engineer, a unit clerk, or the patient) performs a range of tasks using various tools and technologies. The performance of these tasks occurs within a certain physical environment and under specific organizational conditions. The five components of the work system (person, tasks, tools and technologies, physical environment, organizational conditions) interact with each other and influence each other. The interactions between the various components ‘produce’ different outcomes: performance, safety and health, and quality of working life…. Overall, the work system in which care is provided affects both the work and clinical processes, which in turn influence the patient, employee, and organizational outcomes of care.”

In systems parlance, the work system is considered the “inputs”, the processes are the “transformations” and the outputs are just that, outputs. Importantly, the model also shows that feedback mechanisms operate in systems. All of these terms will be expanded upon in the following sections.
This systems model demonstrates several important points relevant to patient safety.

- The healthcare providers and patients are part of the system. This demonstrates that “systems thinking” does not exclude individual contributions to safety, or a lack thereof.
- The placement of the individuals, the providers, patients, support staff, managers, at the center means that an effective system is one that is designed for those individuals.
- It is the interaction among the five system components (person, tasks, tools and technologies, physical environment, organizational conditions), not the individual components themselves, that matters most for safety. Healthcare providers, for example, do not operate in a vacuum. They work in a system defined by the other components. Therefore, when it comes to safety, we need to understand how the different components interact as it is the interactions that produce safety, or a lack thereof. That is another reason why just focusing on individuals, such as physicians or nurses, makes little sense from a systems perspective.
- It is not just patient safety that is affected by the design of the system, but also employee (physician, nurse, support staff, management) safety and organizational outcomes such as regulation compliance.

Inputs

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![Components of the work system](Image)

Karsh et al. (2006) provides a detailed explanation of healthcare delivery system inputs.

Patient and provider factors

These are characteristics of individuals such as health, age, weight, needs, mood, personality, knowledge and experience, intelligence, language and cultural background. Some characteristics are less dependent on the situation, such as personality and intelligence, while others such as mood, fatigue, and stress may vary depending on the situation.
**Task factors**

These are characteristics of the tasks or jobs healthcare providers must execute, including what the tasks themselves are, as well as characteristics such as work flow, time pressure, job control, and workload.

**Technology and tool factors**

Technology factors refer to quantities and qualities of technologies in the organization. Such factors include the number and types of technologies and their availability and location. The design of tools and technologies, including their integration with other technologies, propensity to breakdown or crash, responsiveness, and other design characteristics would also be included.

**Environmental factors**

These are the features of the environment in which healthcare providers work. These features include lighting, noise, and physical space and layout.

**Organizational factors**

These are the structural, cultural, and policy related characteristics of the organization. Examples include leadership characteristics, work culture, regulations and policies, levels of hierarchy, and supervisor span of control.

**External environment factors**

The external environment of any given system is anything outside of that system. The external environment of a patient room is the unit in which it resides, but also includes the hospital, local, provincial/territorial and federal laws, and the economic conditions and demographic makeup of the community. Karsh et al. (2006) go on to explain:

“All, none of these factors may be important to patient safety in and of itself; rather, it is typically the interaction between inputs that can influence patient safety. For example, lighting is not good or bad by itself, but lighting can be problematic for certain tasks or create glare on certain displays. Similarly, a technology such as computerized physician order entry may or may not influence patient safety; rather, it will have a positive or negative impact on safety depending on many factors such as (a) how well it is integrated into the physical environment and the workflow, (b) how much training is provided to end users, and (c) how end users perceive its ease of use and usefulness.”
Karsh et al. (2006) provides an explanation of transformations. Transformations—also sometimes referred to as processes or performances—are the actual acts of transforming inputs into outputs. Physical transformations result in new configurations of the system, such as when a transferred patient now resides in a new location or when a surgery is completed and a patient is physically transformed. Cognitive and social/behavioral transformations also result in new system states—for example, after a difficult diagnosis a physician is more mentally fatigued and the patient more informed than he/she was initially (cognitive); or when the presence of a manager leads a pharmacist to recheck a medication cart before it is transported to the unit by a pharmacy technician (social/behavioral).

From Karsh et al. (2006):

“An output of performance can be as general as ‘surgery completed’ or as specific as ‘tablet placed in mouth of patient’ or ‘nursing knowledge of a policy improved’. Output can be thought of as a new state of the pre-transformation system and is evaluated by referring to a relevant set of objectives and standards—for example, must give right patient the right medication at the right time, and so on. Relevant outputs for patient safety might include achievement of
the five rights of medication administration (Right Patient, Right Route, Right Dose, Right Time, Right Medication), the correct information handed off between healthcare providers (HCPs), or adequate knowledge and skill to correctly use a new computerized provider order entry system.”

Feedback

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From Karsh et al. (2006)

“The idea of feedback is central to the system model because feedback from outputs affects subsequent inputs and thus affects performance and patient safety. This feedback operates in two main ways: (1) it acts as an input into other processes and (2) it influences the same process when it recurs in the future. Consider medication dispensing, which is influenced by a variety of inputs. The output of medication dispensing is either the right or wrong drug dispensed. If data on dispensing errors are tracked and problems are identified in the inputs-transformation-outputs sequence, knowledge about how the output (wrong medication) comes about could be used as corrective feedback to change some of the inputs into the dispensing process (for example, policies, personnel or technology) in order to provide better HCP performance and, subsequently, better patient safety. At the same time, the output of the dispensing activity (which is a dispensed medication) is one of the main inputs into the medication administration process, which follows dispensing in the medication use process.”

The idea that outputs of one process, such as medication dispensing, act as inputs to another process, such as medication administration is an important point for understanding system operations. This phenomenon means that changes to one part of a process will likely impact processes that flow from it. Processes that feed into it may also be affected as the inputs needed for the changed process may change. For example, if a hospital or clinic implements electronic health records (EHR), then the way patients are checked in at admission (a process that serves as an input to the EHR) will have to change and processes that follow use of the EHR, such as charting or medication ordering may also change.
Perhaps the most critical point about feedback is that feedback is that which allows a system to adapt to changes. On a basic level, imagine trying to walk without visual feedback. We would be unable to correct our path for obstacles in our path. Or imagine trying to walk without feedback from our feet about the ground (slippery). We would surely fall without that feedback. The same principle applies to system operation. Similarly, consider how patient treatment would change without being able to use the feedback about patient status provided by vital monitors. Feedback about the status of system operations allows individuals in the system to adapt to changing circumstances. When individuals operate in an environment that lacks feedback about the status of the system they are put in a position of making decisions without important information. If a lab test were ordered in a clinic that tracked specimen processing, any member of the clinical team could know how whether the specimen reached the lab and how much longer they would be waiting for the test, and with that information they could make adjustments to use their time productively and also give better information to the patient on when to expect the results of the test. On the other hand, in a clinic that did not track specimen status, the clinicians would be operating under uncertainty (short of making a call to the lab).

