Chapter

Simulation: A Training Resource for Quality Care and Improving Patient Safety

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Abstract

Patient safety is an ever-present topic in the discussion of educators. It has been 20 years since the publication of *To Err Is Human*, and there are lessons learned, although there is still much to be done. Healthcare systems are becoming increasingly complex, putting the safety of patients at risk. In this context, there is a greater exposure of healthcare professionals to medical-legal liability issues and to becoming victims of situations that are often preventable. Nurses and medical doctors are especially exposed to these situations, since they are visible during procedures, or do so during the points of greater risk during the patient care process. This chapter will review the contribution provided by the curricular integration of simulation-based education as a tool to train technical and nontechnical issues and how this work can be done for the safety of patients through a standardized training plan, under controlled and evaluated processes. We will discuss how resources and elements allow to perform healthcare interventions in a more safely manner. Finally, we will review the existing literature, some experiences, and the available evidence on this topic.

Keywords: patient safety, collaboration, communication, innovation, quality of care

1. Introduction

Nowadays patient safety is a very important topic in healthcare. Healthcare systems are becoming increasingly complex, putting at risk the safety of our patients. In this context, there is a greater exposure of healthcare professionals to medical-legal liability issues. Secondary to this situation, healthcare educators have incorporated this topic into the curriculum of healthcare careers.

As in other areas of human endeavor, such as commercial and military aviation, simulation has provided an opportunity to prepare teams. Teams have the opportunity to practice skills and work through complex situations before facing the real environment, aiming to achieve safety and to prevent the incidence of errors. Mistakes in healthcare can harm patients and also affect professionals and institutions, which can be frustrated, questioned, and sanctioned.

Crisis situations and the complexity of work systems in healthcare can be recreated in simulated environments with the same level of realism as it may occur in real clinical setting. The benefit is that the activity happens in a protected environment, allowing the occurrence of mistakes, their analysis, and reflection. These

scenarios also review group behavior and the implementation of protocols up to the point where there is certainty in the fact that teams could make decisions and are prepared to face real-world conditions. In a simulated environment, error becomes an opportunity to learn and to achieve competencies, which will imply a reduction of incidents and adverse outcomes.

This chapter will provide information about the methodology of simulation-based education, about international standards in clinical simulation and will develop concepts of human factor and patient safety. It shall review the new role of educators and the challenges during healthcare professional training, focusing on physicians and nurses, since they are the most exposed during patient care. Finally, we will also present some methods and assessment tools to evaluate and analyze the current impact of simulation.

The purpose of this chapter is to provide evidence using simulation and experiences identifying how to improve professional competencies, in a time when it is necessary to incorporate new methodologies of education and technologies and innovate toward efficiency and effectiveness, making the process safer toward a culture of safety.

In summary, the authors want to contribute to the knowledge in the field of clinical simulation, patient safety, and safe nursing care, because today is mandatory for clinical teams and healthcare students to have these competencies.

2. Education-based simulation and definitions

Significant changes in clinical attention are being observed worldwide. This evolution has not been without issues, but also has been surrounded by opportunities for innovation. The increased pace of research, growing of knowledge, and progress in technology have contributed to improve the life expectancy of people. Additionally, there are new challenges, such as incoming chronic and infectious diseases, environmental hazards, and demographic and epidemiological transitions. In this scenario, the main challenge for nurses and healthcare professionals is to contribute to deliver safer attention in this increasingly complex and unsafe patient's environment.

On the other hand, those committed to undergraduate, postgraduate, and continuing medical education and train of healthcare professionals must deliver answers to this complex scenario, with fast and continuous changes in the paradigm of teaching and learning [1]. There is a lack of coordination between the competencies that graduates achieve during their careers and the real needs of the clinical environment of healthcare. Graduates need to train technical skills, have more time for clinical practice, and have more chances to interact with real patients. High-quality and efficient healthcare attention requires professionals capable to work immersed in interprofessional teams, with a high degree of leadership and decision-making skills [1].

In this context, the role of nursing is essential. It is a profession that promotes patient safety and, at the same time, guarantees high-quality medical attention. In places where education education and training of these professionals is fundamental to generate changes in the safety culture of institutions [2].

The intervention of healthcare education through the integration of active and innovative methodologies and the strengthening of the relationship between academia and healthcare area are some strategies that have been developed in order to solve this issue.

Many interventions have been described in order to develop these competencies: the use of technologies, virtual tools, problem-based learning, interprofessional education, and specially clinical simulation [3].

