Pilot Program Using Medical Simulation in Clinical Decision-Making Training for Internal Medicine Interns

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Abstract

Background The use of high-fidelity medical simulation in cognitive skills training within internal medicine residency programs remains largely unexplored.

Objective To design a pilot study to introduce clinical decision-making training using simulation into a large internal medicine residency program, explore the practicability of using junior and senior residents as facilitators, and examine the feasibility of using the program to improve interns' clinical skills.

Methods Interns on outpatient rotations participated in a simulation curriculum on a voluntary basis. The curriculum consisted of 8 cases focusing on acute clinical scenarios encountered on the wards. One-hour sessions were offered twice monthly from August 2010

to February 2011. Internal medicine residents and simulation faculty served as facilitators.

Results A total of 36 of 75 total interns volunteered to participate in the program, with 42% attending multiple sessions. Of all participants, 88% rated the sessions as "excellent," 97% felt that the program improved their ability to function as an intern and generate a plan, and 81% reported improvement in differential diagnosis skills.

Conclusions Simulation training was well received by the learners and improved self-reported clinical skills. Using residents as facilitators, supervised by faculty, was well received by the learners and enabled the implementation of the curriculum in a large training program. Simulation can provide opportunities for deliberate practice, and learners perceive this modality to be effective.

Editor's Note: The online version of this article contains a narrative description of the Resident Facilitator Training and case descriptions used in this study.

Introduction

Over the past decade, changes in the delivery of health care have posed challenges to graduate medical education. These changes are especially relevant to interns because the

opportunities available to them for independent clinical problem solving have diminished, particularly in acute settings. In an effort to address these challenges, medical simulation has gained more widespread use in the fields of anesthesiology, emergency medicine, surgery, and obstetrics and gynecology.¹⁻⁴ Internal medicine (IM) residency programs have employed simulation in advanced cardiac life support, procedural skills training, and critical event management in the intensive care unit.⁵⁻⁸

High-fidelity simulation may be an effective platform to teach clinical decision making because it provides a safe learning environment where learners can perform many facets of the patient encounter (history and exam, diagnostics, and therapeutic maneuvers), as well as participate in a dedicated discussion about their performance. Through this process, simulation can provide deliberate practice and coaching that have been shown to be important in training an expert.⁹ Despite its possible advantages, to date there have been limited descriptions in the literature of simulation being used for teaching clinical reasoning as it relates to general ward medicine.

We report our experience with a pilot program using high-fidelity mannequin simulation for clinical decision making on the wards for IM interns. An important component of the program was the use of second- and

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third-year IM residents as facilitators, supervised by faculty. Our pilot program was also designed to evaluate the extent of interns' interest in simulation and the feasibility of implementing such a program in a large IM residency program.

Methods

Setting and Participants

The target audience consisted of all interns in the Massachusetts General Hospital (MGH) IM residency program, and attendance was voluntary. Interns were invited to attend simulation sessions during outpatient rotations. All 75 interns in the residency program had at least one outpatient rotation during the simulation program. The program was administered at the MGH Learning Laboratory, a simulation laboratory located within the main hospital campus at the MGH.¹⁰ This simulation laboratory is intended for use by the entire hospital and has multiple simulation modalities available. Use of the simulation laboratory for core training programs across disciplines is part of the institutional mission of the MGH Learning Laboratory; no fees were assessed to the Department of Medicine. For the IM program, the simulations were set up on a mock general medicine floor, and the debriefing occurred in the laboratory. This work was deemed exempt from ongoing review by the MGH Institutional Review Board.

Each mannequin was operated by 2 facilitators, which could include a simulation specialist (technician), a resident facilitator, and/or a simulation faculty member (IM or emergency medicine attending physicians). Second- and third-year IM residents were recruited to act as volunteer facilitators. Clinical faculty trained in simulation-teaching techniques supervised the resident facilitators, contributed to the debriefing of the intern participants, and gave verbal feedback to the resident facilitators. Prior to serving as a facilitator, each resident was trained on teaching techniques pertinent to medical simulation and observed at least one simulation session (narrative description of training provided as online supplemental material).

