Strategic Debriefing for Advanced Simulation

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Errare humanum est/To err is human

Augustine of Hippo

1.1 Error in Medicine: From Fault to Resource

You are drinking your coffee comfortably seated on your sofa, and you realize that it tastes disgusting: there is salt! Maybe a member of your family has inadvertently swapped salt with sugar, or they were put in similar jars, or maybe the label of one of the two has come off, or maybe this morning you were still so sleepy that you could not distinguish the two jars. The fact is that your coffee is salty and really undrinkable. "Who did this?" It is inherent in our culture and our daily way of thinking to ponder the causes of an event to find out who the culprit is.

This question is the result of a "culture of error" that guides us in our search for the person responsible, the person who made the mistake, and the person who put salt in the coffee.

In its common sense, the word error means a deviation from a linear path; in fact, it derives from the Latin *error/oris* which means "to wander, to err." This definition leads to a deviation from the right path and indicates an abnormal or even pathological behavior.

However, there are many inventions and discoveries that came about not only through creative intuition but also through mistakes, such as penicillin, post-its, mirror neurons, etc.

Einstein said that "we can't expect things to change if we keep doing the same things" and that "crisis is the greatest blessing for people and nations, because crisis brings progress […] it is in crisis that inventiveness, discoveries and great strategies arise."

In healthcare, there is not always this positive conception of error, as medical error can cause harm to the patient.

Often, the responsibility is attributed to the individual professional who finds himself to be the final link in a chain of factors that have contributed to the occurrence of harm to the patient, ignoring the organizational and systemic dimension in which the individual was operating.

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According to this person-based approach, if something goes wrong, it is solely the fault of the person who made the material error. He did not have the necessary knowledge, was not careful enough, or did not do his best. Mistakes are attributed to lack of knowledge, lack of attention, and lack of motivation or negligence, and the result is a culture of blaming, scolding, and mortifying.

According to this perspective, mistakes are avoided by improving knowledge (e.g., with better training) and increasing motivation with warnings ("be more careful next time," "if you concentrate well, you won't make mistakes again") or with threats of disciplinary procedures.

This approach is functional for a healthcare institution that wants to maintain a blameless public image. Instead of looking for institutional responsibility internally, it is easier and cheaper to focus on the individuals who made mistakes. This person-based approach, however, misses the opportunity to improve patient safety by correcting healthcare organizations, because it isolates dangerous actions from their context in the system. Far from being random, incidents tend to fit into recurring patterns. A similar set of circumstances can result in similar errors, regardless of the healthcare personnel involved. This explains why error is not the monopoly of an unlucky few: analysis of accidents in other high-risk technological environments (e.g., civil aviation, nuclear facilities, space exploration) shows that it is often "the best people who make the worst mistakes" [1]. This happens because sometimes, with more experience, people tend to become complacent, or simply because the most difficult tasks are assigned to the most experienced people.

It is therefore reductive to attribute error to the individual, the ultimate executor of a series of actions for which he or she is not necessarily primarily responsible. We must, instead, consider each professional within a system that is composed of the organization, culture, tools, procedures, devices, supervision, human resource management, and communication between those present.

When the focus shifts from the individual person to the processes, you have a "systems approach."

According to this view, instead of looking for a single determining action and, therefore, a single responsible person as being responsible for the incident, all levels of the organization are carefully examined, looking for the factors that contributed to that error. The basic premise in the systems approach is that human beings are fallible and that errors must be anticipated, even in the best organizations.

For example, when an adverse event happens, and a patient is harmed, the main issue will not be who made a mistake, but rather why and how the system's defenses failed and what were the upstream systemic factors that contributed to the incident. Focusing on the system and its weaknesses provides valuable information for further improvement. So, instead of asking who is to blame, we should ask, "What exactly went wrong? How many different types of failure occurred? Is it possible to do a temporal reconstruction of key events? Why did things go wrong? What psychological mechanisms contributed to the development of the accident? How did the various organizational and human factors interact to cause the accident?"

Therefore, mistakes should not be hidden but considered a resource: what is important is not making a mistake in itself but what we do with that mistake, that is, how we deal with it.

From the point of view of error as a resource, simulation plays a fundamental role in that it is a useful and "painless" means of replicating the error in a protected environment that first and foremost guarantees the safety of the patient and the learner.

