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Implementing a Simulation-Based Distance Learning Model: How to Facilitate High-Engagement Experiential Training While Reducing the Risk of Infectious Disease Transmission Amongst Healthcare Professionals

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Introduction
We aim to describe and evaluate a new model for distance experiential learningin order to help reduce the transmission risk among professionals envolved in education activities
Methods
In April 2020, in partnership with our hospital's Emergency Department educational leadership, Valdecilla Virtual Hospital tested and introduced an experiential distance learning model. Professionals wanted to engage from their homes without having to travel to a simulation facility.
Results
Between July 1 and 22, 2020 we ran seven courses following this new model of course. Each one consisted of a two-hour session on two consecutive days. There were 44 participants whose ages ranged from 26 to 53 years (average = 40), 62% identified as female, and 68% reported working at the Emergency Department, 19% at the Cardiology Unit, 7% in Primary Care, and 5% in Internal Medicine.
We evaluated the content validity, feasibility and acceptability of the model. The results of an anonymous survey filled in at the end of the course showed they considered the distance training model as realistic (92%), easy to use (95%), well-organized (94%), an engaging educational tool (94%), and desirable for practising in the future (94%).
Discussion
These results may encourage the educational community to develop more programs using this new approach of "taking care of patients from a distance" not only during a pandemic, but also on a regular basis.We think this model can achieve positive results using distance clinical simulation combining their traditional simulation technology to address the training needs of their healthcare organization

Keywords: simulation, emergency, COVID-19
Short Title in English: Implementing a Simulation-Based Distance Learning Model

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Introduction

Healthcare simulation is a widely used method for training healthcare professionals that contributes to the long-term retention of acquired complex, technical, clinical and teamwork skills. Translational science research shows that measured outcomes transfer to improved patient care practices and improved patient and public health. Simulated training can also yield a favorable return on financial investment (1).

Healthcare simulation subscribes to the theory of experiential learning that a two-dimensional cycle is necessary for learning to occur. The first dimension involves perception, whereby the learner begins by grasping a specific experience or concept. The second dimension involves processing the concept: in this phase, the learner transforms the experience through reflection and active experimentation (2). To complete this cycle, learners and educators usually meet on site to participate in highly interactive, high-fidelity clinical scenarios using mannequins, actors, task trainers, or a combination of these figures. These sessions are followed by debriefing (3). The rapid development of technology-assisted learning methods has gained momentum since the coronavirus disease 2019 (COVID-19) pandemic, helping reduce the risk of transmission among professionals and opening up new alternatives for remote experiential learning (4).

The best approach to implementing clinical simulation activities in this context has not yet been determined. Several solutions have been proposed to bring the pieces together in a way that would allow professionals to continue their training activities, while simultaneously protecting the clinical safety of the participants, avoiding, as far as possible, the spread of coronavirus. These include a variety of simulation-based asynchronous (e.g. recorded videos, vignettes, serious games) and synchronous (e.g. webinars, team collaboration) methods, recreating the clinical environment with different levels of fidelity and learner engagement, and offering a series of reflection strategies (5). Innovations in healthcare simulation technologies can now also provide the learner with opportunities to practice increasingly complex motor, decision-making and communication skills using virtual patient simulation. Dynamic health conditions can be created in a variety of clinical settings that respond to user interventions and help improve learning satisfaction when compared to a case-based learning approach. Using virtual patient simulation to provide simulation-based distance learning experiences that are extremely realistic and highly interactive for the learner remains a challenge. Communicating with patients, family members and healthcare workers, performing physical examinations on patients, monitoring physiological parameters, and evaluating complementary examinations in an actual clinical environment are all limited by mathematical algorithms and software capabilities. A mix of synchronous on-site/on-line distance learning methods may recreate the richness and complexity of a true clinical experience and facilitate reflection on action promoting participant engagement, while limiting exposure to infectious diseases during a pandemic. Our aim is to describe and evaluate a model for distance experiential learning, where participants see simulated patients remotely and interact with other caregivers, and subsequently analyze the session in a debriefing(6).

Material and Methods

In April 2020, Valdecilla Virtual Hospital, in partnership with our hospital's Emergency Department and Intensive Care educational leadership, tested and introduced an experiential distance learning model in response to requests from physicians all over Spain for simulation-based clinical training in the midst of the pandemic. Professionals wanted to engage from their homes without having to travel to a simulation facility, thus effectively preventing possible contagion derived from the COVID-19 pandemic.

