An Overview of Human Errors and Culture of Safety

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CHAPTER
5

Key Terms

Blame and Train Culture—A culture in which the person is assumed to be able to perform without error, if properly educated and motivated. Latent failures are not considered. Errors are attributed to laziness, negligence, or incompetence, resulting in blaming and/or retraining the person that made the error.

Hindsight Bias—The tendency for those evaluating an error to overestimate what they would have known, and what others should have known at the time of the error.

Human Error—The failure of planned actions to achieve their desired ends, without the intervention of some unforeseeable event. Human errors can be further divided into slips, lapses, and mistakes.

Just Culture—A culture that recognizes the contribution of systems in error along with a focus on behavioral choices and accountability. Just Culture distinguishes between acceptable and unacceptable behavior, between unsafe acts and the blatant disregard of safety procedures with which most peers would comply. Just Culture is one component of an overarching safety culture.

Slips and Lapses—A human error whereby the action deviates from the intention. A slip is when an action is carried forth, but deviated from the intention. A lapse is when there was an intention of an action, but the action was forgotten.

Symmetry Bias—The tendency to assign blame for an error in a manner that is proportional to the severity of the outcome (also called *Severity Bias*).

Systems Thinking—Evaluating the whole process rather than a particular single part, since all parts are inter-related. This approach includes consideration of everyone who could potentially influence the process.

Violation—The action of bypassing a rule, standard, or safe operating procedure. Violations can be further divided into optimizing violations, necessary violations, and routine violations.

Introduction

This chapter is designed to introduce the medication safety officer (MSO) to the theory behind **human errors**, and entice him or her to learn more. It provides a foundation for understanding the importance of this information, and how it can be utilized to improve organizational culture and system-wide safety. The historical **"blame and train"** model for error management needs to be permanently abandoned. Understanding human error theory helps an MSO evaluate, improve, and design processes to reduce the risk of error. Even more importantly, human error theory recognizes that when humans are involved in a system, the risk of error can be reduced, but not eliminated. With that in mind, human error theory also helps an MSO to design processes to capture and mitigate the effects of those ever-present human errors, thus reducing the potential for harm. The discussion begins with *How We Think* and *How We Err*. Then the human error is merged with the concepts of culture, which discusses the progression of human error management in health care over time. A discussion of strategies the MSO may use to influence culture follows. Finally, the review of adverse outcome events, and some related tools are discussed.

This chapter serves as an introduction to a broad and complicated subject. It is highly recommended that the reader add two books by James Reason to their reference library, *Managing the Risks of Organizational Accidents*[1] and *Human Error*.[2] These books take chapters to describe, eloquently and in detail, what might be described here in a paragraph. In particular, the sections How We Think and How We Err are derived from these books.

How We Think[1,2]

Skill-Rule-Knowledge Model

The skill-rule-knowledge model assists in the understanding of the types of human errors that can occur during cognitive processing by outlining how the mind is working during different types of tasks. A thorough understanding of this model is essential for the MSO in procedure design and evaluation, during which the goals are to minimize the number of errors that occur, and maximize the likelihood that they are captured before causing harm.

- **Skill-based processing.** Skill-based processing is used when performing routine tasks and is sometimes referred to as *automatic processing*. It is routine, automatic, and requires no real focus, only occasional checks to see that the task is progressing as usual. Skill-based processing allows for multitasking, and without it, humans would be unable to function. An example of skill-based processing would be the process of an experienced driver encountering a stop sign. An experienced driver does not need to carefully consider when to begin pressing the brake pedal; it happens automatically. Braking at a stop sign can even occur safely during a conversation with a fellow passenger, because it is automatic for experienced drivers. In health care, skill-based processing occurs while an experienced pharmacist is performing one of his or her usual daily tasks, such as entering medication orders into the computer, or while an experienced nurse is performing one of his or her usual daily tasks, such as administering medications. The error rate during skill-based processing is a low percentage of the number of tasks that are being done, because the processes are familiar. However, because humans are so often using skill-based processing, the overall number of errors is high. Thankfully, the recognition and correction of skill-based processing errors is also high.