In order to clear the concepts of patient safety and simulation-based education, it is important to state some definitions.

Some relevant definitions of simulation are:

- As per Lopreiato: "A strategy in which a particular set of conditions are created or replicated to resemble authentic situations that are possible in real life. Simulation can incorporate one or more modalities to promote, improve, or validate a participant's performance" [4].

- "Created or replicated to resemble authentic situations that are possible in real life. Simulation can incorporate one or more modalities to promote, improve, or validate a participant's performance" [5].

- "Clinical simulation is a technique, not a technology, that substitutes or broadens a real experience through a guided experience that emulates or replicates aspects of the real world in an interactive manner" [6].

- "Methodology that creates a situation or environment in order to allow the people participating in it to experience a realistic representation of a healthcare situation with the purpose of practice, learning, evaluate or work over aspects of communication and leadership" [7].

A simple definition of Patient Safety by the WHO is "Prevention of errors and adverse effects to patients associated with health care" [8].

Primum non nocere (first, to do no harm) is a basic concept in healthcare. Numerous worldwide studies conducted since the year 2000 show how patients may be harmed as a result of healthcare attention with an important percentage of preventability [9]. A *learning curve* makes reference to a period of time an individual takes to learn a subject or specific skill. This learning period can increase the potential percentage of events resulting in harm for real patients; therefore, it is a priority to implement learning models that do not expose patients to this risk. There is compelling evidence regarding how educational interventions with clinical simulation allow healthcare professionals to acquire knowledge, skills, and behaviors, having a positive impact on patient safety [10]. A paper written by Mary Ann Cantrell allows us to become familiar with studies that show how simulation methodology has an impact on cognitive and procedural outcomes, not only in undergraduate nursing students but also in professionals [11].

Many different classifications of simulation devices exist [12, 13]. The spectrum of clinical simulators includes part-task trainers, computer-based systems, virtual reality and haptic systems, simulated patients, simulated environments, and integrated simulators (both, model- and instructor-driven simulators). The choice of the simulator will depend on the competition or the skill the instructor wants to train [12].

Regarding fidelity of simulation, many different definitions exist too [14]. Following the definitions of the Sim-dictionary developed by the SSH [4], low-fidelity simulation is not needing to be controlled or programmed externally for the learner to participate; examples include case studies, role playing, or task trainers used to support students or professionals in learning a clinical situation or practice. That type of simulation activities called low fidelity requires the educator's feedback. Some examples are intravenous catheter insertion, drug administration, or introduction of a urine catheter.

The other one is high fidelity and refers to simulation experiences that are extremely realistic and provide a high level of interactivity and realism for the

learner. This definition can apply to any mode or method of simulation; for example: human, manikin, task trainer, or virtual reality.

High fidelity uses full-body manikins with computers that give very realistic physiology answers to train nontechnical skills. This modality allows to train leadership and make safe decisions, teamwork, and communication. An example is training for advance CPR. High fidelity simulation ended with a reflexion named "Debriefing", that is the most important part of simulation. Debriefing is for collecting information, a reflection in team about the experience to improve for the next time.

With these types and levels of simulation, this methodology allows both, individual and team training, showing an improvement in the performance of healthcare systems, lowering the incidence of errors and improving the quality of healthcare [15].

There are three domains where clinical simulation may be used by healthcare professionals [10]:

1. Practice and evaluation of technical skills through various models or software developed for that purpose.

2. Practice with a simulated patient to develop communicational skills.

3. Training of teams who face critical situations through the implementation of high-fidelity scenarios, which are characterized by having an extremely high degree of realism, allowing for high interactivity among the participating individuals. This type of scenario is followed by an after-action review, better known as debriefing [4].

3. Values and beginning of simulation-based education

This section presents the main historical events associated with clinical simulation and its value, based on models and theoretical framework that support it. We will review international standards for their implementation, essential elements that have made it a powerful tool regarding patient safety:

3.1 Clinical simulation as a teaching and learning methodology

Since over four decades, the use of clinical simulation as a valuable methodology has shown an important growth worldwide. Its implementation in nursing and other healthcare professions was adopted from other industries known as High Reliability Organizations, which are characterized by operating in complex high-risk contexts, showing low rates of accidents, failures, or catastrophic events. These organizations, such as aviation, electricity, and nuclear energy, are based on five fundamental pillars, being one of them the training of personnel through the use of simulation methodology [16].