-The team: Valdecilla Virtual Hospital, Santander, Spain is a nonprofit, charitable organization that offers instructor and clinical training courses with tuition. It is an educational institute accredited by the American College of Surgeons and affiliated to the Center for Medical Simulation, Boston, USA. Its aim is to achieve superior clinical education programs, enhance patient safety, and promote simulation (7).

The instructional design model followed the Analysis, Design, Development, Implementation and Evaluation (ADDIE) model (8).

- Analysis: unstable heart disease is one of the most common reasons for presentation to the emergency department and was identified as a point of special interest among the target students (9). This type of visit allows participants to effectively interact, but does not require a large number of interventional maneuvers that would be unfeasible to conduct from their homes.

- Design: delivery methods and types of learning activities were selected. Zoom was chosen as a widely available, straightforward platform that allows users to switch back and forth between different types of teaching methods (e.g., live video feed, lectures, small group discussions).

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Participants connected remotely to a live simulated emergency room, and attended simulated patients while interacting with other caregivers who were present in the scenario. Simulated interactions were followed by an instructor-led debriefing to reflect on clinical performance **(Figure 1)**.

- Development: this included creating the instructional content, a prototype, and assessment instruments. Learning objectives were both clinical (establishing the initial approach and providing training on the key premises and complications of the unstable cardiac patient) and behavioral (leadership and effective communication in emergency situations). The prototype included the following phases:

Pre-briefing: this was intended to establish a psychologically safe container that allowed trainees to engage actively in simulation and to display meaningful learning behaviors during post-simulation debriefing conversations (e.g., openly discuss errors or divergent ideas without fear of negative implications) (10). During this phase, the instructor introduced the simulation learning experience and set the tone for the rest of the session, specifically: 1) clarifying objectives, environment, roles, confidentiality, and expectations; 2) establishing a fiction contract (i.e., reaching a collaborative and explicit agreement among instructors and trainees to commit to playing fair with respect to fidelity and realism); 3) housekeeping (e.g., platform instructions for the videoconference, agenda, breaks); and 4) expressing commitment to respecting learners and understanding their perspective (11).

Introduction to the clinical environment and distance interaction: in this phase, participants connected live to the emergency room to meet the nurse and resident who were assisting them in carrying out tasks during the scenario, and to observe how the instructor interviewed a patient. They also became familiar with monitors, requesting additional tests, and calling for assistance. Interactive Zoom platform features were also explained to the participants.

Case briefing and clinical scenario. Two participants saw the patient in each case, and the others participated as observers. One of the instructors briefly introduced the case and then two participants interacted remotely with the patient and healthcare providers who were on site at the simulated emergency room.

Debriefing. Instructors and learners reflected on the simulation experience with the purpose of moving toward assimilation and adaption of learning in future situations (Figure 2). In the debriefing, we used the good judgment method that takes into account the expert opinion of the instructors, while simultaneously valuing the unique perspective of the trainees in order to learn what drives their behaviors, so that both their mistakes and successes can be understood (12).

Summary. At the end of each session, we collaborated with participants to summarize take-away messages that may improve their practice.

Results

Between July 1 and 22, 2020, we ran seven courses. Each one consisted of a two-hour session on two consecutive days. There were 44 participants whose ages ranged from 26 to 53 years (average = 40), 62% identified as female, and 68% reported working in the Emergency Department, 19% in the Cardiology Unit, 7% in Primary Care, and 5% in Internal Medicine. Two

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simulation technology specialists participated. One assisted with the online platform and the other controlled the mannequin and live audiovisual settings during simulations. The nurse and resident not only prepared the cases but also acted as healthcare providers in order to help participants attend the patient and meet the objectives of the simulation. One instructor assisted with the clinical aspects of the cases and co-debriefed, while the other kept participants oriented and led the debriefing session. High-fidelity simulators from different vendors were used for the cases, while the room set-up resembled a tertiary hospital emergency room **(Figure 1).** Each course simulated four different cases. Two had a "linear structure" in which the patient developed clinical complications and participants diagnosed and treated them in real time with no interruptions. The other two cases were paused twice to facilitate in-action reflection and to discuss patient care and the diagnostic and therapeutic measures to be taken, regardless of participants' performance. Pauses lasted three to five minutes and the simulated providers took care of the patient who remained stable. When participants fulfilled the objectives, the instructor terminated the case.