- **Rule-based processing.** Rule-based processing is used when, in the course of skill-based processing, a person becomes aware that there is a problem. The conditions of the problem are matched with the conditions of past problems. When a match with a past problem is found, a past solution is applied, using an "if–then do" rule. *If* a process is not progressing as usual because of a problem *then do* this, as this is what solved the problem last time. Rule-based processing is also described as *intuitive processing*. Continuing with the driving example above, an experienced driver may be on the way home from work when it begins to rain heavily. From experience, the driver knows that deep puddles quickly accumulate at certain street corners during a heavy rain. From experience, the driver knows which alternate route avoids the deep puddles, and the driver sets off on the non-puddle-encountering route. *If* it is raining heavily *then* take the alternate route. In health care, consider the example of the experienced pharmacist entering a medication order into the computer. During order entry, the pharmacist receives an allergy flag, indicating that the patient has an allergy to the medication being entered. The pharmacist recognized that a problem has occurred and applies the usual procedure to solve it—halting the order entry and telephoning the physician with an alternate recommendation. *If* a patient has an allergy to an ordered medication, *then* call the physician to discuss alternatives. As with skill-based processing, rule-based processing has a low error rate compared to the number of rule-matches being done. But, because it is a level of processing that is often used, rule-based errors are seen frequently, although not as frequently as skill-based errors.
- **Knowledge-based processing.** Knowledge-based processing is focused problem solving and is sometimes called *analytical processing*. As with rule-based processing, there is awareness that a problem has been encountered, but with this problem, there is an inability to find a match with a previous problem, so

there is no rule to apply. Knowledge-based processing is entered very reluctantly due to its requirement of focus and attention. Only after every possible rule has been exhausted will a person move to knowledge-based processing. For novices, knowledge-based processing is encountered frequently, until expertise (in the shape of rules) is developed. The potential for a solution, or new rule, increases with time and with the ability to test potential solutions through trial and error. In emergency situations or situations with time constraints and no opportunity to test solutions, there is a high risk of failure, in the form of an incorrect solution. The medical professions recognize the value of experience and the risk of knowledge-based processing and require extensive observed training as part of licensure. Automobile insurance companies recognize the risk of knowledge-based processing as well, as evidenced by the insurance premiums for new drivers. Although the risk of error is very high, knowledge-based processing is not encountered very often. As a result, knowledge-based processing results in a low contribution to the overall number of errors occurring or being reported in most systems.

Interestingly, all three levels of processing may occur at once. Consider a person getting dressed (skill-based), finding shoes to match (rule-based), and thinking about a problem that needs resolution at work (knowledge-based).

How We Err[1,2]

For the purposes of this chapter, we will use Reason's definition of human error: "The failure of planned actions to achieve their desired ends—without the intervention of some unforeseeable event."[2] Human errors can occur in the planning, storage, or execution of a process. Failures in storage and execution of a process are called **slips and lapses** and occur during skill-based processing. Mistakes—failures in planning or choosing a course of action—occur during rule-based or knowledge-based processing. The skill-rule-knowledge model and associated errors are outlined in Table 5-1.

Skill-Based Slips and Lapses

A *slip* is an action that was not carried out, or executed, according to plan. Slips are attention failures, so it follows that the risk of slips is increased with mental states that may affect a person's attention, like stress, preoccupation, depression, or distraction. Slips can also be perception failures, as with look-alike or sound-alike medication names or packaging that results in the wrong medication being picked from the shelf for dispensing. Because skill-based processing involves only occasional cursory checks, the human mind will "fill in the blanks" frequently, so that the mental check appears to confirm that the action is being carried out correctly, when in fact, it is not. A *lapse* is an action or step in the process that was forgotten. Lapses are memory failures, so it follows that the risk of lapses increases with interruption during the action (causing a person to forget their place in a series of actions) or if there is a delay between the time the action is decided and the time it is actually carried out (causing the person to forget the action altogether). An example of a lapse would

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Table 5-1. Skill-Rule-Knowledge Model and Associated Errors

Processing	Description	Error Types
Skill-based (Automatic)	Routine tasks with occasional checks	Slip (execution/action failure) Lapse (storage/memory failure)
Rule-based (Intuitive)	Problem encountered, use experience to solve (refer to previously used rules)	Mistake (planning failure), rule-based ▪ Good rule/wrong time ▪ Bad rule
	Bypassing of rules or safety procedures	Violation ▪ Optimizing (thrill-seeking) ▪ Necessary (impossible to follow rule) ▪ Routine (corner-cutting)
Knowledge-based (Analytical)	Problem encountered, no experience, create solution	Mistake (planning failure), knowledge-based ▪ Created solution incorrect

be forgetting to place an auxiliary label on a medication before dispensing, resulting in a call from the nurse to inquire about food-drug interactions.