Sim One, *Harvey*, and *Resusci Anne* were the first simulators which over five decades ago were designed with interactive characteristics to enable the development of certain skills in the training of healthcare professionals. Currently there are a large variety of resources that have allowed for clinical simulation to become a gold standard and a valuable and essential methodology for the process of teaching and learning in healthcare careers.

Simulation has been developed around the world, with various degrees of development, involving scientific societies in the fields of academia, research, and

program accreditation. Simulations allow an important collaborative and networking job between countries and organizations [17].

The value of simulation as a methodology is provided in no small measure by the models and theoretical frameworks that support it; the most relevant are described below:

Andragogy: It refers to the learning theory of how adults learn. Professionals who work in the field of healthcare are adults that base their learning in the main principles of andragogy: internal motivation, a taste for problem-solving, autonomy, exacting standards, preference for practical activities, and previous experience. Clinical simulation as a methodology enables learning by respecting each one of these principles, which enhances its value in the training of professionals for the improvement of patient safety [18].

Deliberate practice: This theory on an experience that allows for the accomplishment of a competence through systematic and controlled practice, allowing the learner to have a full awareness of their progress and achievements. When deliberate practice is carried out through clinical simulation, it allows to learn by means of repetition, without sacrificing patient safety. This theory is also known as the expert theory, which states that expertise goes beyond a genetic condition, being a person, through practice, able to achieve its maximum potential in a given field [3].

David Kolb: This theory states that through concrete and active experience, based on reflection, the individual who performs a training activity with simulation can achieve behavioral changes through abstract conceptualization [3].

Dreyfus and Dreyfus: This theory states that every professional in the field of nursing or other healthcare profession goes through five stages that range from novice to expert professional. Simulation as a methodology strengthens the transition through these stages from undergraduate training to continuing education in highly experienced professionals [19].

Reflective practice (Schön): This theory formulates that reflection is essential for learning. All learning practices must include a moment of reflection that accompanies the performed action. Feedback and debriefing are the intentional reflexive methods that accompany a clinical simulation experience, during and after the action where the educator can verify learning achievements [20].

3.2 International standards for the implementation of teaching based on clinical simulation

In the academic environment, the need to implement and evaluate the integration of simulation methodology in the educational processes arises. The training of these new educators with quality tools and evidence-based standards is also necessary.

The development and implementation of standards allows for continuous improvement based on established benchmarks, and it is through the work of experts and scientific societies around the world, such as the National League for Nursing (NLN), the International Nursing Association for Clinical Simulation and Learning [21], and the Society for Simulation in Healthcare (SSH), among others. These are the bases to begin with tools which establish and give the reference frameworks, glossaries, codes of ethics, good practice standards, and research topics. They created this methodology, allowing subsequent growth and development.

Below are the main implementation standards recommended for teaching based on clinical simulation:

3.3 National League for Nursing accreditation standards

Dedicated to excellence in nursing, the National League for Nursing is the premier organization for nurse faculty and leaders in nursing education [22]. The NLN offers professional development, networking opportunities, testing services, nursing research grants, and public policy. NLN members represent nursing education programs across the spectrum of higher education, healthcare organizations, and agencies.

The NLN promotes global excellence standards in the field of nursing education through a process of accreditation that respects the diversity of the mission statement of a program, study plans, learners, and faculty, with the objective of implementing a culture of continuous improvement in the field of nursing education.

Its standards are:

- Standard I: Culture of Excellence—Program Outcomes
- Standard II: Culture of Integrity and Accountability—Mission, Governance, and Resources
- Standard III: Culture of Excellence and Caring—Faculty
- Standard IV: Culture of Excellence and Caring—Students
- Standard V: Culture of Learning and Diversity—Curriculum and Evaluation Processes

3.4 SSH accreditation standards

The purpose of the Society for Simulation in Healthcare is to serve a global community of practice enhancing the quality of healthcare [23]. This society has an international accreditation program that considers five areas of accreditation, each one with defined criteria:

- Core
- Assessment
- Research
- Teaching/education
- System integration

3.5 International Nursing Association for Clinical Simulation and Learning Standards (INACSL)

The mission of this society is "To advance the science of healthcare simulation" [24].

The latest official standards of this organization include recommendations for:

- Simulation design
- Outcomes and objectives

- Facilitation
- Debriefing
- Participant evaluation
- Professional integrity
- Simulation-enhanced IPE
- Operations

4. Patient safety concepts and curriculum integration in health careers

Patient safety has been recognized as a fundamental right, which has been expressed in various laws and declarations, and we must strive toward it [25, 26].