Metrics: We evaluated the content validity, feasibility and acceptability of the model, as follows:

Content validity is the extent to which the content of a simulation is representative of the knowledge or skills that have to be learnt for application in the real environment. The course was coordinated by two clinical educators. We applied a modified Delphi technique using four sequential interviews combined with 3 pilot programs to define the aspects of the simulated environment, including the emergency room environment, patient characteristics, monitoring, equipment, simulated providers, teleconferencing, telephone communications and complementary tests available (12). Three physicians (two emergency room and one intensive care), four cardiologists, two nurses, one nurse assistant, three simulation specialists and two educators participated, all of whom had between five and twenty years of experience in designing simulation-based courses. Everyone had to be in agreement for a component to be incorporated into the simulation model.

Feasibility evaluates all relevant project factors to determine whether the plan of action is likely to produce the anticipated result. We analyzed the benefit of the operational, technical, financial, and educational capabilities of the project in terms of economics and organization.

Acceptability explores participants' experience with the model, the perceived realism, and their opinion on whether it efficiently achieves the desired teaching goals. The results of an anonymous survey **(Figure 3)** completed at the end of the course showed that they judged the distance training model to be realistic (92%), easy to use (95%), well-organized (94%), an engaging educational tool (94%), and desirable for practicing in the future (94%). The survey contained some open-ended questions in which the learners could comment on relevant aspects of the course. **Table 1** shows some representative comments shared by participants at the end of the session.

Discussion

Due to the COVID-19 pandemic, remote learning simulation has become a new element for simulation in university hospitals. The performance of this new model and possible difficulties are reviewed below.

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Evaluation: we included formative assessment to facilitate learning, using the good judgment method during debriefing to reflect on participants' performance. This helped reveal the internal frames of trainees (including knowledge, assumptions, and emotions) that drove their actions during the cases (14,15,16). The instructor helped participants to maintain or reframe those drivers, and to take action to maintain results or achieve better outcomes in the future (1).

Hurdles:

Technology. A hidden danger was viewing simulation solely as technology, since it does not facilitate learning alone. Simulation is an educational methodology and once the learning needs are identified, the instructional design must be properly planned and the technology must then be appropriately aligned to achieve the objectives (Technological Pedagogical Content Knowledge [TPACK] Framework) (17,18). Most of the challenges were related to the participants' equipment, especially connection issues and background noise during the sessions.

Maintaining an engaging learning environment. The main challenges were creating experiences that are realistic for the participants and facilitating involvement during cases and debriefing. Key elements to address these issues were setting and discussing expectations, modeling the interaction with the simulated providers during the scenario, being able to talk to the patient and observing changes in vital signs online, encouraging people to speak up, and fostering respectful disagreement. It was also important to discuss the origin of the cases, and to interact in a high-fidelity environment that resembles a "real scenario" with medications, defibrillators, monitoring, and other commonly used elements.

Where to start: The basic principle is to generate a training tool that maintains the essence of simulated clinical practice but which allows participants not to be personally present in the simulation room in order to guarantee their safety in the midst of the COVID-19 pandemic. This model can achieve positive results using remote clinical simulation combined with traditional simulation technology to address the training needs of healthcare organizations.

Key takeaways:

Distant learning combining on-site simulation technology with teleconferencing software based on experiential learning principles is feasible and easy to implement (20). This modality is well-accepted by participants for acute care training in the emergency room. These results may encourage the educational community to develop more programs using this new approach of "remote patient care" not only during pandemics, but also in our daily work. It seems likely that this new model will be able to facilitate future learning courses in the health field.

