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REVIEW ARTICLE

The Educational Utility of Simulations in Teaching History and Physical Examination Skills in Diagnosing Breast Cancer: A Review of the Literature

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This paper is a review of the literature examining the use of medical simulations to teach our future healthcare providers how to diagnose breast cancer. MEDLINE and Embase databases were searched to identify the literature published between 1990 and 2014. In total, 113 articles were retrieved and evaluated for their relevance to the topic. Simulation methods, such as standardized patients and breast models were found to enhance students' abilities to perform patient histories and physical examinations to detect breast cancer. In addition, simulation can help trainees learn how to communicate bad news to patients effectively. There is an abundance of literature supporting the continued use of simulations in the curricula of medical schools. However, future studies based on sound theoretical frameworks are needed to evaluate the positive effects of simulation-based education on patient outcomes.

Key Words: *Breast neoplasms, Models, Patient simulation, Standardized patients*

INTRODUCTION

Breast cancer is the leading cause of cancer in women worldwide, and is the second most common type of cancer when both sexes are considered [1]. The majority of the 1.15 million global cases in 2002 were found in industrialized countries of Europe and North America [1]. In 2008, 690,000 new cases were estimated to have occurred in both developed and developing regions of the world, for a global estimate of 1.38 million new cases [2]. The incidence rates are much lower in other parts of the world, such as Africa and Asia; however, in 2002, cancer registries in China recorded annual increases of 3% to 4% in the incidence of breast cancer [1]. Given the prevalence and increasing incidence of breast cancer worldwide, it is of the upmost importance that our future providers of health care from all continents are well informed about the process of conducting a comprehensive medical history and physical examination to diagnose breast cancer.

Simulation is defined as "an imitation of some real thing, state of affairs or process" [3]. Practice is a key component of learning and maintaining one's skills, and simulation has been used to practice technical skills, problem solving, and judgment. Simulation has been used in the military for quite some time, and gained momentum in medical education toward the end of the 20th century, with the introduction of doctor-patient simulations [3].

Simulation methods used in medical education may be classified into five categories: 1) verbal (role-playing); 2) standardized patients (SPs) (actors); 3) part-task trainers (physical and virtual reality); 4) computerized patients (computer screen, screen-based virtual world); and 5) electronic patients (replications of clinical sites, mannequin-based, and full virtual reality) [4]. All of the aspects of the different categories of medical simulations continue to be integrated into the restructured curricula of medical schools to varying degrees.

Diagnosing breast cancer begins with a comprehensive history and physical examination. A delay in the diagnosis of breast cancer is one of the most common reasons for litigation against physicians in the United States [5]. Once a diagnosis is confirmed, surgery is the mainstay of treatment to optimize patient outcomes. The concordance between the patient's history and physical examination, radiographic images, and pathology, known as the "triple test," is needed to provide an accurate diagnosis [6,7]. Although this process is rigorous, it can be improved using all of the categories of medical simulation to enhance students' practice, with the ultimate goal of reduc-

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ing medical errors and improving patient outcomes.

The objective of this literature review is to focus on the ways in which medical simulation is currently utilized and to promote its value in teaching medical students, residents, and practicing physicians how to diagnose breast cancer. Focusing on the initial step in the process of care–performing a comprehensive history, physical examination, and breaking bad news to patients–we hope to reinforce the knowledge of how simulation is shaping the way our future healthcare providers obtain the skills needed to be astute diagnosticians and communicators.

MEDLINE and Embase databases were searched by a professional health sciences librarian to identify the relevant literature published on the topic between January 1990 and April 2014. The search encompassed all languages and countries of publication. A combination of keyword terms and database-specific subject headings were used in the search queries. These terms included but were not limited to: patient simulation, computer simulation, role playing, part-task trainer, models, mannequin, virtual, computer-assisted patients, and SPs. A total of 113 unique article citations were retrieved, which were evaluated for relevance by the author, and categorized into history taking, physical examination, and breaking bad news.

COMPREHENSIVE HISTORY

Education within the field of oncology begins with learning about specific types of cancer (e.g., breast cancer) and preventative health measures, such as physical exam and screening skills. A strong foundation in communication skills is integral to meeting these educational objectives [8]. Medical simulation has been found to be beneficial in acquiring both communication, assessment and screening skills [8].