Feedback processes operate continuously, whether we realize it or not. If a nurse questions a physician and the physician ignores the nurse, then that is feedback to everyone who witnessed the event. Each witness, though, may interpret the meaning of the information differently. Some may interpret it as the physician not hearing the nurse or not wanting to be interrupted at that time. Others may interpret it as the physician not
valuing nursing input. Each interpretation carries with it important information for subsequent behavior. People with the former interpretation may wait to talk to this physician until he/she is not busy. Those with the latter interpretation may never attempt to interrupt this physician, even if they think they need to. This brings up another important point; feedback needs to be specific and meaningful. Because the feedback from the physician was ambiguous, each person is left to interpret the action. If there is a pattern, the interpretations may converge. But, had the physician said “please give me one moment while I concentrate then I’ll be happy to chat” it would have told the witnesses what they could do differently the next time. Or the physician might have said “Don’t ever interrupt me!” which would have provided very different feedback to the witnesses and affected each of their subsequent behaviors with this physician differently. So feedback constantly informs us about how to behave and operate within a system, whether we realize it or not. Realizing that now, you can be more aware of how your own behavior and communication provides feedback to others.

System boundaries

It is also important to understand that systems have different kinds of boundaries. These boundaries are rarely hard boundaries, but the implications of the boundaries are important for system design and redesign. Karsh and Alper (2005) describe four types of boundaries:

1. temporal;
2. spatial;
3. process; and
4. hierarchical.

Temporal boundaries

A temporal boundary is a boundary in time, such as between shifts or among seasons. These are important because any design or redesign must work across temporal boundaries. For example, any change to medication ordering or administration must work for the day shift, where staffing is typically highest, as well as night shift, when unit staffing levels are typically lower, patients are sleeping, and the pharmacy may have less
staff. As another example, more pediatric cases might be seen during certain times of the year when infections with respiratory viruses are more common and therefore staffing levels might need to be higher.

**Spatial boundaries**

A spatial boundary is a physical boundary such as a patient room, surgery suite, unit, central pharmacy, or a hospital. Because different spaces may be designed differently, for example patient rooms or unit designs may be different, and therefore any system design or redesign must fit with the different spaces. If a hospital elects to implement barcode medication administration using a barcode scanner tethered to a computer on wheels, the computer on wheels needs to be able to fit within the different spaces it will travel.

**Process boundaries**

A process boundary is the point at which one process is considered to end and another begins. For example, in the medication use system, it might be the boundary between ordering and transcription or dispensing and administration. These boundaries are important to identify because if a change is made to one process, the processes that come before and after may be impacted and also need to be changed.

**Hierarchical boundaries**

Finally, there are also hierarchical boundaries, which represent different levels within an organization. As Karsh et al. (2006) explained:

“... any given system is part of a larger system and also contains subsystems. For example, an inpatient nursing unit—which is itself a system—exists within a larger system such as a hospital. Also, that nursing unit contains subsystems such as patient rooms, medication administration systems, and within unit communication systems. These hierarchies (or nestings) of systems are important to understand for patient safety because they influence [provider] performance, and thus patient safety. This implies that (re)design of healthcare delivery systems
must involve careful consideration of (a) the context in which the system resides (higher level systems), (b) the influence of and impact on lower level subsystems, and (c) the impact on the inputs and outputs of other systems. Unintended negative consequences may otherwise occur.”

Figure 1 shows an example of such nested systems in healthcare delivery systems.

**Figure 1: Hierarchies under a healthcare system**

![Diagram of nested systems in healthcare delivery systems](image)

**Epidemiology of preventable patient harm**

As the previous sections explain, the care of a patient is influenced by many systems and their interacting dynamics. Looking at healthcare in this way shows just how complicated the cause of any single patient safety event really might be. This is all the more reason to carefully guard against jumping to blame and instead consider the system dynamics that
influenced the unwanted event. The idea of system hierarchies provides an especially important point.

As Karsh and Brown (2005) explained “Because these organizational hierarchies exist, they may exert as yet untested influence on the levels below; that is higher level organizational variables may impact medical errors through their influence on the lower level structures in the hierarchy. By ignoring these hierarchies, patient safety researchers may be inadvertently assigning erroneous causes and effect size magnitudes to variables that are in fact influenced by such dependencies.” The problem is that if you only look for causes at the sharp end, then you can only find causes at the sharp end. But if you cast a wider net and look at other parts of the system, you may find the underlying contributing factors. For example, if a patient is the victim of a wrong site surgery, and you only look for causes related to the surgeon, you will likely only find causes related to the surgeon. But if you use system thinking, and instead examine the information flow prior to the surgery, the technologies that were used leading up to the surgeries, and at cultural influences, you might find other underlying contributing factors. Consider a case of a patient receiving a wrong medication and a nurse being found photocopying patient identification barcodes. If we just look at the nurse, we conclude that the nurse was at fault for photocopying the barcodes. But if we look at the entire system under which the nurse works, we might find (or not) that the computer on wheels to which the scanner was tethered could not reach patients furthest from the door in the double occupancy rooms, and that management had told nurses to “do what you have to do”. In such a case, the underlying problems of the computer on wheels not fitting is what needs to be addressed, not the nurses.

**Applying the healthcare delivery system model**

To successfully analyze, design or redesign a system to improve patient safety, one must:

- be able to determine the inputs, transformations and outputs;
- be able to correctly bound the system; and
- be able to anticipate how a change in system elements will impact other elements.
Changes to system elements

Considering the complex interplay between system elements, changes to these elements are likely to have broad consequences. Any “simple” change is likely to reverberate throughout the system in planned and unplanned ways. Additionally, any “simple” change is likely to impact other elements, at different levels of hierarchy. That means if you change part of a system (computerized order entry, new alarms, new policies) you will impact the performance of your staff and the other components of the system.

