The Nexus between Nursing and Patient Safety

Cynthia A. Oster
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Editors

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Contents

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Part I

Foundations of Patient Safety

Patient Safety: History, Current Models, and Future Directions for Improvement

Jane S. Braaten

1 Introduction

Patient safety is a term echoed daily throughout the halls of hospitals, clinics, ambulatory healthcare agencies, and anywhere where healthcare is delivered. It is a non-arguable fact that we, as healthcare professionals, should keep those who are in receipt of our care, safe from harm. Even Florence Nightingale [1] asserted that hospitals at the very least should do the sick no harm. However, achieving the goal of reliable and consistent safety is not as easy as Nightingale's declaration. Patient safety today is complex, multifaceted with technology and social factors intertwined. As commonplace as the term "patient safety" is used, it is still somewhat elusive and misunderstood at many levels. Patient safety deserves a new understanding and actions to move forward to achieve the outcomes that Nightingale envisioned.

1.1 Definition of Patient Safety

The World Health Organization (WHO) defines patient safety as follows: "Patient Safety is a health care discipline that emerged with the evolving complexity in health care systems and the resulting rise of patient harm in health care facilities. It aims to prevent and reduce risks, errors and harm that occur to patients during provision of health care. A cornerstone of the discipline is continuous improvement based on learning from errors and adverse events" [2]. The WHO has declared patient safety as a global health priority and states that the occurrence of adverse

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events due to unsafe care is likely one of the ten leading causes of death and disability across the world. Furthermore, the issues that are most concerning in patient safety include:

- Medication errors
- Health care associated infections
- Unsafe surgical care procedures and complications from surgery
- Unsafe injection practices that transmit infections
- Diagnostic errors
- Unsafe transfusion practices exposing patients to adverse reactions and transmission of infections
- Sepsis
- Radiation errors
- Venous thromboembolism [2]

The significance of patient safety cannot be overstated. The measurement, understanding of how errors occur, and how to improve patient safety is a continual challenge. For example, patient safety is measured in various ways with limitations that leave us with an incomplete picture of harm from preventable mistakes. Clinical measurement of patient harm includes retrospective chart reviews which focus on identifying "triggers" that may suggest an adverse event; voluntary error reporting systems, electronic surveillance that detects triggers of adverse events, administrative data which is used to detect coded events of harm and patient reports of harm [3]. This type of measurement is quantifiable and easily understood with patient safety defined as the absence of adverse events. However, patient safety is much more than just metrics.

The discipline of nursing is at the frontline of preventing harm in healthcare. As the care providers who spend the most time with patients, nurses need to not only be clinical experts but also experts on how harm occurs and how to prevent harm. This chapter will provide a lens for which nurses can view and make sense of patient safety through first, an introduction to the history of patient safety and the current state of healthcare harm. The next section will discuss current models used to understand error and prevention with a distinct focus on frontline care. The chapter will conclude with a discussion of future directions that inform the roles of all healthcare providers, specifically clinical nurses who intentionally and visibly protect those in our care from harm and serve as frontline leaders for patient safety.

2 History of Patient Safety and Current State

2.1 To Err Is Human

As mentioned earlier, keeping patients safe and free from medical errors is not a recent concept. Accounts of unintentional errors and harm go back for decades [4]. However, when safety historians are asked what started the patient safety movement, most agree that the report by the Institute of Medicine (IOM), *To Err is Human*, published in 2000 [5], caused a burning platform that began a force for change [6]. This report highlighted preventable medical errors that caused harm. The authors stated that 44,000–98,000 humans were killed every year due to medical errors and more than a million more people were injured. They equated this to a jumbo jet crash every day. This connection was frightening and made headlines nationally and internationally.

An article published at the time [7] discussed why, after many years of mistakes and unintended outcomes, the IOM report caused such an uproar. The simple answer is that the report was designed to create a public demand to increase safety in healthcare. The jumbo jet comparison probably was intended to make headlines to create a quote to lead the change. The report included stories of individuals who had died from medical errors. Wears and Sutcliffe [6] state, despite many criticisms and inaccuracies, the report achieved status because it played upon the fears of the public toward a trusted profession. The use of the word "error" in the IOM report created a victim (the patient) and a perpetrator (the healthcare system). It also made clear the imperative that the healthcare community needed to "fix this problem." This report and its controversial jumbo jet comparison created the perfect message for journalists to disseminate. The public and professional recognition of the problem called for nothing other than a commitment to improvement from the medical community. Although the patient safety movement existed long before this report, the public attention to patient safety began in earnest.