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Visual elements:

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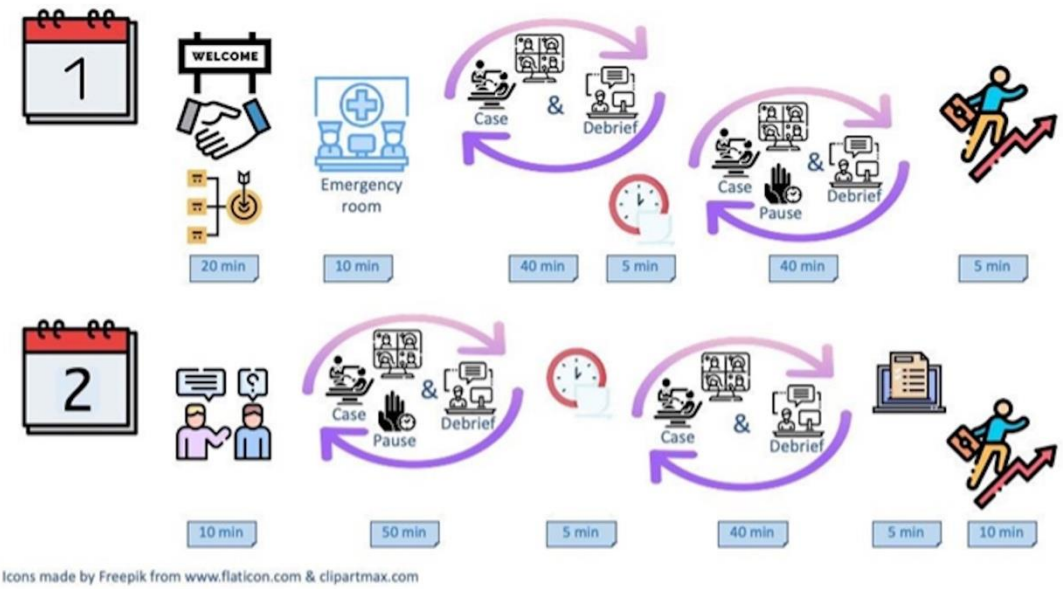

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Figure 1. Course timeline.

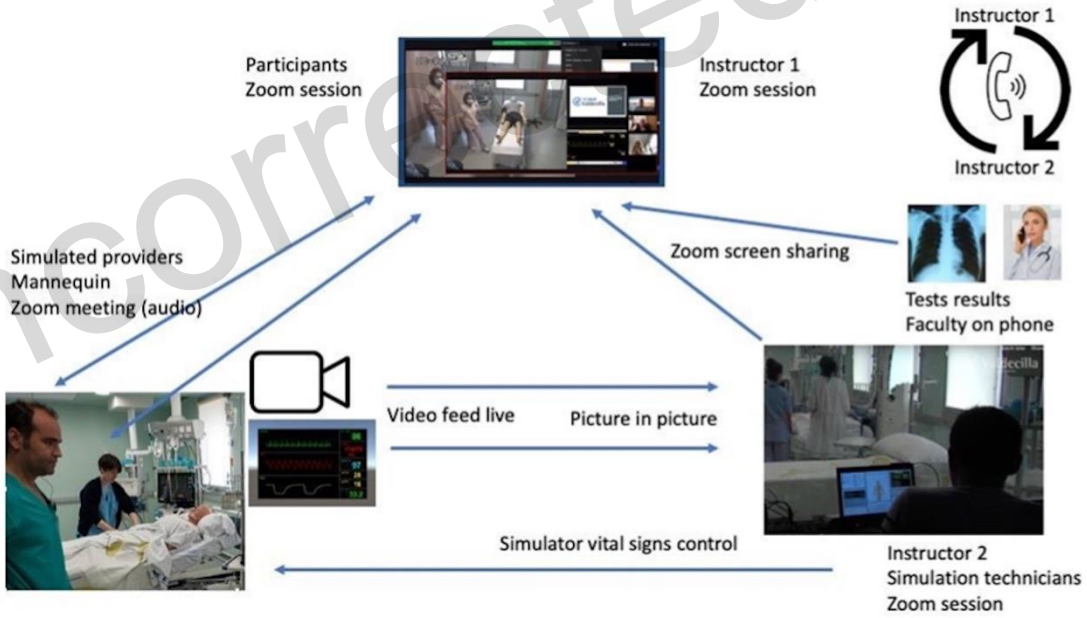

Figure 2. Technical assembly.