Systems engineering design

When thinking about making a change to a system, by implementing a new policy, changing a layout, hiring a new manager, or implementing a new information technology, it is important to consider all of the different outcomes for which your system change must be designed. An important lesson from systems thinking then is that “good design” means a system that is designed to be able to achieve all of the different goals it may have. Those goals include patient safety, employee safety, productivity, efficiency, quality, fit with other technologies, fit within the physical environment, compliance with external and internal regulations and policies, and others. While this may sound impossible, evidence from other industries shows that if you take all of those goals into consideration in the first place, you can design a system to meet all of them. It used to be thought that achieving safety meant compromising productivity, but it is now well
recognized now that is a myth. In PSEP – Canada Module 2: Human Factors Design: Applications for Healthcare, examples are provided that show why you can achieve both safety and productivity simultaneously. The important point here is to realize that anytime you plan to design or redesign a system, you need to consider all of the different goals the system must achieve and take those into account.

**Is systems-thinking the same as a “blame-free” culture?**

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*Systems thinking vs. “blame-free” culture*

- Systems thinking is not a “blame-free” culture
- Emphasizes analysis of the entire system of care instead of a rush to blame individuals
- People are part of the system
disregard for professional responsibility is grounds to hold an individual accountable

Despite the fact that the systems thinking differs from the traditional blame culture, this does not imply that systems thinking is a “blame-free” culture. Systems thinking helps to ensure that when an adverse event occurs that there is not a rush to blame sharp end providers, but instead the entire system of care is analyzed. If after carefully studying the system it is determined that one of the factors that contributed to patient harm was disregard for professional responsibility when it could have been executed, then holding the responsible people accountable is justified.

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*Elements of a just culture of safety*

- There is focus on system, not on individual
- The organization accepts appropriate responsibility and accountability
- The organization does not tolerate willful misconduct and misbehaviour
- There is “a collective understanding of where the line should be drawn between blameless and blameworthy actions”

The following are important elements of a just culture of safety.

- The reasons for clinical outcomes and events are not prejudged, and any rush to blame individuals is avoided. Rather, there is an attempt to understand at the time the event occurred the circumstances and context for the actions and decision-making. The main focus of this analysis is on system failures. These are identified and to the extent possible corrected.
• The organization accepts appropriate responsibility and accountability. Individuals are not held accountable for system failures over which they have little or no control.
• The organization does not tolerate intentionally unsafe actions, reckless actions, disregard for the welfare of patients or staff, or other willful misconduct and misbehaviour.
• There is “a collective understanding of where the line should be drawn between blameless and blameworthy actions.”

Using systems thinking to determine accountability

The following case example illustrates how systems thinking can help determine accountability.

A patient receives the wrong medication. It was determined that the nurse administered the medication without first scanning the patient’s barcoded identification band. Instead the nurse had photocopied his three patient’s identification barcodes and kept the photocopies in his pocket. Should the nurse be held accountable?

In this case, it depends on what factors contributed to motivating the nurse to not scan the patient’s bar coded identification band. If the nurse did this because the scanner, which was tethered to a computer on wheels could not reach the patient because there was no room, then perhaps not. Perhaps that same nurse and others had been complaining that the scanners could not reach their patients, but nothing was done. Perhaps there had been tacit acceptance that nurses could not scan patient ID bands and everyone chose to look the other way? In all of these cases, it would seem the problem was that the system of care was not designed to support nurses scanning patient identification bands. The nurses had to still administer medications, and they did what they felt was a reasonable compromise. Systems thinking would suggest that holding the nurse personally responsible would not be appropriate. The nurse knew the correct procedures, but the environment prevented him from following the procedures.
On the other hand, in this same case, it might be determined that the patient’s identification band could have been scanned, but the nurse still chose to make the photocopy of the identification barcodes because the time he saved allowed him to take a longer lunch break. The nurse in this case should be held accountable.

Typically, the circumstances surrounding an adverse event will be quite complicated. Systems thinking and systems engineering approaches to studying accidents will help to ensure that the right decisions for action are made.

**Relationship to systems analysis**

You may have already heard of many system/safety analysis or and improvement techniques such as root cause analysis, failure modes and effects analysis, lean, and six sigma. All of those methods provide different ways of analyzing and improving system design and function. But, if you don’t first have systems thinking, any of those methods can lead to the wrong results. As already mentioned, if you try to use root cause analysis to analyze a sentinel event, but the analysis team has not been trained in system thinking, they will all likely conclude it one of the care providers was simply at fault without ever looking at the underlying contributing system dynamics.

**Applying systems thinking to the concept of human error**
Reason defined errors as “planned sequences of mental or physical activities that fail to achieve their intended outcomes, when these failures cannot be attributed to the intervention of some chance agency.” Errors may occur by doing the wrong thing (commission) or by failing to do the right thing (omission).

The definition contains three elements: a plan or intervention that includes a goal and the means to achieve it; a sequence of steps or actions initiated by that plan; and the extent to which steps or actions are effective in achieving their purpose. He developed three categories – slips, lapses and mistakes – to help analyze and understand the nature of errors.

**Slips and lapses:** errors resulting from some failure in the execution and/or storage stage of an action sequence regardless of whether or not the plan which guided them was adequate to achieve its objective.

**Mistakes:** deficiencies or failures in the judgmental and/or inferential processes involved in the selection of an objective or in the specification of the means to achieve it, irrespective of whether or not the actions directed by this decision-scheme run according to plan.

Irrespective of whether errors are described as slips, lapses or mistakes, they all involve a deviation from the goal. When a person making one of these types of errors is in direct contact with another person, equipment or system, Reason calls these **active failures**. These are also referred to as active errors or errors at the sharp end of the system. The origins of the events leading to an active failure may have commenced days, months or even years earlier.

Reason says two primary elements are always involved in accidents: active failures and **latent conditions**. Active failures are errors made by humans (for example, pilots, taxi drivers, crews, factory operators) which have an immediate adverse effect. Latent conditions involve poor decisions, poor designs, poor supervision, inadequate tools and equipment and actions by humans long before a given adverse event.