SPs have been used since the 1960s and have become integrated into the curricula of the majority of medical schools in North America [9]. Unlike real patients, SPs are available at any time and in a multitude of settings. In addition, they present the same patient problem to all students, and their use offers the advantage of avoiding the mistreatment of actual patients. Moreover, medical students can work with them without embarrassment, as they provide an ideal transition to a real patient for junior medical students [9].

In 1994, Heard et al. [10] developed a comprehensive breast evaluation education program at the University of Arkansas. Traditionally, students received standard instructions on breast examination and history taking. The information was presented by a faculty member and included a 1-hour classroom session on risk factors, screening recommendations, and a video demonstrating a clinical breast examination. Students then proceeded to practice palpating nodules on plastic breast models. In comparison, the comprehensive breast evaluation education program used a simulation-based method, in which students received the same standard handout but also interviewed a SP about breast problems and risk factors; received 1:1 instruction from the SP during the clinical breast exam, and practiced recommendations for screening and instruction in the breast self-examination. After accounting for students' baseline knowledge, this study found that the group who received the traditional instructions had a mean score of 69.9% (standard deviation [SD], 13.7) on an objective structured clinical examination (OSCE) while the students who received instruction using the simulated-based method of the comprehensive breast evaluation education program had a mean score of 84.1% (SD, 9.1) [10]. This research study was one of the earlier publications on the positive findings on the effectiveness of (SPs) in the improvement of students' clinical performance in evaluating a patient with a breast problem.

One of the criticisms of using SPs is it that they are resource intensive. Since 1994, there has been a widespread development of high fidelity computer simulations and virtual reality systems in response to this disadvantage. Other forms of simulation also have been found to enhance the traditional methods of education [11]. Deladisma et al. [11] investigated whether a curriculum designed to teach breast history taking during a third-year surgery clerkship could provide adequate preparation to a medical student for an interaction with a real patient by reducing their anxiety, thereby making them more confident. In their study, all of the students (n = 21) received a 1-hour didactic lecture regarding the symptom presentation, diagnosis, and surgical treatment of common breast complaints. These activities were complemented by a small group session lasting 1 hour, in which the pertinent points about breast-related history and history taking skills were reviewed. The students randomized to the experimental group (n = 15) also conducted a 10-minute interaction with a virtual patient who presented with a new breast mass. Within 1 week of the interaction, all of the students in both groups performed a history and breast examination on a real patient in a surgical oncology clinic. Their results showed that the students in the virtual patient group reported a higher level of confidence (4.3) than the control group (3.5), as measured on a Likert-type scale where 1 (least confident) and 5 (most confident) in their history-taking skills [11].

These studies illustrate how everything from a SP to a high fidelity virtual patient can be utilized with success to teach students how to confidently perform an effective history-taking assessment of a breast complaint, as measured by objective outcomes (Table 1). Since these early studies, the curricula in

Table 1. The role for simulation in teaching how to complete a history and breast examination

Study	Design	No. of students	Intervention	Outcome measure	Outcome
Heard et al. [10]	Intervention/ control	144	Comprehensive breast evaluation education program with SPs Control: standard instruction	Performance on objective structured clinical examination	Test performance superior in intervention group (84.1% vs. 69.9%, $p=0.001$)
Deladisma et al. [11]	RCT	21	Interaction with VP versus standardized instruction	Confidence in history-taking and clinical breast examination anxiety level	VP intervention group has higher mean history-taking confidence (4.27 ± 0.47 vs. 3.50 ± 0.71, $p<0.05$)
Madan et al. [12]	RCT	47	Formal sessions including video and practice on silicone models	Pre- and posttesting locating masses in silicone models	Formal session group demonstrated improved true positive score (2.2–2.8, $p<0.05$) as well as improved false positive score (3.0–2.0, $p=0.30$)
Pilgrim et al. [13]	RCT	156	Intervention group: practice and feedback on silicone breast models and women volunteers Control group: lecture only	Ability to detect masses in breast models	Significant improvement in mass detection and technique in intervention group ($p<0.05$)
Sachdeva et al. [16]	RCT	153	Intervention group: interact with an SP in addition to traditional teaching Control group: traditional teaching only	Pre- and posttest	Experimental group performed better on breast examination ($p=0.002$), and professionalism
Campbell et al. [17]	RCT	54	Intervention group receive standardized teaching by either a family medicine faculty or well women teacher in addition to model training. Control group: unstandardized teaching	Performance detecting breast masses on silicone model, examination technique	Standardized-teaching group had more consistent examination techniques and higher sensitivity in mass detection

RCT = randomized controlled trial; SPs = standardized patients; VP = virtual patient.