In addition, what is essential in simulation is the "psychological protection" of their learners who, not feeling "guilty and judged," will not run the risk of losing their positive self-image, and denying the error or hiding it instead of sharing it.

For these reasons, in the post-simulation debriefing, it is important to create a climate of listening and non-judgmental acceptance that makes learners feel free to express themselves without fear of being attacked or criticized, to encourage a process of growth and evolution, starting from their mistakes, which can be taken as an integral part of their lives and their professional career.

The way in which the debriefer approaches the error will condition the way we conduct the debriefing: having a non-judgmental attitude and behavior toward our learners will depend, above all, on the vision that we ourselves have, both of our own errors and of the errors of others. For this reason, it is important to be aware of our attitude and of the fallout in terms of learning of our learners.

1.1.1 Error Classification

When an adverse event occurs and a patient is harmed, one should speak of an organizational accident rather than of human error. The main issue to be addressed is not who made the mistake, but why and how the system's defenses failed, i.e., what were the systemic factors upstream that contributed to the incident.

In the study of factors that influence the efficiency and reliability of performance at work, the most widely used model of reference is the skill-rule-knowledge postulated by Rasmussen [2] who proposes a classification of human behavior that responds to a critical situation based on the degree of familiarity with similar situations.

Rasmussen's model indicates three different categories of error-related behavior, based on experience and familiarity*: skill-based behavior*, *rule-based behavior*, and *knowledge-based behavior*.

The three levels of performance correspond to different levels of familiarity with the environment or task, as experience and familiarity with a situation allow the practitioner to use his/her "skills, rules and knowledge."

Skill-based behavior: literally means routine behavior based on learned skills. This is the level of skills, the abilities that refer to all those automatisms acquired through exercise. Walking, driving, cycling, and tying our shoes are our daily *skill-based behaviors*: routine actions and behaviors that we carry out without consciously thinking about them and without having a conscious memory of having done them because the cognitive effort required is very low and reasoning is unconscious.

The utmost familiarity with these actions leads us to make unintentional mistakes and oversights, i.e., actions performed differently from what was planned.

In rule-based behavior, usual problems are addressed whose solutions are given by the simple application of rules. For example, the caregiver has all the algorithms and procedures to perform known tasks; he only has to recognize the situation and apply the appropriate procedure to perform the task and solve the problem. Errors at this level may be due to a misapplied rule, applying the wrong rule well, or not applying a rule at all, such as a doctor not recognizing that a flu fever may be meningitis and therefore not applying the appropriate procedure.

In knowledge-based behavior, the behavior is knowledge-based and aimed at solving problems in the presence of situations that are not habitual and not very familiar.

The errors referred to in this behavior are those linked to partial, incorrect knowledge or errors in the assessment of the situation and for which a specific procedure has never been defined.

Based on the model proposed by Rasmussen, three different types of errors have been identified: *slip*, *lapse*, and *mistake*. The first two are execution errors, and the third is a scheduling error.

The *slip error* is an error of execution that occurs at the skill level; it is given by the unintentional inability to complete the task; it concerns a lack in the execution of an action. A *slip* error is a "slip," such as grabbing the television remote control in the act of answering a call when the cell phone rings. They are such obvious and automatic actions that require minimal cognitive effort and can occur due to distraction or perhaps because we are overthinking. The intention was good, to answer the phone, but the execution was wrong, gripping the remote control like a handset.

Another example of a *slip* is inadvertently selecting the wrong energy level on your defibrillator or prescribing a different medication than you had in mind because you got distracted.

Lapses are errors of execution caused by a memory deficit; they occur when some important steps in a sequence of actions are omitted, due to environmental distractions or to forgetfulness or carelessness. The cause of the occurrence of *lapses* is to be attributed to the automatic memorization of procedures learned with repeated practice, and that can also be carried out in an unconscious way. The *lapses* are involuntary forgetfulness, such as sometimes forgetting the slice of bread in the toaster and remembering only when you are aware of an unpleasant smell of burning. In this category are classified all those actions performed differently than planned, that is, the operator knows how he should perform a task, but does not do it, or inadvertently performs it incorrectly.