Patient safety was branded as a universal concept in 2004 [25]. The English physician Dr Liam Donaldson, based on the book *To Err is Human*, decides to create the World Alliance for Patient Safety under the wing of the World Health Organization [25]. This group proposes, as its first objective, to coordinate, disseminate, and accelerate around the world all improvements related to patient safety, sharing common strategies and standardized procedures around the world. This work produces the "Hand Hygiene" protocol (Indications for Hand Hygiene) [27], known and applied around the world. Another major contribution was the creation of the protocol for surgical safety pause [28]. Likewise, many other subjects have been developed by the World Alliance, whose objective is to achieve patient safety and low cost and high satisfaction on the achieved objectives.

One of the relevant results emerging from this work is to have a unique definition for patient safety, which allows us to enable a series of actions and interventions around the world that stem from this concept. We shall now review the latest definition, which was worked on and discussed at length, over several months, by the community of the WHO Patient Safety Network, and published in 2018.

"Patient safety is the absence of preventable harm to a patient during the process of health care and reduction of risk of unnecessary harm associated with health care to an acceptable minimum. An acceptable minimum refers to the collective notions of given current knowledge, resources available and the context in which care was delivered weighed against the risk of non-treatment or other treatment" [25]. This definition is quite similar to the previous one; however, resources and context become relevant, including the concepts of knowledge and update. We can therefore consider as a self-evident truth that, in the face of development and the availability of technological and academic conditions for education, the use of simulation-based training is a valuable and increasingly affordable alternative.

Dr Liam Donaldson remains to this day a leader in this subject and has developed a global work agenda that already has experts among its ranks that through virtual networks communicate and organize subgroups and commissions in permanent development of initiatives. There are events and congresses, societies with strategic projects, and preset goals to be fulfilled within defined timelines. They are looking for common results that, if achieved, shall be highly impactful with a global scope. Within the World Alliance objectives declared for 2016–2025 period, we find reducing medication errors that now comprise one of the leading causes of death [29] and also damage caused. This problem has not been sufficiently researched, but we can infer that harm and damages are also high, many of which could be

preventable if the strategy is strong and known for all. This is a concern for many different countries and groups around the world. All the above also implies elevated costs to society, which may be better used in research, new hospitals, and vaccines, every one of them very worthy of consideration in the field of healthcare. However, work on patient safety is not only an exclusive concern of the clinical field but is also arising in the context of academia, where it is fundamental to prepare students from healthcare careers, making them safe professionals. This is increasingly more demanding on account of the legal aspects of healthcare, and a more active participation of patients and their families in sanitary issues, and their role when facing medical decisions. In the book *To Err Is Human*, the need to incorporate the use of clinical simulation is first established [30]. It presents a proposal that shall lead directly to a change in paradigm in education, since it shall be acceptable that errors occur, and to avoid or diminish their impact, they must be analyzed. We can point out and recognize that this is a starting and inflection point toward change and therefore also the moment for integrating the methodology into the environment of healthcare. At that time this was an innovative idea, which was not being applied in human health area. Nevertheless, during the decade of the 1960s, we can already find evidence of a small successful result by means of simulation. As it was previously stated, this wasn't either the first proposal for its use in a clinical setting; however, due to various reasons, it had not prospered, and only from the year 2000 clinical simulation is associated with the subject of error, which is still a very complex topic. From this moment onward, various initiatives are generated around the world, from where leaders emerge, mobilizing clinicians and educators to this day. Worth mentioning are David Gaba, anesthesiologist and a pioneer of simulation techniques for crisis management in Stanford, known as the Crisis Resource Management [31]; Dr Peter Dieckmann, who from the area of psychology has researched and analyzed debriefing models; and lastly Dr Pamela Jeffries, nurse and a renowned leader on account of her theoretical model and her contributions to society through her research in the area of clinical simulation.

Also, along the same lines, scientific societies emerge, which now call professionals from around the world to attend events and dedicate their work to the training of simulation methods and evidence gathering, such as SSH and INACSL, among others previously described.

It has been nearly 20 years devoted to becoming aware of the need for change. The World Health Organization, in 2010, proposed a curriculum for the training of midwives and nurses, highlighting the need for simulation laboratories at the same level of classrooms and libraries [32].

Around the same time, in 2009, the curricular safety guidelines for medical students and in 2011 for other professionals are made available [25], which again propose the integration of simulation in training.

These documents are the fruit of the work and data collection by experts, which makes clear the need to intervene and generate change.