Canadian medical schools has changed and incorporated simulation activities to provide students with more and earlier exposures to real-life clinical scenarios.

BREAST EXAMINATION SKILLS

The clinical breast examination plays a significant role in the detection of breast masses, and similar to history-taking simulations, can play an important role in better preparing students to examine actual patients in a comfortable and respectful manner [12]. To date, the silicone breast model remains the most commonly used form of simulation for educating medical students on how to perform a focused breast examination; however, other forms of practice, such as SPs are also utilized [12].

Madan et al. [12], in 2002, provided third-year medical students with formal training in clinical breast examinations. This included a video session and also a hands on demonstration of the proper technique by a surgical oncologist on a silicone breast model. When compared to the students who did not receive the simulation training, those who received it (n = 22) improved or true positive scores, i.e., accuracy, as defined as a mass marked by the student within one centimeter of an actual mass in a breast model, on a one month follow up test. Similarly, Pilgrim et al. [13] randomized 156 students to either watching a videotaped clinical breast examination alone, or in conjunction with practicing the examination on a silicone breast model with simulated breast masses. Students randomized to the practice group received the model, were able to practice the exam as they watched the video, and were allowed to keep the model for home practice. Six months later, the teaching intervention was evaluated during a simulated examination of clinical skills administered to all second-year medical students. The students who received the teaching intervention (he experimental group), used the instructional techniques significantly more often than did the control members on a simulated patient (5.3 vs. 2.1), spent more time on the clinical breast examination (183 seconds vs. 121 seconds); and detected a higher number of lumps on a silicone model (4.7 vs. 4.4).

Over the years, the fidelity of breast models has been further developed, and when compared to traditional models of breasts, the newer ones have been associated with higher rates of lump detection and greater skill transfer of the students [14]. In fact, models have been developed to provide students with tactile feedback as they perform clinical breast examinations. Compared to the traditional, more static models, the newer ones have been associated with an increase in the number of lumps detected and a decrease in the number of false positives made [15].

In addition to part-task trainers, using SPs to teach breast examination skills to third-year medical students has been found to enhance their clinical skills significantly. Sachdeva et al. [16] tested whether a single intervention with a SP as a supplement to the traditional teaching method would enhance learning in 153 students. They found that the students in the experimental group who received instruction with a SP performed more accurate and thorough breast examinations, and demonstrated more professionalism during this examination compared to the students who were not exposed to a SP. Campbell et al. [17] randomized first-year medical students (n = 54) to a standardized teaching method taught by either a faculty member in family medicine or a trained women's health educator. Both groups received training on a silicone breast model but the group taught by the women's health educator in women spent an additional hour examining the women's breasts. Testing was conducted using six silicone models and both groups of the first-year students were compared to 70 second-year students who received unstandardized teaching from faculty in their clinical rotation. The standardized teaching group had more consistent examination techniques (varying pressures, horizontal or vertical search pattern, and thoroughness) and a significantly higher sensitivity to the presence of lumps than the nonstandardized group (71% vs. 55%; $p = 0.0001$; confidence interval, 9.2–22.4). Of note, is that the students taught by the women's health educator performed as well as those taught by the family medicine faculty.

Few studies have compared the different simulation methods; however, Schubart et al. [18] compared breast simulators to SPs in teaching medical students a clinical breast examination. They found that both types of simulations were comparable as the two groups in their study (n = 113 and n = 131) did not differ significantly in the mean number of positive findings detected, or in their ratings of their comfort level when tested using the breast palpation simulator [18]. This finding suggests that perhaps breast simulators can be used as an alternative to SPs, avoiding the ongoing, recurring financial cost of hiring SPs.

Regardless of the type of simulation, it is clear that when comparing the use of a simulation method to not using a simulation in teaching clinical examination skills, students who train using a simulation method, either in the form of a model or SP, outperform students who do not use one (Table 1).

BREAKING BAD NEWS

Teaching students how to deliver bad news in a caring and compassionate way is an extremely important aspect of providing care to women with breast cancer. Typically, students learn to communicate bad news to patients through trial and error or through observing the skills of senior physicians [19]. SPs have been found to significantly enhance students' ability and comfort in this difficult aspect of clinical care (Table 2) [19].