Stelfox et al. [8] noted a substantial increase in publications on the topic of patient safety after this report was published. More attention was focused on patient safety than ever before. Patient safety began to become a part of national dialogue as well as embedded and institutionalized into healthcare organizations. Efforts also included adopting safety interventions from national organizations and other fields, measuring patient safety with metrics, and creating improved information technology [9]. Examples of campaigns, programs, and movements that came after the IOM report and their respective websites are below:

- The Institute for Healthcare Improvement (IHI) launches the 100,000 lives campaign, a massive campaign to improve safety in hospitals as well as a follow-up campaign with a broader safety goal, to save five million lives. (Overview | IHI—Institute for Healthcare Improvement)
- Patient safety specialists, patient safety officers, created as well as a certification for patient safety expertise, the Certified Professional in Patient Safety (CPPS). (CPPS: Certified Professional in Patient Safety | IHI—Institute for Healthcare Improvement)
- The National Patient Safety Foundation (NPSF) creates the Lucian Leape Institute to promote patient safety. (IHI Lucian Leape Institute | IHI—Institute for Healthcare Improvement)
- The AHRQ releases the Hospital Survey on Patient Safety Culture (HSOPS). (Surveys on Patient Safety Culture (SOPS) | Agency for Healthcare Research and Quality (ahrq.gov)

- The Josie King Foundation created to prevent harm from medical errors. (Landing—Josie King Foundation)
- Patient safety indicators introduced to reliably measure patient harm from a variety of causes. (AHRQ QI: Patient Safety Indicators Overview)
- The Joint Commission introduces annual patient safety goals to guide care and raise awareness. (National Patient Safety Goals | The Joint Commission)

This is, of course, not a complete list, but examples of the work that commenced after the IOM report and continues to take place in the world of patient safety. So does all this activity equate to real safety? Are we now safe in healthcare? The jury remains out on these questions due to variation in measurement over the years. Clinical measurement of harm has not been consistent, so it is difficult to clearly show improvement. Also, reporting and acknowledgment of adverse events have increased dramatically so it is difficult to know if we are just reporting and noticing these events more often or if they are more prevalent.

3 Are We Safer?

Thirteen years after the IOM report, James [10] used a trigger tool to identify harm in healthcare and found that more patients died per year than originally cited in the IOM report. He estimated that up to 400,000 patients die each year due to medical harm rather than 98,000. Pangioti et al. [11] found that in various medical settings, 1 in 20 patients experience harm. More recently, 23 years after the IOM report, Bates et al. [12] found that up to 25% of patients in a hospital setting experience an adverse event and that a fourth of those events are preventable. In the publication, *Still Not Safe*, [6], the authors list 17 studies from 2004 through 2016 that found safety had not improved as anticipated and as expected. As noted earlier, the variation in measuring "error" and "harm" is not consistent and the complexity of healthcare is not the same as it was in 1999, so it is difficult to measure progress in any standardized method [13]. However, despite all the action and programs directed at patient safety, it appears that healthcare is still not as safe as it could or should be.

As explanation for the lack of improvement, Donald Berwick stated in an editorial, that safety has taken a back seat to other issues in healthcare [13]. Wears and Sutcliffe [6] discuss conditions that may explain why patient safety has not improved much over the years:

- Patient safety has become institutionalized in healthcare with a system that has become more bureaucratic than anything else with measuring and monitoring as the focus.
- Safety science from other fields has largely not been translated to healthcare.
- Framing medical harm and adverse events as "error" places the onus on the individual at the frontline to change and not the organization that supports the frontline.

The authors compare the difference between healthcare's advancement of safety to the airline industry:

> Aviation safety was not advanced by pilots working on "safety projects, but rather by partnership between subject matter experts (pilots, air traffic controllers, mechanic etc.) and safety scientists (psychologists, engineers, communication scientist etc.) [6, p. 197]

In other words, aviation safety advanced due to knowledge and experience from the frontline and collaboration between safety scientists and the frontline experts. This collaboration has not occurred as readily in healthcare.

Others have reflected on the progress or lack of progress. A recent inquiry [14] asked 13 hospital and healthcare executives for their opinion on why healthcare safety has not improved. The interviewees all acknowledge the difficulty in measuring progress in error and harm reduction. They also identified many areas that have improved such as anesthesia care, reduction of hospital acquired infections, transparency of harm, and high reliability organization culture change. On the other hand, the interviewees cite that patient safety suffers from the following:

- Lack of proactivity
- Lack of real system change
- Lack of innovative thinking
- Lack of transformation within the context of current healthcare reality (financial constraint, staffing shortages)
- Lack of robust measurement
- Lack of patient input on patient safety
- Lack of usage of safety science engineers
- Lack of learning from near misses and close calls as well as successful cases

Adding to that challenge is the difficult landscape we have been navigating through, during and after the pandemic. Preventable hospital acquired infections that had shown great improvement regressed during the post pandemic time period [15].

In summary, patient safety is a dynamic challenge for healthcare. It is dependent on collaboration between clinicians/patients with safety science to understand and prevent errors and should be focused on how to support the frontline as the complexity of healthcare is growing exponentially. The understanding of how patient safety is realized in healthcare is still somewhat elusive and is focused more on metrics than how safety is created by systems and individuals. The next section will discuss the safety models relevant to frontline clinicians as means to understand and prevent error as we place patient safety into a context that nurses can and do apply every day.