The nursing profession has led the way around the world, garnering momentum for a movement in favor of the advancement in the integration of simulation in curricular proposals.

This is how educational projects, which have been successful around the world, on different continents, mainly the United States, Australia, and the Nordic countries, are initiated. It should be noted that the integration of simulation in study programs requires work oriented to obtaining measurable and observable results that allow proposing continuous improvement, in which the role of the teacher is key to the success of the experience [33]. Carrying out planned work, along with the development of a series of tools to be considered as guides, rubrics, and guidelines, as well as a permanent training plan, an institutional strategic plan,

and a continuous reflective look, makes this methodology a permanent challenge. Considering that the authors are from Chile and they have developed their experience in countries of the region, it is possible to point out that there are already successful integration experiences in undergraduate programs in nursing and some, but in smaller numbers, in medicine; in graduate and postgraduate degrees, they are still very scarce. It is therefore an interesting moment to carry out research and generate reports of the results achieved to date.

5. Patient safety and relationship with human factors

The book *To Err Is Human* raises the issue of the complexity of the work system in the environment of healthcare, which is generated by various reasons, such as the multiplicity of simultaneous events, interruptions, fatigue, work flows, etc., and illustrates this in a model that is used today to explain the phenomenon that is known as the *theory of Reason* (after James T. Reason, of the University of Manchester) or of the *Swiss cheese model*. The remarkable thing about this way of presenting the processes in a system, in this case from a sanitary standpoint, is how didactical it is to better understand errors. The image of the Swiss cheese allows observing that between processes multiple instances arise in which there are possible breaks of safety controls. The field of engineering has always worked considering that error is part of their work, and, as pointed out by Mavilde da Luz Gonçalves Pedreira in her book *Nursing on a Daily Basis: Patient Safety* published in 2011, the engineer trains for this eventuality and creates intervention and safety points in risk areas, constantly evaluating and measuring, with optimal results for the user. However, this does not occur in healthcare where, for example, we do not have rigorous induction and orientation processes in place, which in other industries are known as "trainee programs." Our working day is normally long and many times needs to be extended beyond human capacity. The feedback loops are not in place; there is no testing of protocols; there is a lack of both guidelines for checking any of the above and reflection times for decision-making, which in our region are also part of a very hierarchical and compartmentalized cultural issue. All of this is known as the human factor, meaning the integration between the organization, work itself, and staff, which has been studied deeply by sociologists and ergonomists [34]. It is still today a subject that is rarely discussed by administrative staff and the managers of clinical institutions and integrated into the programs and curriculum of healthcare careers in most countries of the world. However, today is part of the terminology of the Sim-dictionary, and this has two major foundations [4]. The first is what the WHO points out in 2004 in its publication *Learning by Errors* in which it is emphatic to declare that this is a subject that should always be taught but that we see that it is mostly unknown [35]. And the second is provided by the objective of simulation, whose purpose is to work for the safety of the patient, and it is Dr. Gaba, recognized for his work in crisis management and expertise in high-fidelity scenarios, who states that in the performance of professionals, they are exposed to certain critical points [36], which are all associated with the elements present in the human factor concept; therefore they are not only technical issues but also of systematic, in which, for various reasons, human behavior can put safety at risk. One of his last publications, *Human Factors Engineering in Patient Safety* [37], allows to finally unite the world of engineering with healthcare and raises an interesting proposal of the intervention of engineers and the resources of their discipline for simulations, in a capacity of trained experts who can suggest how to avoid breakpoints in the safety chain through simulations designed by a multidisciplinary team.

As previously stated, it is Dr Gaba, an anesthesiologist from Stanford University, United States, who incorporates into simulation a tool already used in the field of aviation, which first he adapts to anesthesia and subsequently implements for general clinical activity, called Crisis Resource Management or CRM [38]. This modality, which is carried out in very realistic scenarios, identifies 15 key points that, according to what Gaba observed in his institution, generate the most errors [39]. It should be noted that one of them, effective communication, is the key issue that has been analyzed, investigated, and evidenced by many, being considered as the one that triggers the most errors. This implies, therefore, that it is essential to train as teams in simple and complex scenarios where the element of crisis allows to look for individual and collective safe behaviors, which after being analyzed through debriefing will allow to achieve good performance objectives in a shared, and therefore safe, manner.