Colletti et al. [19] randomized 21 students to discuss a new diagnosis of cancer, prognosis, and treatment with an SP during their clerkship rotation. When compared to 17 control students who had no SP experience, those that had a SP experience scored significantly higher on the medical school's required clinical performance examination at the end of their junior year. These skills are obviously transferable to other areas of medicine in which counseling is required.

Rosenbaum et al. [20] developed an educational program for third-year medical students on how to break bad news to patients. Students participated in a required skills training module in which they received a lecture on delivering bad news to patients, followed by a short written case describing the bad news to be delivered. They were required to interact with a SP to break the bad news. The sessions were videotaped and after the encounter, each student discussed his or her feelings about the encounter, and received feedback from the SP, other students, and a faculty member. The group evaluated the impact of the educational intervention by developing a survey in which the students were asked to rate their level of comfort when discussing the bad news. They compared a presession survey to a postsession survey that students received 4 weeks after the session, which included many of the same questions but also asked them to evaluate the effectiveness of the sessions. Finally, a 1-year follow-up survey was conducted to assess the impact on a long-term basis. Their findings indicated that students were more confident and comfortable in communicating bad news after the intervention, and that the effect remained unchanged for 1 year. A large positive change

Table 2. The role for simulation in teaching how to break bad news

Study	Design	No. of students	Intervention	Outcome measure	Outcome
Colletti et al. [19]	RCT	38	Interaction with SP to discuss new diagnosis of cancer	Performance on CPE at end of year	Those students who had a SP "breaking bad news" experience performed significantly better on CPE ($p < 0.05$)
Rosenbaum et al. [20]	Descriptive	341	Small group teaching, role play with SP	Self-reported comfort levels in delivering bad new before and after	Significant increase in comfort level
Andrade et al. [21]	Descriptive	10	Interaction with an Avatar in a virtual world	Before and after self-efficacy scores	Significant improvement in scores ($p < 0.001$)

RCT = randomized controlled trial; SP = standardized patient; CPE = clinical performance examination.

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on the Likert scale (average effect size, 1.1) was observed between the pre- and posttest. In addition, students found the educational experience to be high with a mean of 3.41 on a 5-point scale, 5 (excellent) and 1 (poor) [20].

Other forms of simulation to help students learn how to deliver bad news also have been examined. In 2002, Andrade et al. [21] studied the feasibility of creating an SP avatar in a virtual world to train students to deliver bad news. Virtual worlds are three-dimensional computer-generated simulated environments in which the user interacts with a graphical character referred to as an avatar. Medical students were recruited to inform the avatar of her new diagnosis of breast cancer. The student was asked to evaluate his or her self-efficacy in delivering the bad news by an affective competency assessment before and after the encounter. In addition, two palliative care specialists evaluated each trainee's performance. The self-efficacy scores of the trainees were found to improve overall (20 ± 4 before and 24 ± 3 after), and all of the participants considered the experience to be positive. Despite the small sample size ($n = 10$), this study found that virtual worlds can be used as an alternative to SPs to help students learn to break bad news [21]. Finally, after breaking bad news to a patient, a surgeon will often discuss the need for surgery. Not surprisingly, SPs also have been used to provide surgical residents with feedback on the way they handle the process of informed consent for breast cancer surgery [22].

CONCLUSION

Providing care to women with breast cancer is a challenge to the physician's diagnostic and communication skills. Simulation has been used often to train physicians to provide the highest quality of care and reduce the likelihood of errors. A major criticism of simulation-based learning is the lack of conclusive evidence that this learning strategy positively affects patient outcomes. This variable is extremely difficult to measure as evidenced by the fact that none of the aforementioned studies used patient outcomes as a measure. In the future, researchers evaluating the role of simulations in educational oncology must extend their study's designs beyond simple comparisons of an intervention with no intervention, often referred to as "comparing something with nothing." It is no longer original to show that some education is better than no education, or that more education is better than less, regardless of the format in which it is delivered [23]. Future research needs to be innovative and have a theoretical foundation to justify the need for the study that is being designed.

Finally, "no industry in which human lives depend on the skilled performance of responsible operators has waited for unequivocal proof of the benefits of simulation before embracing it." [4] This review should remind educators, particularly in the field of breast cancer, that there is a valuable role for simulation-based learning. This field should continue to develop, and researchers should examine, ways to demonstrate its impact and effectiveness.

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CONFLICT OF INTEREST

The author declares that he has no competing interests.

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