4 Useful Models of Safety

4.1 Swiss Cheese Model (SCM): A Simple, Well-Known Model for Understanding of Error

The Swiss Cheese Model (SCM) created by James Reason [16] is one of the most widely known and used models to understand how accidents and errors occur. In this model, accident-causing conditions move through several weak layers in a system and finally result in a harm causing event. The simple explanation is that each layer of cheese represents a barrier to an accident. When the barrier is weak as compared to a piece of Swiss cheese with holes, the error continues through the block of cheese until it meets a barrier that is solid which stops the error. If no barriers are solid and without holes or weaknesses, the error finally gets through the cheese or system and causes harm.

This model explains errors that are caused by active and latent factors. These factors have also been described as “sharp end” or “blunt end” errors [17]. The latent factors or blunt end errors occur within the system and often are not realized until harm occurs. Currently, these latent contributors can include organizational culture, leadership and supervisory factors, equipment issues, staffing issues, policies that do not work at the frontline, production pressure, and many more. An active or sharp end error is one that happens nearest to the harm and is often experienced by an individual. These are usually caused by three types of human error as shown in Table 1. Skill based, rule based, and knowledge based errors are originally described by Jens Rasmussen [18].

There are many critiques of the SCM which include that it is too simplistic, linear, and static [19] so that it does not assist in the dynamic environment in which healthcare is practiced. However, a key contribution of this model is that it identifies two ways that accidents and errors occur: from acts by individuals and by issues within an organization or system which may be contributing factors. The model has practical power and makes sense to healthcare for the following reasons:

- It visually explains a basis for accidents that makes sense.
- It explains that accidents do not just occur because of an individual making a mistake: many factors contribute.

Table 1 Types of human errors

	Skill-based error	Rule-based error	Knowledge-based error
Definition	Lapse, slip, misstep	Failure to follow a process or procedure	“Figuring it out” Failure to obtain guidance when in an unfamiliar situation
Cause	Usually occurs while doing routine processes. Can be caused by inattention and or distraction	Process wasn’t known, available, clear, or able to easily follow	Pride, illusion of competence, culture doesn’t support asking questions

- It acknowledges that contributors to accidents are within the systems we create and exist long before an accident occurs. These contributors need to be corrected in order to prevent reoccurrence of an accident.
- The model emphasizes that even though we believe we have safeguards to errors in place, there may be weaknesses in the implementation of those safeguards that allow an error to progress.
- It subtly depicts that an error can be prevented or averted by one action that "plugs" up a Swiss cheese hole. However, acknowledging that this may prevent one accident from progressing but may not prevent the next one.

Weigmann and colleagues [20] give a great example of the practical application of the model. They recall the old story of the Dutch boy who noticed a leak in the dam and plugged the dam up with his finger, saving the city from flooding. The leak was an error that was noticed and corrected immediately by a person at the frontline, thus preventing harm. However, the factors that led to the leak needed to be addressed or the hero would have been stuck with his finger in the dam for days. This is a simple application of how latent factors contribute to errors that can be corrected quickly by an attentive frontline but need to be addressed at a higher level.

Let's apply this to an understanding of a common error involving clinicians working within a medical system: the medication error. The example in Fig. 1. illustrates the error within the SCM.

Specifically in this model, an error does not cause harm immediately. The error typically goes through several layers of barriers until it gets to a patient to cause harm. Several factors within each step of the error can be effectively examined within this model. Note that in each step of the process, there may be active failures as well as latent conditions as shown in Table 2.

This model, as any model, has strengths and weaknesses. Still, the main points are strong and practical.

- Errors in a complex system will go through many layers prior to causing actual harm. Healthcare providers are the frontline of defense who can recognize red flags of failure and stop the error from progressing.
- There are many factors at a system level that contribute to errors that are not recognized or addressed.