Educational Intervention

The curriculum was composed of 8 common acute clinical scenarios frequently encountered in the general medicine wards (TABLE 1), offered sequentially based on complexity. A detailed description of all 8 cases is provided as online supplemental material. Intern participants were scheduled such that those who attended multiple sessions were administered cases that they had not previously encountered. The cases were chosen by the investigators based on a survey administered to the previous intern class

What was known

Simulation has been used in a wide range of areas, but its use in assessing and enhancing cognitive skills is relatively less explored.

What is new

Simulation training can be effective in improving self-reported differential diagnosis skills in internal medicine interns. Using residents as facilitators, supervised by faculty, was well received by the learners and enabled the institution of the curriculum in a large training program.

Limitations

Small sample, single-site study may limit generalizability, sampling (volunteer) bias; outcomes may be limited to learner perceptions with no objective evaluation of gains in cognitive skills.

Bottom line

Simulation can offer opportunities for deliberate practice of cognitive skills, with learners perceiving this modality to be effective.

assessing their interest in a simulation curriculum and soliciting suggestions for scenarios. The scenarios were written by the investigators (E.M. and E.H.) or adapted by the investigators from cases previously used by the MGH Learning Laboratory and the Gilbert Program in Medical Simulation at Harvard Medical School.¹¹

Each scenario began with the learners being summoned to a patient's room because of a change in his/her clinical status. The learners were given a brief past medical history and then had to elicit further history from the patient, perform a physical examination, use laboratory and radiologic studies to narrow the differential diagnosis, institute a treatment plan, and assess the patient's response to treatment. Each scenario included specific learning objectives to guide the debriefing. Sessions were held twice monthly from August 2010 to February 2011 from 7 AM to 8 AM, before the start of daily clinical duties.

Each hour-long session consisted of 2 case scenarios lasting 15 minutes each, and the remainder of the session was reserved for debriefing. Groups of 2 to 3 interns worked on each mannequin, sometimes with another 2 interns observing their peers, with all learners participating in the debriefing portion. A maximum of 8 interns could attend each session. If 2 mannequins were used in a session, the 2 groups of interns debriefed separately. The high-fidelity mannequins used as the simulated patients were SimMan Essential (Laerdal Medical, Wappingers Falls, New York) and/or Emergency Care Simulator (METI, Sarasota, Florida). Two facilitators led each group of interns; one facilitator operated the simulator while the second functioned as support staff (administering medications and providing test results to the learners). At least one of the study investigators was in attendance during each session. One or two physician facilitators participated in the debriefing session, which focused on differential

TABLE 1 Case Scenarios		
Scenario	Case Progression	Expected Actions
COPD	Hypoxemia not responding to bronchodilators, necessitating NPPV	Recognize COPD
		Administer bronchodilators
		Consider antibiotics and glucocorticoids
		Avoid overoxygenation
		Administer NPPV
Atrial fibrillation with rapid ventricular response	Rapid atrial fibrillation leading to hypotension	Recognize atrial fibrillation
		Administer intravenous fluids judiciously
		Administer amiodarone or digoxin
		Consider electrical cardioversion
CHF	Progressive hypoxemia requiring NPPV	Recognize CHF
		Assess etiology of CHF
		Administer diuretics after load-reducing agents to control blood pressure
		Administer NPPV
Hypertensive emergency	Hypertension leading to headache and non-ST-elevation MI, unresponsive to initial antihypertensive agent	Recognize hypertensive emergency
		Administer antihypertensive agents to reach appropriate reduction in blood pressure
GIB	GIB leading to hypotension in a patient with active myocardial ischemia, stage V chronic kidney disease, and possible cirrhosis; fluid resuscitation is complicated by respiratory failure	Recognize GIB
		Initiate consult for upper endoscopy
		Attempt resuscitation with blood products and intravenous fluids
		Manage respiratory failure in the setting of fluid resuscitation
		Administer proton-pump inhibitor
		Consider administration of octreotide
ACS	Initial presentation with Wellen syndrome, progressing to STEMI, leading to hypotension	Recognize STEMI
		Initiate consult for cardiac catheterization
		Administration of anticoagulation and antiplatelet therapy
		Management of cardiogenic shock
Alcohol withdrawal	Alcohol withdrawal presenting with agitated delirium, with administration of benzodiazepines leading to respiratory depression	Recognize alcohol withdrawal
		Administer benzodiazepines
		Consider administration of haloperidol
		Management of hypercarbic respiratory failure
Cardiac tamponade	Viral pericarditis progressing to cardiac tamponade, leading to hypotension	Recognize cardiac tamponade
		Administer intravenous fluids
		Initiate consult for emergent pericardiocentesis