6. Learning activities to teach safety competencies with simulation

To conduct the curricular integration of the methodology is not currently an easy subject for academics and clinicians. It implies changes of the teaching paradigm, mainly by a new role of the teacher that in addition to be a healthcare professional must be familiar with medical education or education in health sciences. The simulation educator or simulationist, which requires at least 2 years of training, must carry out his/her work under standards of simulation education applying new teaching tools such as feedback, coaching, reflection, deliberate practice, and others [24]. The simulationist must guide their teaching toward the learning outcomes and not only from the designed objective, understanding that this methodology should be used in all required levels, that is, undergraduate, postgraduate, and continuing education [4, 40].

There are models designed to implement this proposal; however, the most complex aspect of this is that this frame of reference is designed from the curriculum project of the unit, which implies serious and profound interventions [41]. Without this, it is not feasible that the process responds to the profiles of graduates, postgraduate, or specialty programs. Let us remember that any curricular intervention requires logic and a coordination of all the educational strategies to be developed, making it unique and respond to a construction not only of contents or disciplinary elements.

We present below the models of two of the authors of this chapter, which have been constructed based on the units responsible for the integration projects of the simulation. It is interesting, given that the first is the result of a curricular project designed for the school of nursing of the Finis Terrae University of Chile (**Figure 1**) and the second from San Sebastian University of Chile (**Figure 2**). Even though they have two different origins, they share a series of elements that are transversal to any current simulation proposal.

It seems important to point out and recommend to clinicians other instances of the application of the simulation, such as simulation in situ. This application of simulation is understood as one performed in the real setting, that is, in the clinical environment with its physical resources, equipment, and systems, in addition to its protocols, routines, and usual work teams to be trained [42]. The purpose of this modality of simulation is mainly oriented to safety, and one of its proposals is aimed at training teams to identify latent safety threats in their work environments. Simulation in situ is a newer modality than simulation in centers and must solve issues such as spaces, times, fears from professionals, and contamination of

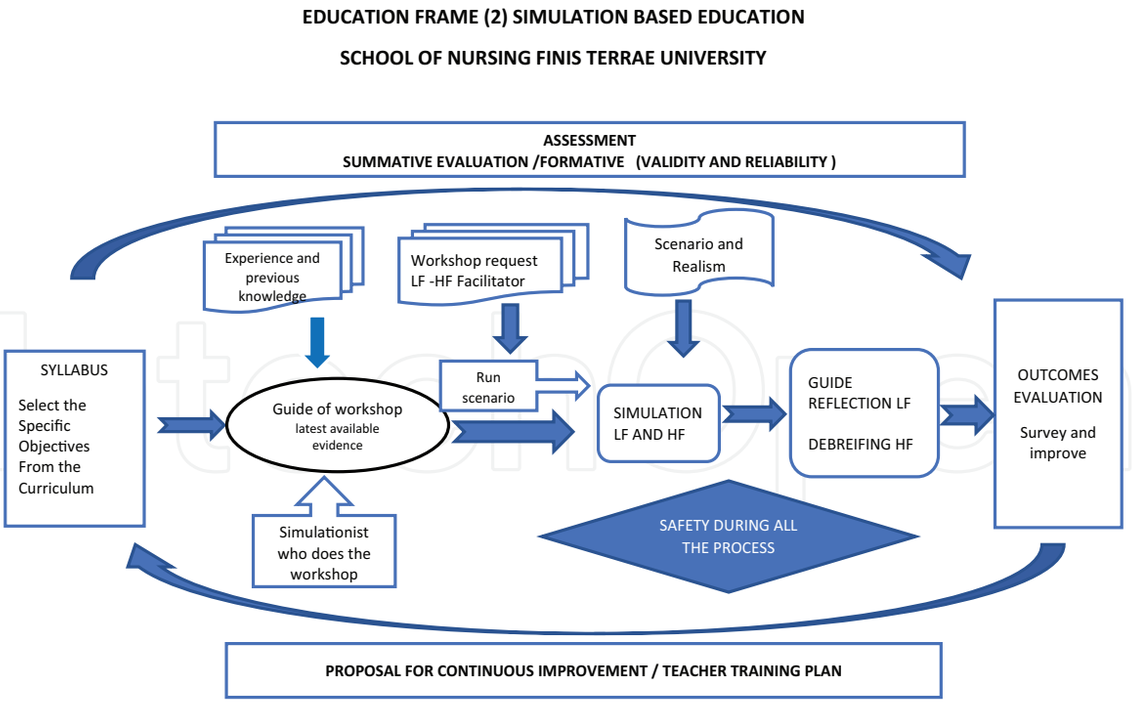

Figure 1.
Frame of simulation from nursing of the Finis Terrae University of Chile.