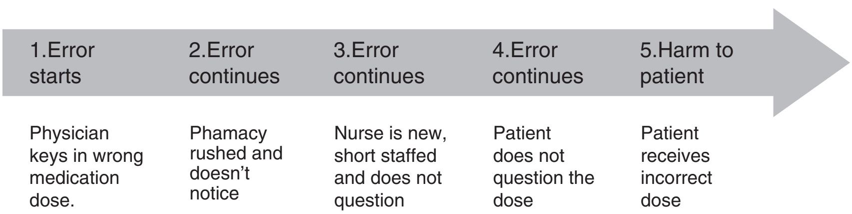

Fig. 1 Application of SCM to medication error

Table 2 Active failures and latent conditions in a medication error

	Active failure	Latent condition	Active solution that would've prevented error from progressing	Latent solution
Physician keys in wrong medication dose	Doesn't double check the dose entered	Physician is pressured to see more patients. No ability to review orders before filing	Physician realizes he is distracted. Double checks and corrects the error.	Adding a visual double check summary of order prior to submitting
Pharmacy rushed and doesn't notice error	Distracted and defers to physician	Supervising many new staff and no ability to easily contact physician for questions	Pharmacy notices a higher dose and questions the order	Electronic alert when dose is higher than normal. Examination of staffing level and effect on workload
Nurse new, short staffed and doesn't question dose	Assumes the dose is correct. "It's gone through two check points"	No ability to easily locate medication resource in order to question order	Nurse calls pharmacy and questions the order	Easily accessible medication references. Expectation to question orders that do not make sense
Patient does not question the dose	Assumes dose is correct. "Nurse knows their job"	Patient has no prompt to ask questions of healthcare providers	Patient tells nurse that the dose is higher than normal	Prompt in patient information to ask questions about medications and procedures

In order to promote safety, we must assure that frontline staff are empowered to notice and stop errors in the moment and that systems provide resources to examine the system contribution to the error before it occurs again and causes harm. The next model that complements and helps understanding of failures in the SCM model is human factors.

4.2 Human Factors and Patient Safety

A field of study that pertains widely to safety in healthcare and nursing is human factors and ergonomics. The definition of human factors as adopted by the Human Factors and Ergonomics Society (HFES) is:

> Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance. Ergonomists contribute to the design and evaluation of tasks, jobs, products, environments, and systems in order to make them compatible with the needs, abilities, and limitations of people [21]

In other words, human factors study how humans and the system interact in order to produce outcomes. Human factors work focuses on how to optimize human performance within the context that human beings work and live. Human performance is fraught with frailties. Human factors science appreciates this and attempts to optimize the systems with which humans interact in order to account for these frailties.

As noted in Table 1, there are three types of human errors: skill based, rule based, and knowledge based. Additionally, the field of aviation has identified 12 common human factors that lead to these types of errors and has coined them the "dirty dozen" [22].

1. Lack of communication
2. Distraction
3. Complacency
4. Stress
5. Lack of resources
6. Lack of teamwork
7. Pressure
8. Lack of awareness
9. Lack of knowledge
10. Lack of assertiveness
11. Fatigue
12. Norms

Human factors account for these types of errors and attempts to identify system, process, or workflow design in order to mitigate these errors. Considering how this is seen from the SCM, human factors attempt to correct the latent failures within a system by making them more noticeable or stoppable at the point of human contact.

The application of a human factors lens is important because healthcare is a complex sociotechnical system. This is a system that is interconnected, cannot be easily reduced to individual parts, and is a balance between social (humans) and technology (machines/devices/computers). Two main tenants of a sociotechnical system are as follows:

1. The interaction between the social and the technical aspects of work is paramount to the success or nonsuccess of the work product.
2. An overemphasis on either the social or technical focus can lead to an imbalance and defects in the other category [23].

Thus, the goal of a sociotechnical system is termed "joint optimization" of the social and technical aspects of work [24]. This is the basis of application of human factors science to healthcare. Optimization means to design systems and processes that make it easier for humans to do the right thing and more difficult to do the wrong thing. For example:

> A new medication dispensing cabinet has been installed on the nursing unit. This new unit promises to increase productivity, decrease medication errors, manage medication inventory, and allow dispensing of medications more quickly by allowing nurses to type in the first letter of the medication for a "pick list" display that the nurse can use to quickly select the medication. Nurses become used to quickness of the system and have selected incorrect medications when getting interrupted or distracted (skill-based human error). The pick list also comes up with many different strengths of the same medication, so dosage errors have occurred. The system is designed to bring up the medication and dosage that is most selected as the first on the pick list. It is very easy to select the wrong medication and administer to a patient without noticing, especially if there is poor environmental lighting or the nurse is busy, distracted, or fatigued.

Looking at this issue through a human factors lens, it appears that the dispensing cabinet and the frontline staff who access the cabinet have an imbalance in joint optimization. Perhaps the installation was intended to increase productivity and increase speed of dispensing; however, the initial analysis was only focused on the technology. Focusing on how the frontline staff member interacts with the cabinet within the context of the busy nursing unit would lead to the discovery of many processes that could fail. Mitigation of these processes such as a "no interruption zone" while at the cabinet or hard stops that do not allow high-risk medications to be removed without an additional verification considers human factors and could prevent error. However, these interventions that consider human factors may not necessarily save time as the installation of the cabinet was intended to do.

Human factors science is incredibly important to nursing in healthcare today as technology innovations are abundant and always changing how we do our work. Focusing our lens on how technology and human beings can interact to produce outcomes while not allowing technology to take over is one of the most important safety challenges currently, and of the future. The current popularity of artificial intelligence poses an interesting new challenge in how to optimize the technology without allowing it to dominate. The presence of human factors scientists is rare within the current healthcare landscape but as more and more technology and artificial intelligence emerges, the use of these scientists will be critical.