Mistakes are errors due to a deficient plan of action despite the actions being implemented as they were planned. They can be of two types: *rule-based* and *knowledge-based*. The first are errors due to the choice of the wrong rule because of a misperception of the situation; the second are errors due to lack of knowledge or its incorrect application. The negative result of the action lies in the erroneous knowledge that led to it. The error based on knowledge is caused by a wrong attempt to solve a situation that one knows little about, as if a cardiologist was asked to take care of a patient with oncological problems, or a rather rare pathology that he does not know.

This type of error is inherent in the limited rationality or otherwise the difficulty of giving answers to problems that present a wide range of possible choices [3].

In summary, if in the *skill-based* activities the skill consists in carrying out the task without necessarily having to know the reasons, since they are automatic and elementary activities, in the *rule-based* or *knowledge-based* activities, the operator needs to possess all the knowledge and motivations that underlie the task to be able to perform it properly.

According to the definition of Reason, an aviation psychologist, we speak of error in all those occasions in which a planned sequence of physical or mental activities does not reach its goal, and this is not because someone has intervened to prevent the achievement of that goal but because the dynamics involved are many and complex.

1.1.2 Working with Error in Simulation for Patient Safety

Not all the mistakes we make result in harm or an accident; in fact most of our mistakes have no consequences whatsoever. The errors that we have classified as *slips*, *lapses*, and *mistakes* are active errors because they are visible, they cause accidents in a direct way and have immediate consequences, and they occur when our actions precede an accident, a damage.

However, there are also latent conditions that can remain hidden in the system for a long time, but when they intercept an unsafe action of ours, they turn into an error.

Remember our coffee with salt? Having the same cans for sugar and salt is the latent condition in the system that encourages the active error of swapping salt for sugar to occur.

An incident makes evident those latent errors that were present in the system itself but had not yet manifested themselves. In this regard, Reason [4] introduced the “Swiss cheese” model (Fig. 1.1), in which the cheese slices would represent the barriers and defenses put in place by the organization to intercept the possible trajectory of an error. If the trajectory intercepts all the holes in the cheese that have simultaneously aligned, i.e., the flaws in the system, an incident occurs; if, on the other hand, it encounters a defensive barrier (i.e., the cheese slices with the misaligned holes), the error is intercepted and does not cause negative outcomes.

For an accident to occur, our action must penetrate different layers (different slices of cheese), and each layer is a defensive and protective barrier of the system, which may be deficient, as in the case of lack of supervision (such as not having made a checklist of the equipment in the truck), organizational deficiencies (such as the presence of excessive loads of work, timetables, and shift patterns), unsafe acts (exchange of vials), and the pre-conditions for unsafe acts (tiredness, personal

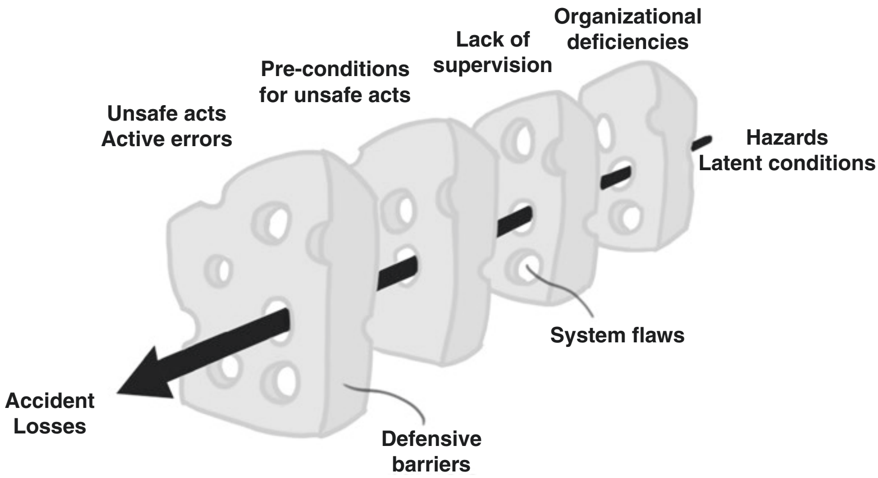

Fig. 1.1 Model of Reason

reasons). If the defensive barriers fail, the holes in the Swiss cheese line up, and the mistake can turn into an accident.