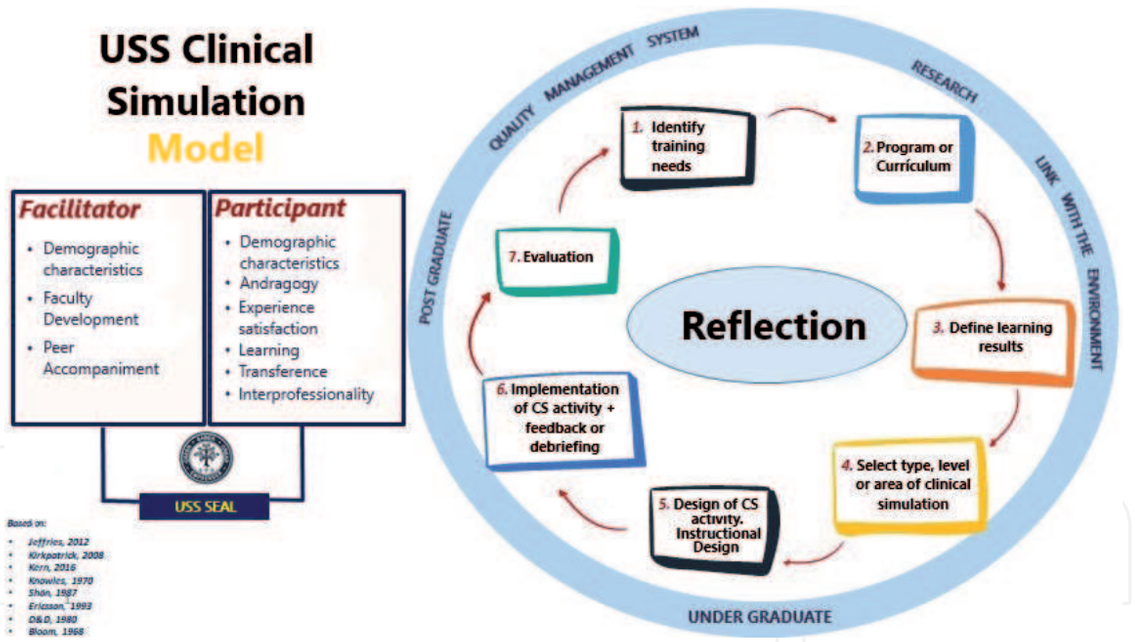

Figure 2.
Frame of simulation from San Sebastian University of Chile.

simulators, among others. The experiences carried out have been well evaluated, for example, in the cases of hospital emergencies, although there is still much to be developed and researched in this regard [43].

6.1 Strategies and tools

Many systematic approaches have been developed in order to achieve an effective teamwork and communication in healthcare. One example of these strategies for patient safety is SBAR: Situation-Background-Assessment-Recommendation. This is a tool that provides a framework for communication between members of

the healthcare team about a patient's condition. This instrument is useful in emergency or for giving information through a phone call, for example. It has been used successfully in clinical environment [44]. The school of nursing from Finis Terrae uses and trains the students with SBAR. The students are prepared to phone the physicians or a colleague and summarize all the most important information about the case and the patient. The students do for several times during the career to be ready and sure.

Another resource that is necessary to mention is Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS). This strategy has been considered like a good model for training the teams, and part of this is doing with simulation and optimizing team performance across the healthcare delivery system [45].

7. How to assess competencies of safety patient with clinical simulation

According to the pyramid model described by Miller, we can assess learners at four different levels [46]. These levels are (1) knows (knowledge), (2) knows how (applied knowledge), (3) shows how (performance), and (4) does (action or behavior in real practice) [46]. Different methodologies have been used to evaluate these four different levels of competence. For example, if we want to assess trainees to "show how," the ACGME Toolbox of Assessment Methods suggests that simulations are the most appropriate methodology. One of the strengths of simulation as an assessment methodology is the high degree of reliability. We can present a situation in the same manner for every student, situation that becomes especially important for certification and recertification processes [47].

Regarding how to measure competence during simulations, many assessment tools have been described in the literature. Based on the literature related to simulation-based assessment, two types of observational scales have been described, explicit process and implicit process [48]. Explicit process scores take the form of commonly used checklists or key actions. Implicit process scoring is a tool where the entire performance is rated as a whole and is named global rating scales. In general, the choice of metrics will depend on what we want to measure. If we want to assess "technical" skills (airway management, drug administration, and placement of catheters), it is usually possible to identify key actions and to develop checklists. On the other hand, if we want to assess "nontechnical" skills such as communication, teamwork, and situation awareness, it is better to use global rating scales.