4.3 High Reliability, Complexity, and a Resilient System

Furthering the work on the importance of sociotechnical optimization, the human factor, and system causes and barriers of and to error is the model of highly reliable organizations (HRO). This model is based on the concepts of anticipation of error and the ability to mitigate or catch errors before they make it through the system (recall the SCM) to harm a patient. Highly reliable organizations are those that are high risk, complex, and potentially dangerous, but have very few errors [25].

The concept of highly reliable organizations began early in the 1990s, however, it became more widespread in healthcare, with the publication of *Managing the Unexpected: Assuring High Performance in an Age of Complexity* [25]. Weick and Sutcliffe studied organizations with a record of high risk and few errors and found that these organizations have characteristics in common that were quite different and even groundbreaking when applied to a healthcare setting. Table 3 describes the five characteristics:

Highly reliability theory states that errors and error-producing conditions in highly complex systems cannot be completely eradicated. However, they can be anticipated and caught by astute human beings prior to the error causing harm. Thus, error-producing factors are always present; however, individuals and systems that are alert to red flags can mitigate the error so harm does not occur or is minimal. HRO theory focuses on what is called mindful organizing [26]. Mindful organizing in this context is the ability to pay attention so unexpected deviations are noticed and dealt with prior to a harm causing event. For example:

- HROs do not simply follow protocols and check off tasks on a checklist.
- HROs practice continuous monitoring of situations for red flags that might indicate potential failure.

Table 3 Characteristics of Highly Reliable Organizations (HROs) [26]

	Practical definition	Mind set	Example	Absence
Preoccupation with failure	HROs always anticipate failures in a proactive manner	See small failures as "red flags" or the beginnings of a larger failure	Encouraging discussion of the possibility of failure with each process	Avoiding or discouraging discussion of possible failure points
Reluctance to simplify	HROs take error producing situations seriously even if they don't cause harm	Investigating events that do not cause harm as intensely as those that do	Investigating close calls and near misses for system changes	"No harm, no foul" failure to investigate events unless they have caused harm
Sensitivity to operations	Paying attention to how processes really work at the frontline	Testing a process to examine for failures with the staff who perform the work	Management observing processes at the frontline and asking about workarounds	Expecting "top down" protocols to succeed without input from the frontline
Deference to expertise	HROs shift decisions away from formal authority toward expertise and experience	"Who is the most knowledgeable about this topic?"	Including variety and diversity to decisions made	All decisions come from the top
Commitment to resilience	HROs pay close attention to their capability to improvise, adapt and act	"How can we assist our frontline to make decisions in urgent situations?"	Allowing those at the frontline the resources available to adapt to changing situations	Hierarchy of control that stalls decision making at the frontline

- HROs practice collaboration, communication, and expertise to develop on the spot options to prevent harmful situations from escalating out of control.
- HROs deal proactively to red flags of errors that are about to occur instead of reactively after the event occurs [26].

The opportunity here is one that is often missed in healthcare: identifying and acting on weak signals of failure prior to the “weak signal” escalating of out control. Consider the following examples of weak signals in healthcare today:

- “We have only new nurses with less than 1 year of experience working on the nightshift.”
- “This patient has been off of the ordered telemetry monitor for an hour and no one is placing her back on.”
- “This piece of equipment has failed two times. Thankfully, it did not harm a patient yet.”

These are only a few examples that come up often in healthcare. Early detection and mitigation of these small failures could avert a large failure that causes harm. However, small failures that do not cause harm in the moment are often not corrected. Near misses such as the examples mentioned should be considered priorities that need correction instead of successes because they did not cause harm. Small failures are not easily identified but are much easier to correct than large failures.

A key factor in mindful organizing for a more emergent situation is sensemaking. Sensemaking is about assessing a situation while it is in progress and determining action from the constant and changing assessment [27]. A team focus is important in identifying concerning conditions, making sense of the potential of danger, and finding options for solutions while in the moment. An example of this in healthcare is the team response during a resuscitation event.

- A 72-year-old female patient is on the way to the bathroom when she suddenly falls to the ground. This is noticed by the telemetry observer who notices that the cardiac rhythm is slowing. The telemetry observer calls the nurse. The nurse responds first to witness the patient on the floor and helps her back up to the bed. She calls the emergency response team. The team responds and notes the bradycardia, discusses current medications the patient is on, and places the patient on an external pacemaker. Patient is transferred to the intensive care unit, and medications are adjusted. She is discharged in stable condition 3 days later.
- What were the keys to the successful outcome of this situation in a HRO?
  - Sensemaking and identification of red flag: The slowing of the cardiac rhythm clued the telemetry observer that something was not right.
  - Acting on a red flag: Calling the emergency response team, brainstorming the cause from patient information and recognizing the patient was on medications that might lower her heart rate.
  - Team discussion: Allowed for a variety of opinions from the local experts (frontline staff) on the current and changing condition.