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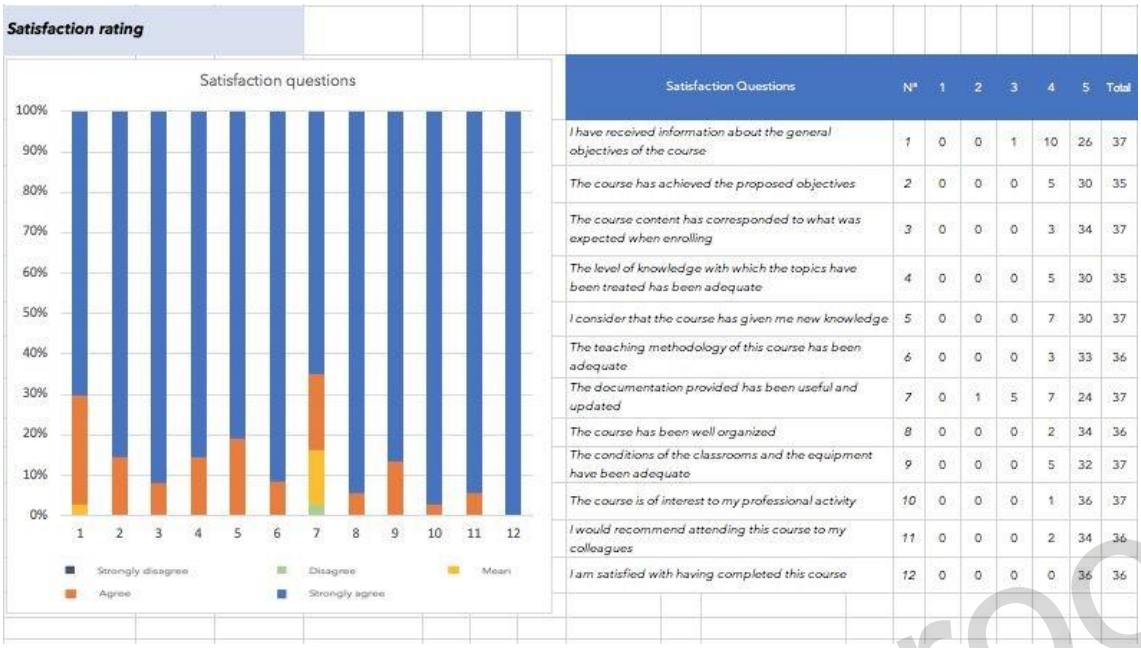

Satisfaction Questions	Nº	1	2	3	4	5	Total
I have received information about the general objectives of the course	1	0	0	1	10	26	37
The course has achieved the proposed objectives	2	0	0	0	5	30	35
The course content has corresponded to what was expected when enrolling	3	0	0	0	3	34	37
The level of knowledge with which the topics have been treated has been adequate	4	0	0	0	5	30	35
I consider that the course has given me new knowledge	5	0	0	0	7	30	37
The teaching methodology of this course has been adequate	6	0	0	0	3	33	36
The documentation provided has been useful and updated	7	0	1	5	7	24	37
The course has been well organized	8	0	0	0	2	34	36
The conditions of the classrooms and the equipment have been adequate	9	0	0	0	5	32	37
The course is of interest to my professional activity	10	0	0	0	1	36	37
I would recommend attending this course to my colleagues	11	0	0	0	2	34	36
I am satisfied with having completed this course	12	0	0	0	0	36	36

Figure 3. Satisfaction rating

Table 1. Participants' comments.

Methodology	*"Cases were surprisingly interactive!* *"The novelty is doing everything virtually! And I love the take-home final messages!* *"Quite a fun and novel mini cardio review!"* *"I managed to understand the complexity of making critical decisions"*

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Dynamics groups of job	*"I find the "mini-room" tool very useful to pause and think"* *"Being from the same hospital, it's an opportunity to practice together"* *"I realize how important it is to have an explicit leader!"* *"What I liked the most about the course were the small pauses to discuss with the rest of the colleagues who are watching the case from outside, and therefore they have more time to think"*
Duration	*time"* *"I wouldn't mind if it were longer, maybe sessions lasting a few weeks"* *"Time flew by!"* *"It was a bit short, considering that online interaction takes some more*
Technical aspects	*"Transfer of complementary tests (especially with ultrasound) take time to upload"* *"Do any writing and images on the virtual white board"* *"We had no problem with the connection!"* *"Patient voice sometimes was difficult to understand"*

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Conflict of interests

The authors declare that they have no financial relationship with any commercial company of products or services related to simulation. Valdecilla Virtual Hospital is affiliated with the Center for Medical Simulation, Boston, USA. Both are nonprofit, charitable, educational institutions offering tuition-based clinical and educator training programs.