A more dramatic example of a lapse is reported all too frequently in the newspaper: the story of a child forgotten in a car on a hot summer day. Typically, the person driving the child does not routinely drive the child. The child is in the back of the vehicle, and the driver begins a routine route, such as driving to work or driving home. Once the process of driving the routine route has begun, the driver enters skill-based processing. Because taking the child out of the car is not part of this normal routine, and because the child is often sleeping quietly and out of sight, there is nothing to alert the driver at the end of the process, and the sleeping child is forgotten. Story after story tells of a parent calling the person who drove the child—the other parent, grandparent, or friend—hours later, to ask why the child is not at daycare. It is at that moment that the person who drove the child realizes that the child is still in the car.

What is interesting about these two lapses—forgetting an auxiliary label on a medication leading to a nurse's phone call, or forgetting a child in the back of a car leading to death—is that they are the same human error, even if the consequences are tragically different. Why does the death of a child make that lapse seem so much more blameworthy? It is because there is a tendency for humans to assign blame for an error in a manner or amount that is roughly proportional to the severity of the outcome. To illustrate this **symmetry bias**, Reason refers to the writings of Sir Frances Bacon in 1620, "The human mind is prone to suppose the existence of more order and regularity in the world than it finds."[3] This tendency has also been referred to as severity bias.[4] Recognizing the tendency to incorrectly balance the blameworthiness of an error to the severity of the outcome is extremely important when evaluating medication errors as part of a medication safety system.

Rule-Based Mistakes

Rule-based processing requires application of rules to solve problems. *Rule-based mistakes* can occur if the current problem is assessed incorrectly, and therefore incorrectly "matched" to a previous problem, so that a usually good rule is applied at the wrong time. This misapplication of a rule occurs for a number of reasons such as the need to review a large number of factors to assess the current problem for matching, the similarity of the current problem to past problems in which the rule would be correctly applied, and the good rule's previous frequency of success. An example of a good rule/wrong time error would be a technician mistakenly sending a fragile, protein-based medication through the jarring tube transport system to a nursing unit. Many hospitals use tube systems to deliver first doses of medications or medications that are needed emergently. The technician knows that *if* the medication needs to be delivered emergently *then* it is sent via the tube system. This rule typically results in success. However, this rule does not apply to a very small subset of fragile, protein-based medications.

A *violation* is another rule-based mistake that involves a good rule. A violation is a good rule that is not used when it should be, when a standard or safe operating procedure is bypassed. Violations are discussed in detail later.

There are also rule-based mistakes that involve the use of a bad rule. Bad rules are usually due to procedures that are incomplete or misunderstood, which results in an informal method for carrying out the task. The informal method may, unbeknown to the users, introduce safety risks. An example of a bad rule would be the use of intravenous syringes to deliver a dose of oral medication, when oral syringes are available for use but there is no procedure dictating that they must be used. It may be that a nurse observed this bad rule in training: *if* an oral medication must be administered *then* these intravenous syringes will accomplish the task. Without an understanding of the danger in the use of intravenous syringes to administer oral medications, or a policy outlining the appropriate use of oral syringes, the availability of oral syringes does not cause the nurse to change this dangerous practice and use them.

Knowledge-Based Mistakes

Knowledge-based mistakes are those that occur during focused problem solving. Because there is no experience with the problem and no rule that can be used to manage it, there is a high likelihood that the devised plan will be incorrect. Most pharmacists remember many knowledge-based mistakes from early in their practice and remember how thankful they were to be working under the oversight of an experienced pharmacist.

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Violations

As stated earlier, a violation occurs when a good rule, standard, or safe operating procedure is bypassed. Violations are further divided into three types: optimizing, routine, and necessary.