In this situation, the outcome might have been different if the red flag was not noticed or not acknowledged. Listening to the telemetry observer's concern, considering the context of the low heart rate and a new medication and calling for other opinions contributed to the positive outcome. Sensemaking is an active process and involves listening to subtle cues, asking for a variety of opinion, considering all aspects of the situation and changing course on the spot to create a positive outcome [27]. These factors all contribute to adaptability in the face of changing conditions which is a hallmark of an HRO.

5 Safety II: Learning from Success

All models discussed previously in this chapter are different but build on each other and provide direction for nursing and patient safety as they explain how harm can occur and be avoided as shown in Fig. 2.

The Swiss Cheese Model views errors as beginning higher up within the system, making their way through weak barriers to cause harm at the frontline of care. Human factors science views errors as occurring because there is a mismatch between the system and how humans typically work within the system. High reliability views errors as occurring because of a lack of adaptability in the system and individual to unexpected situations. The common denominators within these models include humans, systems, adaptability, and failures. The last model that will be discussed focuses on all those factors, except failure.

Our final model of safety complements our prior discussion on error models but flips the mindset. Eric Hollengal [28] introduced the concept of Safety II or

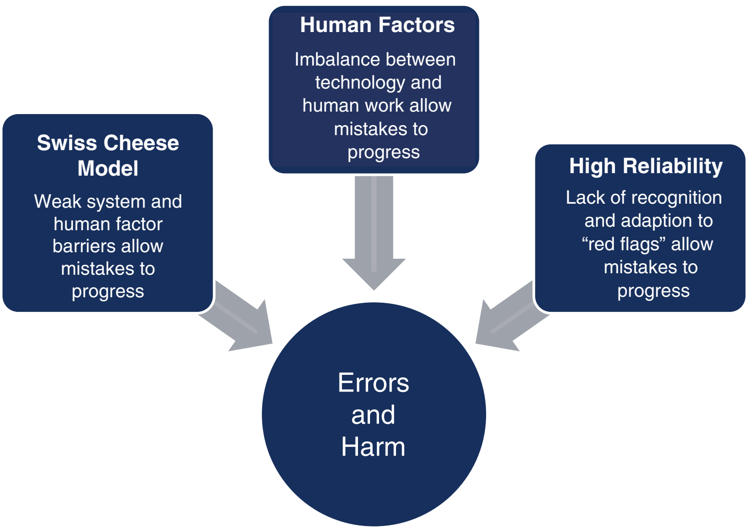

Fig. 2 Summary of how errors and harm occur from the lens of current safety models

focusing our efforts on learning how we achieve success and not how we fail. It is similar to the concept of appreciative inquiry [29], learning from a lens of capability or strength as opposed to deficit and failure. This is a change of focus for most patient safety programs as we currently begin our work when a failure occurs and not the opposite.

A key difference in Safety II is the lens in which we view people and safety. Traditionally, errors and failures get attributed to a human error by not following protocol or deviation from a set standard. Safety II realizes that people are not problems to control tightly with standards. People are problem solvers who adapt to emergent situations for which there exists no standard [30].

Hollengal compares Safety II to the traditional field of safety in which we currently operate which he calls Safety I [28]. Safety I focuses on what goes wrong and finding the cause of that failure and fixing it. Key principles of looking at safety through a Safety I lens include the following [31]:

- Safety is an absence of adverse events.
- An adverse event triggers an investigation.
- Adverse events occur because of a failure in a linear process.
- There is a root cause for every failure that can be found and corrected.
- Safety can be achieved by anticipating all expected conditions of work and adhering to standard protocols and procedures that exist for all conditions.
- Processes create safety and people should operate within existing processes.

These principles reflect a somewhat reactive process designed for use when an error occurs and remains dormant when error free. Our current safety systems traditionally measure outcomes and therefore, safety, in these terms. For example:

- "We have had 5 patient falls with injury this month"—find and fix the causes. We are not safe.
- "We have had no indwelling catheter urinary tract infections this month"—no need for action. We are safe.

Safety I has been a useful philosophy and has led to improvements such as the use of the Root Cause Analysis (RCA) and 5 Why's methods for investigation and improvement in standardizing and assuring compliance with standard processes [17]. The SCM is an example of a Safety 1 theory for which root causes lie within the layers of Swiss cheese and one only must ask "why" five times to get to the root cause. However, as critics of the SCM will state, achieving safety is not that linear or simple within a complex sociotechnical system where the unexpected is the norm and not the exception. It is impossible to anticipate all emergent conditions that might arise in our current systems and creating a system where frontline staff only have tools to deal with expected conditions is a system that is destined for failures. So, what is needed to deal with this gap?

Safety II attempts to fill this gap by recognizing that human beings at the frontline often must adapt and adjust in the moment dependent on ever-changing conditions. Variability, flexibility, and improvisation are needed when dealing with the unexpected to create positive outcomes. In comparison with Safety I, Safety II attempts to study how this adaptation is created at the frontline to learn the skills and conditions necessary to "make things go right" despite the absence of perfect conditions. Whereas traditional safety or Safety I has somewhat rigid rules and standards and does not allow for creative deviation. This leaves a gap for the unexpected events when the rules do not exist.