Reason describes latent conditions as “resident pathogens” which may or may not lead to an adverse event or patient safety incident. Management decisions, instructions by designers, builders and clinicians all have the potential to lead to future errors. In other words, the system thinking approach to error, as explained by Reason and others, is that underlying active errors (e.g. ordering or administering the wrong dose, unintentionally) are latent conditions or system design failures that create the conditions for the active error to occur.

These latent conditions are also known as hazards. As such, the systems thinking approach to the idea of errors is that while they do occur, our focus needs to be on the conditions that allow them to occur. A nurse might accidentally connect an enteral feeding tube to an IV medication port. That would be an error, but the hazard or latent condition in this case is that the feeding tube could connect to an IV connector in the first
place. Good systems thinking therefore deals with this unwanted outcome not by scolding the nurse or telling her to be more careful, but by making the connectors not connect.

Another approach to thinking about error using systems thinking is provided by Hollnagel. He suggests that the term human error is meaningless because a human cannot err in a vacuum. That is, the error is always defined by system interactions. In the preceding example, if there was no tubing, that error could not occur. The unwanted outcome was defined by the interaction between the nurse, the tubing, the patient, the policies and regulations, the physical environment, and the culture. Therefore calling something “human error” is to necessarily miss the point. He also points out that most attribution of “human error” is based on flawed reasoning and biases already discussed.

Applying systems thinking to the concept of violations

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Unlike errors, which are unintentional, violations are considered intentional. That is, except for what are known as erroneous violations which are violations committed because one does not know about the policy or rule. A traditional approach to violations is to punish the person violating the rule. The thought goes that if the person is intentionally violating a rule, they need to be held accountable for their actions. However, systems thinking demonstrates that such a view may be overly simplistic.

First, consider that violations that everyone agrees are more effective than current practices are often re-titled “best practices” and adopted institution wide. Those “violators” are rewarded for finding better ways of working. Second, sometimes following policy may not be appropriate for the situation. In a code situation it may be expected that certain policies that otherwise should be followed are disregarded because of the severity and time sensitive nature of the situation. If during a code people were to attempt to follow all policies, and the patient died, the responders would likely be blamed for not realizing they should disregard policy. Third, there are other times were system design prevents following policy. If there is a policy that nurses should always scan patient identification bands with barcode scanners prior to administering medications, but in some parts of the hospital the wireless system doesn’t work, or the hand held scanners keep losing their charge, or the scanners are not updating well because of other network
problems, then the nurses may simply not be able to follow policy despite their best efforts. To help with this, leadership can ask, “Is it alleged there is a deliberate violation of sound policy by an individual provider?” This gets to the heart of policies that are being ignored by all the staff, as they may not be known (a system issue) or that they are unrealistic or not resourced, so that workarounds are common (also a system issue).

There are many other examples of where violations may be the right thing or the only thing possible. All of this does not mean it is okay to violate policy; instead, it means that violations, like adverse events, often have underlying causes that need to be studied. One needs to consider if the policy is widely known by the staff, and assess whether it is unrealistic or not resourced so that workarounds are common. If there are latent conditions facilitating the violations, then it would be preferable to fix those conditions instead of blaming the provider.

Applying systems thinking to safety design

The core principle underpinning most “accident” frameworks is that multiple factors invariably are involved in accidents: individual situational factors, workplace conditions and latent organizational and management decisions all have a causal relationship with the underpinning processes leading to the accident. More complex processes and structures usually present greater potential for multiple factors and latent errors in the system.
Reason’s analysis of large scale disasters occurring in the 1980s noted that latent human errors rather than technical failures were dominant. Even when faulty equipment or components were present he observed that human action could have averted or mitigated the bad outcome. Healthcare providers at the sharp end most often catch the multiple failures that are cascading to cause the harm, but these individuals are fallible and eventually a patient may be harmed.

Pidgeon, who analyzed the findings of the Chernobyl investigation, observed that some large scale investigations failed to examine the wider organizational cultural issues. He argues that organizational errors and violations of operating procedures are often viewed as evidence of a “poor safety culture” rather than organizational characteristics contributing to the incident.

Reason says that only a systems approach (as opposed to a person approach) will create safer work cultures. His theory is strongly supported by evidence from the technological hazard industries which show the benefits of built-in defenses, safeguards and barriers. Engineered defensive systems include automatic shut-downs (alarms, forcing functions, physical barriers). Other defensive mechanisms are dependent on people, such as pilots, surgeons, anesthetists, and control room operators. Procedures and rules are also defensive layers.

For Reason, the pivotal post incident/accident question is why safeguards fail, rather than who caused it. Reason is credited with creating the ‘Swiss Cheese’ model to explain how vulnerabilities in the different layers of the system lead to incidents.

The above diagram building on Reason’s Swiss cheese model shows that a failure in one layer of the organization is usually not enough to cause harm. Bad outcomes in the real world usually occur when a number of failures occur in a number of layers (for example, rule violations, inadequate procedures, faulty equipment) and momentarily line up to permit a trajectory of accident opportunity. To combat this happening Reason invokes the “defense in depth” principle. Successive layers of protection (understanding, awareness, alarms and warnings, restoration of systems, safety barriers, containment, elimination, evacuation, escape and rescue) are designed to guard against the failure of the underlying layer.
According to the United States (US) Occupational Safety and Health Administration (OSHA), safety programs are comprised of five elements:

1. management leadership and employee involvement;
2. worksite analysis;
3. hazard prevention and control;
4. safety and health training; and
5. evaluation.

Management leadership and employee involvement

They explain that the first component is management leadership and employee involvement:

“Effective protection from occupational hazards takes leadership and commitment from top management. Management leadership provides the motivating force and the resources for organizing and controlling activities within an organization. In an effective program, management regards worker safety and health as a fundamental value of the organization. Ideally, this means that concern for every aspect of the safety and health of all workers throughout the facility is demonstrated.”

OSHA considers safety a value, not a priority. The difference is that priorities can change, where as values are held constant. If safety is considered a value, then no decision should be made without considering the safety implications to patients and staff.