- **Optimizing violations.** *Optimizing violations* are the bypassing of a good rule because it is fun or exciting. An example of an optimizing violation would be driving at excessive speeds while test driving a sports car. Optimizing violations are well recognized in the common aviation expression: *There are old pilots, and there are bold pilots, but there are no old bold pilots.* An optimizing violation is difficult to imagine in the medication-use process, aside from riding a delivery cart down a hospital hallway. Although there are violations that clearly lead to a shorter pathway from point A to point B, these should not be confused with optimizing violations because those are not the result of thrill-seeking behavior.
- **Necessary violations.** *Necessary violations* are the bypassing of a good rule because it is impossible or inadvisable to follow the good rule at that time. An example of a necessary violation would be the requirement for a nursing double check of subcutaneous insulin doses. This requirement might work well on most days, but be difficult to meet on a shift in an outlying clinic when one of the two nurses working must leave suddenly for a family emergency. The remaining nurse may deem it necessary to administer the insulin to a hyperglycemic patient without the double check, which is a necessary violation. In the absence of an adverse outcome, the nurse may choose to again bypass the double check of a subcutaneous insulin dose on a day when both nurses are present, but really busy. With continued absence of adverse outcomes, the nurse may adopt the bypassing of the double check into the routine insulin administration process. This is no longer a necessary violation; it has become a routine violation.
- **Routine violations.** *Routine violations* can also be called corner-cutting. Routine violations may be due to clumsy procedures, or those that seem clumsy because of an inadequate understanding of the need for the procedure's additional safety steps. As humans will naturally gravitate toward the processes that require the least effort, or the shortest route from point A to point B, routine violations can always be found in an organization. An example of a routine violation is the bypass of double checks of subcutaneous insulin doses when two nurses are present, as above. The most effective way to manage routine violations is to reward those complying with the safety procedures, rather than punishing those who do not.

Migration: Production Versus Protection

Within an organization, there will be fluctuations in the balance between production goals and protection goals, which can affect the frequency of necessary and routine violations. Production refers to output—things like the number of patients seen, paperwork completed, orders entered, surgeries done, etc. Production keeps the bills paid and the organization open for business. Protection refers to safety procedures that prevent error and harm but can also slow production. Production pressure is increased when practitioners are encouraged to do more with less resources, time, or staff. To keep up with the load, the staff may begin to bypass safety procedures. Without a visible adverse outcome, the staff will be rewarded by their managers for meeting the production goals. Ironically, the managers are also unknowingly rewarding the staff for bypassing safety procedures.

This might go on for some time without an adverse outcome. Eventually, the bypassed safety procedures will undermine protection, and processes will migrate to beyond the edge of safe practice. Suddenly, the organization is faced with a catastrophic event due to an error. In response to the event, the original safety procedures are judged inadequate, even if they would have prevented the event had they not been bypassed. Additional, unnecessary defenses might be added to enhance the safety procedures, increasing protection, but decreasing production. The cycle continues after some time passes, and production comes back into focus, as is necessary to keep the bills paid and the organization open for business.

It is important to realize that there will always be this fluctuation in the balance between production and protection, and there will always be migration toward the violation of safety procedures. The best course of action is to investigate the system-based sources of the migration.[2,5,6] Consider the need for updating of safety procedures that may no longer apply or could be streamlined. Also, review what is being rewarded by management and whether both production and protection rewards are included.

Culture of Safety

Culture is the collection of values and practices shared by people and groups in an organization. These shared beliefs and attitudes determine the way people and groups interact with each other and with stakeholders outside the organization. Simply put, the culture is "the way we do things here." Patient safety culture is often thought of as a subset of the overall organizational culture. Reason describes five components of a safety culture: flexible, informed, learning, reporting, and Just Cultures (see Figure 5-1).[7]

Evolution of Cultural Perspectives in Patient Safety

Adverse outcome events are comprised of both active failures and latent failures. Active failures are the human errors and violations. Latent failures are at-risk situations that have set the stage for an active failure to become an adverse event, by either increasing the likelihood of the active failure, or by allowing the active failure to go unnoticed. Latent failures occur through the allocation of resources, hiring practices, training, scheduling, layout of workspaces, etc. Latent failures will always be present in a system.[2,8]