Regarding assessment tools for procedural skills, recent investigations suggest that global rating scales may be more sensitive in determining competence for procedural skills [49]. Ma and colleagues provide an example whereby the use of a global rating scale may be preferred over the use of two currently available checklists during central venous catheter placement [50]. Additionally, checklists have been unable to find differences between novices and experts [51]. A possible explanation is that knowledge acquisition through lectures, videos, or other material reviewed prior to the assessment session allowed novices to complete easily the majority of the key actions requested by the checklist from a cognitive standpoint. This interpretation challenges the utility of checklists as an assessment tool for procedural competences.

Additionally, more sensitive technical performance measurements, such as limb kinematics (trajectory, velocity, and acceleration), may provide additional performance assessment [52]. The use of these motion devices in the evaluation of motor skills allows obtaining quantitative data complementing previous validated visual scales [53]. Recent evidence supports their use in specific procedures. Clinkard

provided evidence of construct validity for hand-motion-tracking analysis during US-guided CVC installation in a simulated setting. They concluded that motion analysis is a feasible tool for assessing competence in US-guided CVC, discriminating between performance level of novices and experts [54].

Regarding assessment tools for nontechnical skills (NTS), such as teamwork, communication, and decision-making, multiple tools have been developed over the last decades. A recent systematic review with the aim to analyze the context of use, method of development, evidence of validity, reliability, and usability of tools for the observer-based assessment of NTS in healthcare found 76 tools for assessment of NTS in healthcare [55]. The authors suggested a need for rationalization and standardization of the way we assess NTS in healthcare and greater consistency in how tools are developed and deployed.

In another systematic review aimed to synthesize available tools assessing teamwork performance of teams in crisis situations, 13 tools are identified for assessing teamwork of teams in crisis situations [56]. The tool TEAM may be the most promising tool given its measurement evidence [57]. Finally, they mentioned that there is a lack of tools to assess teamwork performance during intraoperative crisis situations [56].

8. Evidence regarding how simulation improves patient safety

Evaluating the patient impact of simulation-based education has become a priority in the present time. A recent review about using clinical simulation to study how to improve quality and safety in healthcare determined that using simulation in the study of healthcare improvement is a promising approach that could usefully complement established research method [58].

Simulation training in anesthesia has been used successfully and has shown to increase many skills of anesthesiologists. Nevertheless, there has not been a demonstrable improvement in patient outcomes with simulation training [59].

Unfortunately, systematic reviews indicate that patient outcomes are reported in only 0–5% of medical education studies [60]. Most of the simulation research body has focused on the performance of students, both in simulated environment and its transfer in the real patient. However, the impact of such simulated training, on the real patient outcomes, has been poorly studied.

A review on the evidence regarding educational interventions to enhance patient safety using a nontechnical skills training approach was published in 2012. A total of 22 studies met the inclusion criteria. There was a variation in the focus of outcomes among the studies, with representation of all levels of Kirkpatrick's adapted hierarchy. Only three measured patient outcomes. The methodological quality of published studies is reasonable, although the reporting of specific interventions is poor. There is a significant variation in the outcome measures used in this research, which limits the strength of conclusions on the effectiveness of these interventions [61].

A systematic review published by Zendejas identified 50 studies reporting patient outcomes in the evaluation of simulation-based education for health professionals [62]. All the studies included in this systematic review involved procedural skills training (airway management, gastrointestinal endoscopy, central venous catheter insertion). Most outcomes of this group of studies are procedural success rate and complications. Unfortunately, the minority of studies reported other patient outcomes such as survival and duration of hospitalization. Finally, a meta-analytic synthesis demonstrated small to moderate effects favoring simulation in comparison with no intervention and small nonsignificant effects favoring

simulation in comparison with non-simulation instruction. The authors stated that simulation-based education is associated with downstream benefits on patient care.

9. Conclusion

Clinical simulation is a very valuable methodology for training, aimed at increasing patient safety. It is not a methodology that is proposed only for professional nurses, which motivated this chapter to be developed by a doctor and nurses.

Today simulation is considered an important option to achieve a safety culture, and evidence points out that it is a great contribution and it is very accepted by the new generations of health professionals. We must not forget that there are many groups working around the world to achieve this objective and also many initiatives that must be linked and associated through collaborative networks. A challenge that remains is to involve patients and let them know more about the subject and join in to be an active participant for their safety.

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