Continuing to discuss management leadership and employee involvement, OSHA says:

“Other recommended actions for management leadership include visible management involvement, assigning and communicating responsibility, authority and resources to responsible parties and holding those parties accountable. In addition, management should ensure that workers are encouraged to report hazards, symptoms, injuries and illnesses, and that there are no programs or policies which discourage this reporting.”
Employees are encouraged to report hazards and close calls, not incidents. OSHA goes on to explain that part of management leadership is accountability:

“Any accountability system should have the following elements to be effective: established standards in the form of company policies, procedures or rules that clearly convey standards of performance in safety and health to employees. Resources needed to meet the standards, such as a safe and healthful workplace, effective training, and adequate oversight of work operations. A measurement system which specifies acceptable performance. Consequences, both positive and negative. Application at all levels. When managers and employees are held accountable for their safety and health responsibilities, they are more likely to press for solutions to safety and health problems than to present barriers. By implementing an accountability system, positive involvement in the safety and health program is created.”

The most important thing is whether the accountability system is supportive or punitive. Organizations should be encouraged to consider an approach that favours appropriate remedial action and education. Discipline and other sanctions should only be used if appropriate.

**Worksite analysis**

The second component, worksite analysis, refers to processes for identifying hazards, not errors. As Karsh et al 2006 explains:

“A hazard is anything that increases the probability of errors or of patient/employee injury. ‘Hazard’ is a safety term that means the same thing as ‘risk factor’ in healthcare or epidemiology and, like risk factors, hazards can vary by frequency, duration, location, predictability, and magnitude. As such, hazards can be located anywhere in the structure of the work system…Importantly, because all of these hazards occur in the real work environment, they typically interact with each other and can therefore lead to other hazards. For example, when a nurse is using a hand held wireless scanner for scanning patient identification bands and medications at the point of care, the medication and patient information displayed in the scanning device may be difficult to read because of poor contrast between the text and background in the display. The readability of the display could be even worse in situations where room lighting creates glare, possibly requiring the nurse to hold the scanning device at uncomfortable wrist angles. These interactions among inputs can be hazards in that they are potentially detrimental to different types of performance—in this case visual perception, decision making, and grasping may be affected which, in turn, may impact patient safety, employee safety, and quality output goals.”
Importantly, reporting is just one way to identify hazards. In other industries, inspection by safety experts is also used to identify hazards. Safety experts walk the halls to spot hazards that staff might not otherwise notice. Such inspections are most effective in identifying permanent fixed physical and environmental hazards that do not vary over time. They are less effective in identifying transient physical and environmental hazards, or improper workplace behaviors, as these hazards may not be present when the inspection is taking place. Therefore, both inspections and employee reporting are necessary as they complement one another.

There are benefits to working to identify hazards instead of errors.

- Hazard identification is proactive, whereas error identification is reactive. Identifying hazards is proactive because it does not require waiting for a patient safety incident or patient harm.
- Hazard identification removes the specter of blame because nothing bad has happened yet. On the other hand, if staff is encouraged to report errors, there is almost no way to do so without staff feeling blame is involved. A recent study by Morag and Gopher (2006) found that staff participation significantly improved when hospitals moved from error reporting to hazard reporting. In order to encourage incident reporting, staff should be lauded for reporting hazards and close calls.
- Hazards are things that can be directly acted on, whereas errors are not. Hazards are the underlying causes and are thus those things that need to be changed to improve safety. Errors are outcomes that themselves have causes.

**Hazard prevention and control**

The third component of a safety program is hazard prevention and control. After hazards to patient safety have been identified, they need to be controlled. There are many strategies for controlling hazards and they have varying levels of effectiveness. Within safety engineering there is a well-accepted hierarchy of hazard control which delineates what are the most effective safety interventions. The Institute for Safe Medication Practice (www.ismp.org) has adopted a similar hierarchy specific to medication safety. The general hierarchy is the following (from strongest to weakest).

**Eliminate the hazard**

Examples from the ISMP include “removing potassium chloride for injection concentrate from all patient care areas; using medication cups or specially designed oral syringes (not parenteral syringes) that will not connect to IV tubing for all liquid oral medications.” In these examples the hazards themselves are removed (medication is actually removed from the floor) or the hazard is eliminated (the tubes cannot connect). These are considered the most powerful safety interventions because the underlying cause is removed. Removing the medication from the floor eliminates the chances that nurses will
accidentally administer it. Making the tubing connections incompatible eliminates the possibility that nurses, even when being careful, will misconnect the tubes.

**Prevent access to the hazard or guard against the hazard**

In some cases, hazards cannot be eliminated. In these cases, creating barriers or limiting access is effective. In a factory, an example would be having a guard over a rotary saw blade. The factory needs to cut timber, so the hazard of the rotating saw cannot be eliminated, therefore the guard is put up to prevent access. In healthcare the same principle is used when certain medications are locked away or retractable needles are used. These types of interventions are clearly weaker than the first, but still provide a strong control of the hazard. For example, separating hydromorphone (Dilaudid) from the morphine supply would lessen the likelihood of a mix up. As hydromorphone is five times as potent as morphine, if given in the usual dosage as morphine it could result in respiratory arrest.

**Training**

Training and education are critical for safety. People must understand how to work safely. Relying on training alone to produce safety is ineffective however, unless it is combined with good system design. For example, a nursing home could train personal support workers in two-person patient lifts, but if they don’t staff sufficiently to have personal support workers available to help each other lift, the training is useless. Similarly, physicians can be trained to use a new order entry system, but if there are insufficient numbers of computer terminals available, the training is unlikely to be applied and the physicians will find other ways to get their orders placed.

**Warnings, rules and policies**

Like training, warnings, rules and policies are important to help facilitate safety, but they do not create safety. Good system design creates safety. Warnings may be missed because of poor placement or poor readability. Warning and policies can be ignored under time constraints or when they do not match the realities of the care environment. For them to be effective, they need to be supported by good system design.

Notice that the weakest safety interventions are those involving policy changes or educational campaigns. Even though in healthcare these are often the first reactions, they are considered the weakest because they do not change the system. They leave all of the elements of the system in place, which means the underlying hazards are not changed.

**Safety and health training**

The fourth component of an effective safety program is training. Even though training does not by itself create safety, it is a critical element that can facilitate safety when the
rest of the system is also designed well. But, as OSHA explains, safety training also involves training staff to be able to understand and identify hazards (see step 2 above).

**Evaluation**

In addition, an important fifth component is to evaluate the safety program effectiveness and make changes as necessary to improve its operation.