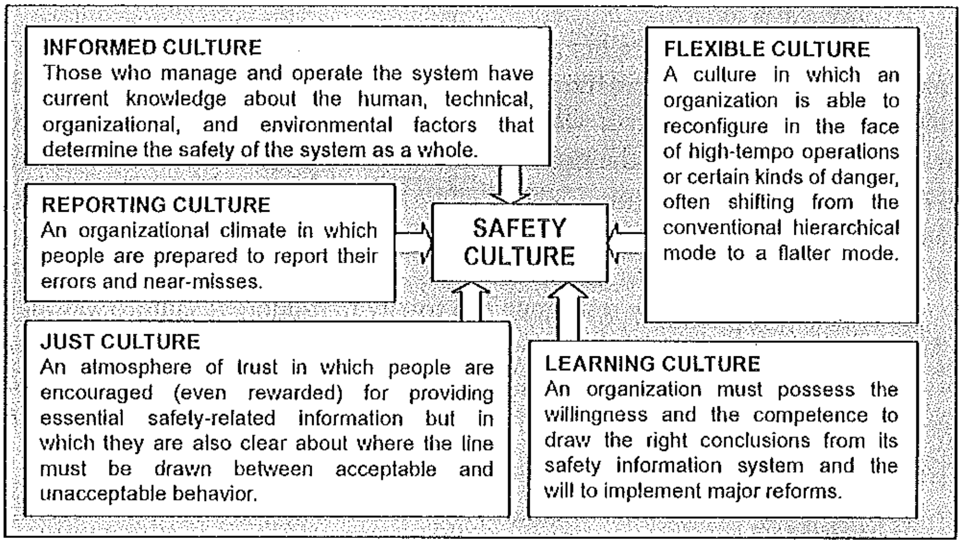

Figure 5-1. Five components of a safety culture.
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Blame and Train/Punitive Culture

Before the 1990s, only the active failures were recognized in medicine. As a result, the culture of medicine was punitive and addressed only the fault of the people who committed the active failures, regardless of the setting in which the errors occurred. This outcome-based approach meant that reckless behavior was unpunished, provided there was no adverse outcome. At that time, it was generally believed that perfect human performance could be achieved through education. Those who did not exhibit perfect human performance needed further education to attain perfection, thus the blame and train model for error management.[9] If the error resulted in a catastrophic outcome, training could be bypassed in favor of termination. It was mistakenly thought that the threat of this type of discipline would encourage those who had not yet erred to continue to exhibit perfect human performance. The result appeared to be almost perfect human performance, but underneath this illusion were countless errors that were unreported, buried out of fear. Buried with them was information that might have advanced patient safety through learning and devising useful risk-reduction strategies. Patient safety no doubt suffered during this time. The blame and train model still survives today, although it has been weakened somewhat. The model is still the focus of many state boards of nursing, pharmacy, and medicine, who continue to respond to errors with discipline and additional educational requirements.

Blame-Free/Non-Punitive Culture

By the mid-1990s, the culture began to shift, and the idea of a blame-free or non-punitive culture was considered the new model. Human fallibility, even that of highly trained and ethical professionals, was recognized as a risk to patient safety. The focus was on the system in which the professional was operating, and the solutions were directed to the systems' latent failures. For those institutions that truly embraced a non-punitive culture, there was a steady progression toward increased reporting. The extent to which non-punitive culture was accepted varied dramatically from institution to institution. The resistance to a totally non-punitive culture was fueled by confusion about how to manage those few practitioners who behaved recklessly, disregarding safety procedures that most peers recognized as necessary, or those very rare practitioners who acted with malicious intent or were intoxicated at the time of a catastrophic event.[10]

Just Culture

The **Just Culture** recognizes the contribution of both latent failures and active failures. It also recognizes that punishment for most active failures—unsafe acts or honest mistakes to which we are all vulnerable—is counter-productive to reporting, learning, and the advancement of safety. However, the Just Culture also recognizes that there must be a clear line between acceptable and unacceptable behavior, between unsafe acts and the blatant disregard of safety procedures with which most peers would comply.

The Just Culture represents a combined, balanced approach: consideration is given to the role of systems in error, along with a focus on behavioral choices and accountability. It is a way of safety thinking that:

- Promotes a questioning attitude,
- Is resistant to complacency,
- Is committed to excellence, and
- Fosters both personal accountability and corporate self-regulation in safety matters.[7]

A Just Culture is considered a component of an overall safety culture.

MSO Role and Culture

Attainment of a safety culture depends on individual and organizational attitudes and behaviors. These values and practices (i.e., culture) can enable or facilitate the unsafe acts and conditions that lead to errors and adverse outcomes. By affecting culture change, therefore, the MSO can promote active identification of safety issues and respond with appropriate action.

The MSO must understand the patient safety culture of their organization. Suggestions for assessment of culture are reviewed in Chapter 3. Does the current culture support medication safety? What improvements are necessary? Before embarking