The main principles of Safety II include [31]:

- Safety is the presence of positive adaptations that lead to success despite adverse conditions.
- Near misses or close calls trigger an investigation.
- Adverse events can occur due to a failure of adaptation to emergent/unexpected conditions.
- There is never just one root cause of an event in a complex system.
- People at the frontline create safety by adapting to current conditions.
- Existing processes do not work for every situation.

Safety II emphasizes the positive and is proactive. Theoretically, much more can be learned from positive opportunities than negative because the former occurs more often than the latter. Dekker [32] wrote about a process which resulted in an error that was investigated. Common causes for the errors were workarounds, miscalculations, not following standards, and other common human behaviors. The solutions included the traditional reinforcement of the standards and avoidance of workarounds. Alternatively, the same process was investigated, many times it was completed without an error and surprisingly, the same human behaviors were found, including the workaround and not following standards. The point of Dekker's story was that the same issues caused failure or success, however, he did find differences in the two investigations. The successful process had several more social/cultural characteristics that the error process did not. For example:

- Variety of opinion and the ability to speak up or disagree
- Discussing risk at all times; not taking routine tasks for granted
- Ability to stop the process or stop the line for a safety issue
- Deference to expertise or deferring to the person with the most knowledge
- No barriers between disciplines, departments, or traditional hierarchy
- Creativity to adapt a process
- Pride in workmanship and the product

Notably these characteristics are similar to those found in HROs. The focus for success is not learning how people cause failures but how they create success. The key to this approach is recognizing that studying how human beings work to create safety is just as important as investigating process failures.

An example of Safety II in action was the response of hospitals and healthcare facilities to the global pandemic of 2020. There were no existing protocols to guide

Table 4 Work as done versus work as imagined [28, 31]

	Practical definition	Impact to safety
Work as imagined	How those outside of the frontline imagine how the work is done	Standards do not always fit to unexpected situations and when not created by those at the frontline do not fit within the complexity of work
Work as done	The work done at the frontline with adaptations to achieve expected outcomes	Adaptations can be done to create safety or can lead to shortcuts that are a detriment to safety. Contributing factors to successful adaptations need to be supported and work that cannot be adapted needs to be identified

us through this emergent situation. What we relied on was the expertise, innovation, collaboration, and resilience of teams within these facilities to create dynamic processes that worked to keep communities safe. This type of adaptation is created by empowered frontline workers acting to create safety in real time without a guideline or an existing framework to follow. Facilitating this resilience is the power of Safety II.

5.1 Work as Done Versus Work as Imagined

A focus on the work as completed at the frontline is a key concept in understanding Safety II. Traditional healthcare systems operate with an abundance of procedures and protocols to manage and control the work that is being done. However, these policies and procedures often do not match what is happening at the user interface. Policies and procedures created by designers of work specify the "work as imagined" and attempt to create a process to follow for every imagined possibility. "Work as done" is what happens when these documents meet the user at the "sharp end" and they often do not fit all the situations imagined by the designers [31]. Consequently, those at the frontline then need to adapt work to meet outcomes and deadlines successfully. Take note, that this does not mean frontline workers do not follow safety protocols; it means that they adapt to achieve safety even if the protocol does not fit perfectly as summarized in Table 4.

5.2 Implementation of Safety II Concepts

Safety II is not as radical as it seems and may be already something that exists but needs intentionality to create change. Suggestions to implement Safety II concepts include the following:

- Ask different questions [33]
  - Instead of always asking what went wrong, ask about near misses and how an error was avoided.
  - Ask staff how they adapt to production pressure or high turnover times to assure safe care in the allotted time frame.

- Practice a true deference to expertise [33]
  – Review and match workplace standards and policies to the actual way the work is done to identify imbalance and mitigate risks.
  – Test processes and revise with input by frontline staff prior to implementation.
  – Ask for a variety of opinion for every situation and assure all voices are heard.
- Review successful or simulated high-risk cases and point out strengths to be promoted and reinforced [34]
  – Focus on how anticipation of failure, situational awareness, and questioning attitude lead to success in high-risk situations.
  – Search for contributing factors to the success of a situation dependent on teamwork and communication.
- Make proactive thinking a habit [27]
  – Promote tools and practice simulation to increase situational awareness and sensemaking in real time.
  – Make anticipation of error a habit.
- Examine the idea that safety is the presence of "capacity" [30]
  – Capacity is the ability to adapt to disruptions.
  – Identify resources available in time of crisis.
  – Focus on skills that promote empowerment of those on the frontline.

Most importantly, learn from the ideas, creativity, and adaptability of those people who work on the frontline. They are the key to patient safety.