**High reliability organizations**

High reliability organizations refer to organizations or systems that operate in hazardous conditions but have successfully decreased adverse events. They demonstrate to healthcare organizations that they too can improve safety by focusing on the system. Air traffic control systems, nuclear power plants, and naval aircraft carriers are complex organizations which were originally studied by a group from Berkeley (La Porte, Roberts, Rochlin) who coined the term High Reliability Organization (HRO). These organizations plan for failure and are skilful at avoiding or minimizing catastrophes through promoting creative problem solving.

Obviously a nuclear disaster has a different magnitude than a patient safety incident in healthcare. HROs judge their success by ensuring ‘failure free’ performances. They have fewer incidents, but when they occur they have major impact and long term consequences for many. In healthcare, patient safety incidents are more numerous and when they happen usually only affect a few. Because of the advances in medicine there is now much common ground between HROs and healthcare.

The common ground they share covers the following topics.

**Social and technical complexity**

Healthcare organizations are associated with complex ‘socio-technical’ systems because of the diversity and range of interdependencies among people and technology.
High-risk/high consequence

The known risks associated with complex processes are complicated by the known risks associated with healthcare (medications, procedures and technology) and the risks related to diseases and conditions patients experience.

Knowledge intensiveness

Problem solving is central to achieving reliable patient safety goals.

Uncertainty

Because of the array of technology and diversity of people (patients and providers) it is impossible to predict how they will function at any given moment. It is also impossible to constantly observe and monitor them. In place of direct observation people are required to make judgements and make decisions without the full picture. In such circumstances unpredictable things happen that can undermine good intentions.

The message for healthcare is that organizations have achieved consistently safe and effective performance records despite the unpredictability in the work environments or the dangers that their work present.

Characteristics of HROs

High Reliability Organizations share the following characteristics:

- preoccupation with failure (the acknowledgment of the high-risk, error-prone nature of an organization’s activities and the determination to achieve consistently safe operations);
- commitment to resilience (the development of capacities to detect unexpected threats and contain them before they cause harm, or bounce back when they do);
- sensitivity to operations (an attentiveness to the issues facing workers at the frontline), which comes into play when conducting analyses of specific events (e.g. frontline workers play a crucial role in root cause analyses by bringing up unrecognized latent threats in current operating procedures), but also in connection with organizational decision making, which is somewhat decentralized; and
- a just culture of safety in which individuals feel comfortable drawing attention to potential hazards or actual failures without fear of censure from management.

Management units at the frontline are given some autonomy in identifying and responding to threats, rather than adopting a rigid top-down approach.
Features of HROs

These organizations also share a common set of behaviors or attributes.

Safety is a priority
Each worker in the organization knows and understands their roles and responsibilities. Uppermost in their minds is the need to be alert to the possibility of something unintended happening. They are ready for failure.

Training for all
Knowing one’s job requires training. HROs ensure their employees are fully trained to do their jobs as well as understanding of their role in times of crisis. Experience and education are highly valued in HROs.

Communication and team work
A distinguishing feature of HROs is the organizational support and promotion of flat hierarchies where the most junior members of the team or workgroup are encouraged to bring potential problems to the attention of their seniors and supervisors. Face to face communications are highly valued. People in HROs do not conform to a rigid chain of command; rather, leadership falls to those with the appropriate expertise or immediate authority to act.

Organizational learning
HROs depend on their staff observing the activities around them as well as reflecting on those activities in terms of their relationships and occurrence. What was different this time? How well was the activity achieved? They also need to be creative in their tasks by planning and reviewing their processes. How well is this task designed? None of these activities are worth much, however, unless the worker can act on their judgments or assessment. It may be relatively easy to observe, reflect and create but it is difficult to act because the organization needs to be designed to facilitate this.
Reporting, analyzing and recovering from error

HROs know and understand their mistakes because they report, analyze, and recover from them. They also analyze near misses because of the opportunity to examine any presenting information that nearly resulted in harm. Creativity is rewarded particularly in relation to adapting activity and action to sustain safety.

Preventing the normalization of deviance

HROs do not tolerate routine violations of the rules. Rules are not meant to be broken, except in exceptional circumstances. Reason defines a violation as a deviation from safe operating procedures, standards or rules.

Framework for handling safety information

Ron Westrum identified 3 types of organizational cultures to describe the way they manage information about safety – pathological, bureaucratic and generative. He recognized that organizations with high potential for catastrophe require creative thinkers who can imagine a full range of possible scenarios that might end in failure. He referred to this as Requisite Imagination. HROs (or generative organizations) all demonstrate Requisite Imagination. Organizations experiencing accidents do not have requisite imagination, and this absence of a diversity of thinking is a common feature of most organizational accidents.

Wise after the event

Using hindsight rarely uncovers the true characteristics of an impending disaster. Research shows that people are not accurate about their own or others’ state of foresight knowledge. Reason argues that a warning of an impending disaster can only really be appreciated if the kind of disaster to follow is known. He says that many disasters that happen were disasters that people believed could never happen; Reason called these impossible disasters.
Questions to ask

The next series of slides provide questions that can be asked whenever a change is being considered to a system. That means any technology, personnel, task, organization or environmental change. Regardless of the change, all of the questions should be asked. That means if a clinic is considering a new electronic health record, questions should not be restricted to those on the “technology” slide, but should come from all of the slides.

Technology questions

Slide 43

What technologies, tools, or equipment are used?
• Who uses them and how?
• Where do they come from?
• Who is responsible for maintaining them and how?
• What communication (feedback) is critical? To whom?

Organization questions

Slide 44

What policies and rules are involved in determination?
• What supervision is involved and who supervises?
• Where do rewards come from? What are they?
• Who enforces and / or makes decisions?
• What communication (feedback) is critical? To whom?
- What communication (feedback) is critical? To whom?

**Environment questions**

Slide 45

- What environmental factors might affect system components or execution?
- How do changes to physical layout or structure impact other components?
- What communication (feedback) is critical? To whom?

**People (staff/patient) questions**

Slide 46

- Who influences execution or is involved?
- Where do they come from (other units or temporary agencies)?
- Who provides information relevant to system?
- Important characteristics (e.g., experience)?
- What communication (feedback) is critical? To whom?
**Jobs/tasks questions**

Slide 47

- What information is needed for execution?
- What is needed for cognitive, physical, and social performance?
- What other jobs or tasks affect the influence or are affected the system?
- Who carries out these jobs?
- Who is responsible for them?