The individual-error approach places all the responsibility on the last piece of cheese, that is, the frontline operator, while the system approach assesses the presence or absence of the other upstream protective barriers that prevent the error committed by the individual from generating an accident.

Basically, according to this theory, errors that threaten safety may be made by the person treating the patient at that moment, or they may be the result of decisions already made, in times and places much more distant than the moment of the error. These errors remain latent within the system and may remain so for a very long time, until they contribute to an undesirable event. In essence, active errors and latent conditions differ in the location/level of an organization in which they occur and the amount of time that passes before they reveal an adverse effect on safety.

Active errors are the most visible and cause adverse events or accidents in a direct way, thus causing immediate consequences. Swapping vials and injecting the wrong medication are examples of active errors. Precisely because active errors are easily identified, they become the subject of thorough investigations and often lead to sanctions of the "individual responsible."

However, safety-critical decisions can also be made by people on the other side of the organization, "not on the frontline." Such decisions are made far from the patient, both in terms of time and physical distance, and yet, they themselves have a potential negative effect on the patient, causing latent errors. These decisions are made at every level of the organization: decisions at the highest level, as well as simple administrative acts, can create conditions that facilitate workplace accidents. Latent conditions are hidden within the organization, in structures (e.g., the architectural design of an intensive care unit, electromedical equipment, computer programs), and in processes (e.g., operating procedures, internal guidelines, personnel selection, qualification procedures, human resource management). In every complex system, at any given time, there is a certain amount of hidden latent conditions. Years or even decades may pass before these decisions have consequences for a patient. Until that day, no one would classify them as "errors" even though there is sufficient evidence that latent conditions pose the greatest threat to the safety of a system. Healthcare organizations are particularly vulnerable to latent errors because they must establish resources for two different goals, productivity and safety, which often come into conflict.

An example of a latent error might be a management decision to assign only one physician per operating room, without having a supervising anesthesiologist free to help less experienced staff: this working condition represents a latent condition for possible errors that can trigger a critical situation.

Good teamwork is also an essential element in preventing errors and accidents in medicine. There is a clear relationship between good teamwork and effective performance in the high-risk healthcare environment [5].

One of the most important causes of poor organization and teamwork is the lack of a shared understanding of the importance of this issue, and the actions necessary for good teamwork. As a result, conflicts between team members and a breakdown in communication can undermine collaboration and lead to under- or misuse of available resources and the emergence of new problems. In addition, team members may not share the same assessment of the situation and may be reluctant to question the actions of other participants, even when there are serious concerns about the appropriateness of a diagnosis or treatment.

Safety is therefore a complex concept and difficult to explain, as it seems to be invisible. Much like "health," the word "security" suffers from an instability of understanding. Much more is known "about its temporary absence than about its stable presence" [6].

Just as health is not merely the absence of disease, so safety is not merely the absence of accidents or errors, nor is it a static feature of the system, as Weick [7] states, but a "dynamic non-event," that is, a dynamic absence of critical events, which must be maintained by individuals and teams.

Security is therefore a dynamic task, requiring a series of proactive measures to achieve stable results, considering that the best solution to a problem is not a person but a system response.

Our healthcare organizations are often oriented toward preventing errors rather than promoting safety. When we think about preventing an error, we talk about reactive safety only after the incident has taken place, but there is also proactive safety that establishes actions to be taken before an incident caused by an error occurs [8].

In the 1990s, there was an important change of view given by the publication of "To Err is human" [9]. In this report, it was shown that the error is dependent on many factors and not only on the attention or memory problems of those who commit it. Since then, the error is no longer and not only considered as a characteristic of the human being, but of all systems that include humans.

In fact, the analysis of many adverse events in healthcare has revealed that many causes of error originate from deficits in non-technical performance, such as communication, teamwork, and situational awareness, rather than from a lack of technical and procedural competence [10].

The inappropriate organization of processes and interventions and the environment in which care is delivered play a much more significant role in causing harm than the error made by the individual. Although error is impossible to eliminate completely, it becomes necessary to create systems that minimize the likelihood of errors while maximizing the probability of intercepting them. If to err is human, then one must make the system as safe as possible.