6 The Way Forward: Nurses Lead Patient Safety with the Power of Safety Science

The presence or not of safety is often illusive and not well defined. It is difficult to quantify safety in a healthcare system without discussing the metrics that we feel are an indication of safety. Consider the Leapfrog Hospital Safety Grade in the United States. The Leapfrog organization [33, 35] focuses on measuring patient safety and assigns grades to hospitals (A, B, C, D, F) based on patient safety metrics such as numbers of hospital acquired conditions and the presence of factors that enhance safety such as prioritizing hand hygiene and having certain policies focused on safety. Hospitals that receive an A grade are considered the safest hospitals for which to receive care and lower grades are accordingly not as safe in this grading system.

The measurement model of confirming safety by a safety metric is typically how we measure safety in healthcare. This is generally accepted by all in the field of healthcare; however, it can cause us to rely on these numbers to represent the presence or not of "safety" and forget that these metrics depend on processes and cultural conditions to support safety. As we have discussed in this chapter, safety in healthcare is more than a number or a grade. Safety is created by people who influence systems and processes every minute of the day in high-risk situations. Safety is created by adapting in the moment with expertise and intention. Nurses, specifically, are one of the largest groups with constant contact at the “sharp end” who create safety.

The models we have discussed range from a reactive, somewhat linear model that describes how errors can cause patient harm to a more proactive model which focuses on adaptation and resilience. All models are useful in the healthcare context for nursing. Notably, missing from these models is the effect of diversity and equality and how this contributes to safety events and safety progress. Considering all the models and information presented, nurses, as leaders of patient safety should focus on the following from each area discussed:

- History of safety and lack of sustainable progress
  - Acknowledge that true achievement of safety is not just a metric but it is in what people at the frontline do every day.
  - Thus, safety accountability lies with the systems and cultures that we create and reinforce with our actions.
  - Creation of systems and cultures that reinforce safety should be informed by collaboration with safety science.
- Swiss Cheese Model
  - Application of the SCM to understand how errors begin higher up in the system and only reach a patient to cause harm if barriers are not in place.
  - These barriers can be processes and policies but most often it is frontline staff at the “sharp end” identifying an issue and stopping the process from continuing.
- Human Factors Engineering
  - Apply theory of human factors and use human factors engineers whenever possible to assure that new projects and technology are evaluated from an end user lens.
  - Use a list of human factors when evaluating any error. Asking questions about distraction, fatigue, environmental conditions can identify contributing issues that need to be optimized.
  - Remember that technology is a machine and people are the ones who evaluate the output and make the decisions.
- Highly Reliable Organizations
  - Practice anticipation of errors by asking “What if…?” questions.
  - Look at the structure and communication in teams and identify which voices are heard and which are not. Variety of opinions and ability to ask questions is important.
  - Prepare for the unexpected by increasing capacity and ability to problem solve at the frontline.
- Safety II
  - Ask different questions to provide learning on how success is created in everyday work.
  - Create programs that support reporting near misses and close calls.

– Review and simulate high-risk situations and what processes are critical for a positive outcome.
– Review processes to assure that they can reasonably be completed at the frontline and if not, assure that safe adaptations and resources are available for unexpected situations.

7 Summary

In closing, patient safety is not in its infancy but there is still so much to be realized as to the conditions necessary to achieve safe patient care. The models discussed in this chapter give context to where patient safety began and where it needs to go for improvement. The focus on metrics and the absence of adverse events as our only measures of safety does not tell the complete story. The presence of safety is more about people, expertise, sensemaking, collaboration, freely speaking up, and adapting to situations that could not be imagined. Therefore, safety can only be realized in how we collaborate within teams and at the frontline.

Achievement of patient safety is not an objective feature that an organization has, it is more an outcome of what the organization and the individuals within it do every day and in every second to recognize and prevent error. It is an action and an intention in everything we do and cannot take a back seat to other measures. The intention of this chapter was to gain insight into the history of safety science with application to the role of nursing. The chapters contained within this book will give further examples of the role of nursing in applying this science within the scope and passion of nursing to improve outcomes worldwide.

Key Points

- Patient safety is not in its infancy but still has not achieved the potential that is needed to prevent patient harm.
- A contributing factor to this lack of improvement is a failure to use and apply safety science consistently.
- The presence of patient safety is most often defined by metrics; however, it is much more than that.
- The Swiss Cheese Model is the basic model of patient safety that describes how errors travel from system causes to human failure to cause harm unless a reliable barrier halts the process.
- Human factors engineering, highly reliable organizations theory, and Safety II are among the most robust safety science models that can be used to understand how people at the frontline problem solve to effectively create those barriers.
- Current patient safety practice focuses on failures and does not engage unless there is a failure.
- Learning from successes will give more insight on how adaptations occur and under what conditions foster positive adaptations.

- Bringing the focus back to how people interact within the complexity of a highly sociotechnical organization to adapt and adjust is imperative to safety.
- Nursing coupled with the power of their expertise and situated at the frontline of care is in a prime position to lead this journey.

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