**Summary**

Slide 48

- To blame is human, but once you understand that, you can guard against it using systems thinking
- Healthcare delivery is a complex system of interacting components. The interactions among the components produce safety or a lack thereof

All the evidence about errors and knowledge about humans suggest that the best approach to quality and safety in healthcare is with the application of systems thinking to healthcare. A systems approach as opposed to a person approach has the greatest potential to create safer work cultures because it treats underlying causes, whereas a person approach treats only the symptoms.

Evidence from the technological hazard industries show that when organizations establish built-in defences, safeguards, and barriers, the benefits in terms of greater safety are undeniable. Efforts to improve healthcare will be diminished to the extent that problematic units are focused on in isolation from the whole of the system.

Unsafe organizations usually share the following characteristics:

- a failure to respond to the risks and lack of categorizing the severity of risks;
• no opportunity to share concerns and learn from each other about workplace risks and hazards;
• organizational targets and performance requirements have priority over safety;
• continual use of bad designs;
• hierarchical workplaces where individual team members are prevented from speaking up about safety concerns; and
• routine violations of safety rules without remediation.

### Potential pitfalls

#### Slide 49

1. Do not blame individuals involved in a patient safety incident
2. Be careful about using hindsight in explaining an adverse event or patient safety incident
3. Avoid simplistic explanations for failures and faults

### Pearls

#### Slide 50

1. Think where service fits in the healthcare system
2. Healthcare is a system and this affects thinking about the individual workplace
3. Failures are usually caused by bad processes rather than bad people
1. Think of where the healthcare service fits in the wider healthcare system.
2. Understand how healthcare is a system and how this affects the way one thinks about the individual workplace.
3. Failures are usually caused by bad processes rather than bad people.
4. Organizations can redesign healthcare services that prepare for failure and faults.
5. Remember that organizations learn from mistakes.
6. Understand how complexity can impact on relationships.

**Toolkits & outcome measures**

Refer to the Toolkit and Resource Compendium (PSEP – Canada Appendix 1c) for more details on the following toolkits.

- **The Safety Competencies**: The Safety Competencies were produced in collaboration with The Royal College of Physicians and Surgeons of Canada (CanMEDS Office). This important work was spearheaded by the Canadian Patient Safety Institute’s Education and Professional Development Advisory Committee and was guided and crafted by an interprofessional team of educators (Steering Committee). Each domain was further developed by theme-based working groups. [http://www.patientsafetyinstitute.ca/English/education/safetyCompetencies/Pages/default.aspx](http://www.patientsafetyinstitute.ca/English/education/safetyCompetencies/Pages/default.aspx) [http://www.patientsafetyinstitute.ca/french/education/safetycompetencies/pages/default.aspx](http://www.patientsafetyinstitute.ca/french/education/safetycompetencies/pages/default.aspx)


• **Learning from adverse events: Fostering a just culture of safety in Canadian hospitals and health care institutions.** Ottawa, ON: Canadian Medical Protective Association; 2009.

• **Safer Healthcare Now!** [http://www.saferhealthcarenow.ca](http://www.saferhealthcarenow.ca)

**Resources**

Refer to the Toolkit and Resource Compendium (PSEP – Canada Appendix 1c) for more details on the following resources.


Medical Association Journal, 170(11), 1678-86.


- Crossing the Quality Chasm: A New Health System for the 21st Century:

- OSHA Safety and Health Management
  http://www.osha.gov/SLTC/etools/safetyhealth/comp1_mgt_lead.html
  http://www.ismp.org/Newsletters/acutecare/articles/19990602.asp

References


Principal message

The single most important message your audience should come away with is that seeing healthcare in terms of systems is a powerful way to understand how to make care safer. As a part of this insight, the participant should come away convinced that ascribing accountability only to people at the sharp end of an incident is counterproductive.

Module overview

Patients depend on many people doing the right thing at the right time with interactions, medicines and equipment that work and in a suitable environment; in other words they depend on a system of care. Understanding systems of healthcare is therefore essential.

Health systems are made up of many interacting parts comprising individuals (health professionals, administration and management staff, patients and their caregivers) infrastructure (administration, governance arrangements) and technology (drugs, equipment, diagnostics). The ways they interact with one another and how they collectively act is complex and variable. Understanding the nature of complexity in healthcare is essential for understanding why things break down and for finding solutions.

This module describes the psychology of blame that can result in misleading directions. It defines systems, and describes their inputs, processes, outputs and feedback. It describes system boundaries and how systems interact. It delineates how engineering design reveals a more productive approach to accountability and with better design can help healthcare systems perform safely. Components of a safety program are identified. Lessons from other industries provide for an examination of the characteristics of high reliability organizations. Finally, an approach is set out to handling safety information and for preparing for change.

Preparing for a presentation

1. Assess the needs of your audience

Choose from the material provided in the syllabus according to the needs of your expected participants. It is better for participants to come away with a few new pieces of information, well learned, than to come away with a deluge of information from which they can remember little or nothing.

2. Presentation timing

Allow sufficient time to collect participants’ demographic data and complete the pre-test.
The suggested timing for each part of this module is:

<table>
<thead>
<tr>
<th>Part</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>2-3 minutes</td>
</tr>
<tr>
<td>DVD trigger tape &amp; discussion</td>
<td>5-7 minutes</td>
</tr>
<tr>
<td>Presentation</td>
<td>35 minutes</td>
</tr>
<tr>
<td>Summary</td>
<td>2-3 minutes</td>
</tr>
<tr>
<td>Post-test &amp; Evaluation</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Total</td>
<td>49-53 minutes</td>
</tr>
</tbody>
</table>

3. **Number of slides: 51**

4. **Preparing your presentation**

The text in the syllabus was not designed to be used as a prepared speech. Instead, the text provides material you may want to use. The slides have been designed to trigger your presentation. Although the slides closely follow the text of the syllabus, they do not contain all of the content. Their use presumes that you have mastered the content.

You may want to make notes on the slide summary pages to help you prepare your talk in more detail and provide you with notes to follow during your presentation.

Remember that you can adjust the slides to suit your presentation content, your style, and to make it feel fully familiar and your own.

Practice your presentation using the slides you have chosen, and speaking to yourself in the kind of language you expect to use, until it is smooth and interesting and takes the right amount of time. The most accomplished presenters and teachers still practice prior to a presentation; don’t miss this step.