Training of healthcare personnel is one of the most functional strategies for reducing errors and improving work performance, and should not only focus on technical aspects but also extend to non-technical skills.

Simulation permits the dealing with training aspects related to both technical and non-technical skills, offering the tools to work, according to Rasmussen's behavioral models, on skills, rules, and knowledge.

The learner who participates in a simulation and debriefing session has the opportunity to reflect on his or her actions and independently verify the effectiveness of his or her actions, achieving greater self-awareness.

In this training context, debriefing takes on its highest form of usefulness because it allows access to all those teamwork dynamics that are often the key to solving critical situations that individually would not be solvable.

1.1.3 The Human Factor: Training Non-technical Skills with CRM

It was January 15, 2009, when what the media called "The Miracle on the Hudson" occurred, when airline pilot Chesley "Sully" Burnett, in command of a stalled plane after a bird-strike, made an emergency landing on the Hudson River saving the 155 passengers. After the rescue, he was considered a national hero even though some tried to destroy his career.

We quote this true story, told in a beautiful film starring Tom Hanks (Sully 2016, directed by Clint Eastwood), because it describes when and how the human factor makes a difference: Commander Sully is a fine example of resilience.

The film starts with disciplinary proceedings against the commander and co-pilot of the plane: human error is presumed, because, although the disaster was averted, procedures were not followed and suggestions from the control tower and availability for landing were not accepted.

The question arises: is Sully a hero or an irresponsible one?

In the film, it is clearly shown that it was not "human error," but rather "human factor": it was the ability of man, in this case the great personality and professionalism of Commander Sully, to take the risk of a decision that was not a simple application of rules and customs, but rather the ability to consider all the factors at play in the specific situation and draw the best operational consequences.

When faced with computer and manual simulations that tend to show that the proposed landings would have been possible without damage to the aircraft and people, Sully claims that the human factor should be considered in the reconstruction, that is, those few seconds that it took him to become aware of the situation and decide for the ditching as the only viable alternative. With the addition of those seconds, even the simulations change and show how wise and valuable his choice was.

Sully also adds that this "Hudson miracle," as they called it, was possible because of teamwork, meaning everyone: the co-pilot, the flight crew, the passengers, and the control tower staff.

Human factor "is the study of human potentials, limitations, and behaviors, and the integration of this knowledge into the design phase of the things, places, and work environments in which human beings live and work in order to improve the efficiency, safety, and well-being of people" [11].

The human factor started to be discussed in aeronautics, when they began to study the causes of many air accidents. Scholars have come to argue that accidents were not so much related to the adequacy of professional skills possessed by operators, but to the failure to exercise non-technical skills, for example, communication skills and teamwork. In fact, the technical skills and competences of pilots alone have not been considered sufficient to guarantee the safety of flight operations and to avoid accidents [12].

Non-technical skills (NTS) are involved in the definition of the human factor and are personal and social cognitive skills that integrate with the technical skills of operators and professionals. The most relevant are situational awareness, *decision-making*, teamwork, *leadership*, and, transversally, communication.

NTS are particularly relevant in high-complexity organizations and professions, such as pilots, doctors, hospital staff, and high-risk categories of workers, thus the aviation and healthcare sectors.

Whether we are flying in an airplane or entering an operating room to undergo surgery, we are entrusted to teams of professionals who manage a complex system (operating room or cockpit), perform complex processes, govern high technologies, and manage the human component which is the most important factor for the success of the process of care and safety of patients and passengers.

The aviation industry has identified NTS training as the best way to protect specialists and organizations from mistakes and accidents. In 1981, United Airlines began specific training to make crews aware of the dynamics of human interaction on board and to recognize behaviors found in operational life.

These trainings were called *crew resource management* (CRM), and they constituted and still constitute one of the most effective models of transversal training on work groups, based on the definition of shared mental and behavioral models, on the improvement of safety, and on the training and promotion of non-technical attitudes and behaviors that contribute to the success of a mission through a training method addressed to the totality of the members of the team and not to the single individual.

CRM courses, now successfully tested in aviation, were later transferred to the healthcare field thanks to David Gaba et al. [13], an anesthesiologist and professor at Stanford University, and his collaborators who adapted the aviation model to emergency situations, thus giving birth to *anesthesia crisis resource management* (ACRM).