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References

1. McGaghie WC, Draycott TJ, Dunn WF, Lopez CM, Stefanidis D. Evaluating the impact of simulation on translational patient outcomes. Simul Healthc. 2011 Aug;6 Suppl(Suppl):S42-7.

2. Armstrong E, Parsa-Parsi R. How can physicians' learning styles drive educational planning? Acad Med. 2005 Jul;80(7):680-4.

3. Del Moral I, Maestre JM. A view at the practical application of simulation in 15 professional education. Trends in Anaesthesia and Critical Care 2013;3:146–51.

4. Kerfoot BP, Baker H. An online spaced-education game for global continuing medical education: a randomized trial. Ann Surg 2012;256(1):33–8.

5. Verkuyl M, Lapum JL, Hughes M, et al. Virtual Gaming Simulation: Exploring Self-Debriefing, Virtual Debriefing, and In-person Debriefing. Clinical Simulation in Nursing 2018;20: 7-14.

6. Rojo E, Torres B, de la Fuente A, Oruña C, Villoria F, Del Moral I, Maestre JM. La simulación como herramienta para facilitar el cambio en las organizaciones sanitarias [Simulation as a tool to facilitate change in healthcare organisations]. J Healthc Qual Res. 2020 May-Jun;35(3):183-190.

7. Padilha JM, Machado PP, Ribeiro A, Ramos J, Costa P. Clinical Virtual Simulation in Nursing Education: Randomized Controlled Trial. J Med Internet Res. 2019 Mar 18;21(3):e11529.

8. Khalil MK, Elkhider IA. Applying learning theories and instructional design models for effective instruction. Adv Physiol Educ. 2016 Jun;40(2):147-56.

9. Kontos MC, Diercks DB, Kirk JD. Emergency department and office-based evaluation of patients with chest pain. Mayo Clin Proc. 2010 Mar;85(3):284-99.

10. Roussin, C.J., Larraz, E., Jamieson, K. and Maestre, J.M. (2018), "Psychological safety, self-efficacy, and speaking up in interprofessional health care simulation", Clinical Simulation in Nursing 2018; 17: 38-46

11. Rudolph JW, Raemer DB, Simon R. Establishing a safe container for learning in simulation: the role of the presimulation briefing. Simul Healthc. 2014 Dec;9(6):339-49.

12. Rudolph JW, Simon R, Dufresne RL, Raemer DB. There's no such thing as "nonjudgmental" debriefing: a theory and method for debriefing with good judgment. Simul Healthc. 2006 Spring;1(1):49-55.

13. Normand SL, McNeil BJ, Peterson LE, Palmer RH. Eliciting expert opinion using the Delphi technique: identifying performance indicators for cardiovascular disease. Int J Qual Health Care. 1998 Jun;10(3):247-60.

14. Brett-Fleegler M, Rudolph J, Eppich W, Monuteaux M, Fleegler E, Cheng A, Simon R. Debriefing assessment for simulation in healthcare: development and psychometric properties. Simul Healthc. 2012 Oct;7(5):288-94.

15. Rudolph JW, Simon R, Raemer DB, Eppich WJ. Debriefing as formative assessment: closing performance gaps in medical education. Acad Emerg Med. 2008 Nov;15(11):1010-6.

16. Maestre JM, Rudolph JW. Theories and styles of debriefing: the good judgment method as a tool for formative assessment in healthcare. Rev Esp Cardiol (Engl Ed). 2015 Apr;68(4):282-5.

17. Koehler MJ, Mishra P. What is technological pedagogical content knowledge (TPACK)? Contemporary Issues in Technology and Teacher Education 2009;9(1):60–70.

18. Martin-Parra JI, Manuel-Palazuelos JC, Maestre JM, Gómez-Fleitas M, del Moral I. Changing the paradigm in health care education: Hospital virtual Valdecilla. J Surg Educ. 2014 Jan-Feb;71(1):142-6.

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