5. **Preparing a handout for participants**

The syllabus text and slides in the Participant’s Handbook were designed to be reproduced and provided to participants as a handout. Take the portion you need; they can be used in their entirety, module by module, or for just one specific topic. Please include the following in each set of handouts:

- **PSEP - Canada Front Cover Page**;
- **PSEP - Canada Acknowledgment Pages** (to acknowledge the source of the material);
- **PSEP - Canada Table of Contents** (to give each participant an overview of the PSEP - Canada Curriculum so they know where their topic fits in the larger scheme of patient safety);
- syllabus and slides for your topic; and
- appendix material as relevant.
6. Equipment needs

- Slide projector and screen
- DVD player and monitor or projector
- Flipchart, or overhead projector with acetates, and markers for recording discussion points

Test your equipment beforehand to ensure that it works.

Review your DVD segments to assess which trigger videos or portions you would like to use.

Have a back-up plan so that if there is any equipment failure you can move without panic to your back-up plan. For instance, have in mind that:

- if the DVD fails, you can read the vignette of the trigger tape story;
- if the slides cannot be shown, you can refer to the hand out slides; and
- if the markers or overhead projector do not work, you can have participants list items on their hand outs that you would have written up for all to see.

Making the presentation

1. Introduce yourself

If you have not already done so, introduce yourself. Include your name, title, and the organization(s) you work for. Briefly describe your professional experience related to the information you will be presenting.

2. Introduce the topic

Show the title slide for the module. To establish the context for the session, make a few broad statements about the importance of topic as a patient safety matter. Tell participants the format and time you will take to present the session. Identify the teaching styles that you intend to use.

3. Review the session objectives

Show the slide with the session objectives listed. Read each objective and indicate those that you are planning to emphasize.

4. Show the DVD trigger tape

After reviewing the objectives for the session, show the DVD trigger tape. It has been designed to engage the audience and provide an appropriate clinical context for the session. It was not designed to demonstrate an ideal interaction, but to “trigger” discussion.
Trigger tape content

This module’s trigger tape depicts a physician on the phone with a recently discharged patient. The patient has confused the names of her medications and accidentally taken the wrong dose of a medication. Following the phone call, the physician and her colleague discuss systemic problems with medication instructions at patient discharge and how the system could be improved.

Keep in mind that the facilitator may choose to use any one of the trigger tapes. Since the vignettes are rich and overlap in their teaching points, it may make sense to do this, for instance if an audience has seen the trigger tape already or if a trigger tape from another module is easier for the audience to identify with.

A teachable moment: discussion after the trigger tape

After the trigger tape, ask the participants for their comments about the issues and the interaction they have just seen. To affirm what they contribute, consider recording the important points on a flipchart or overhead projector.

If the discussion is slow to start, you may want to ask more direct questions, like:

- How does this situation illustrate that healthcare delivery is a matter of systems?
- Has a patient ever had something like this happen in your institution? What did you / your colleagues do?
- What is challenging about dropping the inclination to blame?

Use the discussion to set the stage for the material to follow. Do not let the discussion focus on a critique of the technical quality of the DVD or how “real” the players seemed. If the participants do not like something that was said or done in the DVD, acknowledge that there is always room for improvement and ask them how they would do it themselves.

Setting limits to discussion time

It is usually best to limit discussion of the DVD to no more than five minutes, then move on to the presentation. To help move on if the discussion is very engaged, try saying something like:

- let’s hear two last points before we move on, and
- now that you have raised many of the tough questions, let’s see how many practical answers we can find.

For the more advanced facilitator who is confident of both the patient safety material and his or her pedagogic skills, it is possible to use the trigger tape as a form of case-based teaching and to facilitate the discussion to draw out the teaching points of the module. If this approach is used, it is essential to write up the points on a flip chart as they arise, to fill in any gaps and to summarize at the end. The hazard of this approach is that the discussion will not yield the desired teaching points. Return to the slides if this happens.
5. Present the material

**Recommended style: interactive lecture**

An interactive lecture will permit you to engage your audience, yet cover your chosen material within the time. You can use as your interactive components the trigger tape stimulated discussion, perhaps with some resulting case-based teaching, and an interactive exercise.

**Interactive exercise**

This module comes with a jigsaw puzzle kit that pieces together parts of a system. The participants can see how systems interact to bring about or prevent a particular outcome as they play with this puzzle. The puzzle pieces together show a Cause and Effect Diagram. In addition to a minimum of pieces that have described events, there are blank pieces that the participants can write on and add to the ‘backbone’ of what leads to the final event. Other pieces fit on the sides of the backbone; one color depicts factors that make the outcome more likely; another color depicts factors that make it less likely. Again, some of the pieces have described factors written on them, others are blank so the participants can add as they see fit.

Ask your participants to work in small groups to fit the jigsaw puzzle together and to add events or situations that might factor into the outcome in their institution.

When the groups have completed the task, invite them to comment on:

- what they learned about systems thinking, and
- what features of interacting systems were not represented in the jigsaw puzzle.

**Alternative style: trigger tape guided case-based teaching**

Use the trigger tape to include some case-based teaching. To help participants feel involved and invested, you may invite them to give you a case from their institution or experience. However, it is usually best to return to the trigger tape to draw out analytic points for teaching since the case is known to you and you do not need to ‘think on your feet’ too much.

6. Key take-home points

1. Patients depend on system for safe care.
2. Health systems are made up of individuals, infrastructure, and technology.
3. Systems have inputs, processes, outputs and feedback, and they interact.
4. Blame can result in misleading directions.
5. Safety program include: management leadership and employee involvement; worksite analysis; hazard prevention and control; safety training; and evaluation.
6. High reliability organizations have: safety as a priority; training for all; good
communication & teamwork; processes for organizational learning; processes for
reporting and recovering from error; and methods to prevent the normalization of
deviance.
7. Preempt mishap resulting from change by asking engineering design question.

7. Summarize the discussion
Briefly, review each part of the presentation. Recap two or three of the most important
points that were discussed.

8. Debrief about the teaching method
Tell the group that it is time to consider the teaching method used, how it worked and
what its limitations were. Ask them what other methods might work, and what methods
would work best for the topic in their home institutions. Ask them to consider what
method would work best for themselves as facilitators and for their target audience.

9. Post-test/evaluation
Ask the participants to complete the post-test questions for this module and to evaluate
the session in the provided brief survey.