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In Situ Operating Room–Based Simulation: A Review

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OBJECTIVE: To systematically review the literature surrounding operating room–based in situ training in surgery.

METHODS: A systematic review was conducted of MEDLINE. The review was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology, and employed the Population, Intervention, Comparator, Outcome (PICO) structure to define inclusion/exclusion criteria. The Kirkpatrick model was used to further classify the outcome of in situ training when possible.

RESULTS: The search returned 308 database hits, and ultimately 19 articles were identified that met the stated PICO inclusion criteria. Operating room–based in situ simulation is used for a variety of purposes and in a variety of settings, and it has the potential to offer unique advantages over other types of simulation. Only one randomized controlled trial was conducted comparing in situ simulation to off-site simulation, which found few significant differences. One large-scale outcome study showed improved perinatal outcomes in obstetrics.

CONCLUSIONS: Although in situ simulation theoretically offers certain advantages over other types of simulation, especially in addressing system-wide or environmental threats, its efficacy has yet to be clearly demonstrated. (J Surg Ed ∎:∎∎∎-∎∎∎. © 2017 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: systematic review, in situ, simulation, operating room

COMPETENCIES: Patient Care, Medical Knowledge, Practice-Based Learning and Improvement, Interpersonal and Communication Skills, Professionalism, Systems-Based Practice

INTRODUCTION

Simulation is an integral part of postgraduate education in surgery. It is used as a teaching tool for both the individual learner and as a part of team-based practice. Simulation-based training programs, such as the Fundamentals of Laparoscopic Surgery (FLS) and Fundamentals of Endoscopic Surgery (FES), are prerequisites for board certification by the American Board of Surgery. To encourage team-based practice and the development of nontechnical skills, the American College of Surgeons (ACS) has also developed a structured simulation training program that includes a team-based simulation program, the content of which is freely available through the ACS/APDS surgical curriculum portal.[1] Despite this focus, the best way to conduct and evaluate the effect of team-based simulation in the field of surgery is lacking.

The operating room (OR) is a high-risk environment with particular challenges that may benefit uniquely from in situ team simulation. The nontechnical skills taught in team-based training such as communication, decision-making, situational awareness, and leadership are necessary for managing OR crises such as massive hemorrhage and cardiac arrest. In these high-risk stressful events, rapid and coordinated care is critical. Although the reported incidence of an OR crisis is low, the aggregate incidence for a hospital with 10,000 operations a year is estimated to be 145 events annually.[2]

These authors contributed equally to this work.

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When they occur, the effective management of these events in surgical patients has been recognized as the largest source of variation in mortality among hospitals.[3] Not surprisingly, small-scale studies suggest that surgical teams are often unable to manage these crises efficiently and effectively.

The value of team-based in situ simulation in surgery, as compared with traditional team-based surgical simulation, is unclear. The purpose of the current study is to comprehensively review the literature surrounding team-based in situ OR simulation in surgery to establish its merits relative to other types of team-based surgical simulation. OR-based in situ team-based simulation is unique insofar as it employs simulation in an actual clinical environment (rather than a mock environment or a simulation center). A recent study found that although data regarding in situ simulation's role in healthcare is still emerging, early results suggest that it has great potential to impart both technical and nontechnical skills.[4] In situ simulation should, therefore, be of great interest to surgeons, who constantly seek to innovate and improve the training of junior surgeons and who seek to improve safety in the OR. To our knowledge, no one has comprehensively reviewed the use of in situ simulation based in the OR.

METHODS

The aim of the study was to provide a comprehensive review of current research that focused on in situ simulation as an educational intervention. MEDLINE was queried for published studies, including systemic reviews. Searches were conducted by combining a search term for surgery with a search term for in situ training using the "AND" Boolean search operator and then combine all of the individual results with an "OR" operator. In addition to searching MEDLINE, we conducted backwards-citation searching of all articles that were included in the study to identify any articles that may have been missed by the searches. The searches were completed in March 2016. We restricted search results by English language but not by date of publication. Duplicate references were deleted before articles were screened for additional review.

After an initial list of search results was compiled, one analyst (R.R.) reviewed the titles and abstracts of all articles found by the searches and marked articles for retrieval. In uncertain cases, the article was marked for retrieval. All marked articles were retrieved in full text, and 2 research analysts (C.J.N. and R.R.) determined whether each retrieved article met the stated inclusion criteria. Disagreements between the 2 analysts were minimal and were resolved through joint review of full-text articles and discussion.

The results of each included study were abstracted, according to a predetermined abstraction form, by 2 analysts (C.J.N. and R.R.). Evidence quality and sources

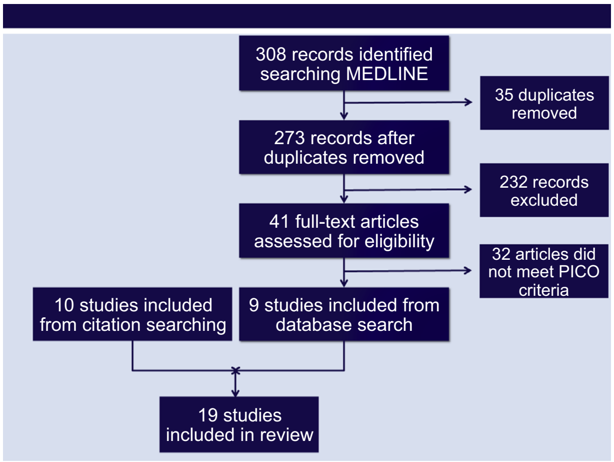

FIGURE. PRISMA diagram.

of bias were not assessed as the authors determined that the qualitative nature and heterogeneity of the material reviewed did not lend itself to evidence quality assessment.

We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology for reporting, as outlined in the Figure. To ensure objectivity in the scope of the review and to determine which studies were included and excluded from review, we used the PICO structure[5] and structured our results based on Population, Intervention, Comparator and Outcomes, as described in Table 1.[6,7] Lastly, to further classify the learning outcome, we used the Kirkpatrick model. This model is a widely recognized tool, used to rank educational interventions on a scale of 1 to 4 based on how strongly the intervention influences the subjects or environment. A detailed description of the model is published elsewhere,[8] but a brief summary follows: Kirkpatrick level 1 (KP1) means participants like the training, Kirkpatrick level 2 (KP2) means participants learned something from the training as measured by the improvement on an objective score or knowledge test, Kirkpatrick level 3 (KP3) means participants changed their behavior in their actual work environment due to the training, and Kirkpatrick level 4 (KP4) means a change in patient outcomes was seen due to the training. Training that produces a change at the higher Kirkpatrick level (e.g., level 4) is considered more effective than training that produces a change at a lower level (e.g., level 1).

TABLE 1. PICO Protocol for Inclusion

Population	A team including at least one surgeon or surgical resident
Intervention	In situ simulation team training in the operating room (OR)
Comparison	Any comparator
Outcome	Any measured outcome

Inclusion criteria: Any published comparative study, except those in abstract form that is written in the English language and meets the PICO criteria.