Abbreviations: ACS, acute coronary syndrome; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease exacerbation; GIB, gastrointestinal bleed; STEMI, ST segment elevation myocardial infarction; NPPV, noninvasive positive pressure ventilation.

diagnosis, patient management, communication skills, and professionalism.

Outcomes

Participating interns were asked to complete a voluntary, anonymous survey for each month of sessions attended.

The survey was written by the investigators, piloted among IM residents in the MGH residency program not involved as investigators in the project, and revised by the investigators. The instrument aimed to assess learner satisfaction with the simulation experience and the impact of the sessions on their self-reported ability to generate a

TABLE 2 INTERN RESPONSES TO POSTPROGRAM SURVEY (n = 32)

Question	Excellent	Good	Average	Fair	Poor
Please rate the overall simulation experience.	28 (87.5%)	4 (12.5%)	0	0	0
	Definitely	Probably	Maybe	Probably Not	Definitely Not
Would you attend future simulation sessions?	29 (90.6%)	3 (9.4%)	0	0	0
	Significantly Improved	Moderately Improved	Somewhat Improved	Not Improved	
To what extent did the simulation experience improve your ability to generate a differential diagnosis?	9 (28.1%)	17 (53.1%)	6 (18.8%)	0	
To what extent did the simulation experience improve your ability to generate and implement a plan?	17 (53.1%)	14 (43.8%)	1 (3.1%)	0	
To what extent did the simulation experience improve your ability to deal with changing/ unexpected clinical situations?	17 (53.1%)	14 (43.8%)	1 (3.1%)	0	
To what extent did the simulation experience improve your ability to function as an intern?	19 (59.4%)	12 (37.5%)	1 (3.1%)	0	

differential diagnosis and develop a management strategy within their role as a medicine intern. The survey was made available to the interns online in the first week of the month following their session participation and remained open until the completion of the pilot program.

Results

Over the course of the pilot, 36 interns (48% of intern class) participated in the program, 15 of whom (42% of total participants) attended more than one session for a total of 60 learner experiences over the course of 15 sessions. Each of the sessions was attended by 1 to 8 interns, with an average of 4 interns per session. More interns attended sessions during the first 4 months of the program, with an average of 6 learners per session. A total of 12 interns attended multiple sessions over the course of 1 month. Therefore, because surveys were administered once monthly, 48 surveys were distributed over the course

of the study. Eight interns were surveyed twice because they attended sessions during more than 1 month.

A total of 32 of 48 surveys (67%) were completed. Survey responses revealed that learners enjoyed the sessions and felt that the program improved their clinical skills (TABLE 2). Most interns stated that they would attend future sessions. All responders reported that the difficulty level of the scenarios was appropriate. Although no formal survey of the facilitators was conducted, one of the investigators was present at each program session and we feel that the learners found the scenarios challenging but appropriate for their level of training. Most learners arrived at the correct diagnosis and instituted an appropriate treatment strategy.

Open-ended questions assessing the program's strengths and weaknesses concluded the survey. A total of 24 interns answered the question regarding the strengths of the session, whereas 17 interns answered the question regarding session weaknesses (BOX). Learners reported that they valued the opportunity to struggle with a realistic case on their own followed by immediate, case-directed debriefing. Case-directed debriefing was cited most often as a strength of the program. Multiple interns commented that they enjoyed the opportunity to discuss the case with residents and that having multiple facilitators expanded the discussion, promoting a deeper understanding of the material. The most common weaknesses reported were that the 7 AM time was inconvenient and that there were not enough sessions offered. Several interns reported that more than 30 minutes should be allocated for each case plus debriefing.

BOX SELECTED EXAMPLES OF OPEN-ENDED SURVEY RESPONSES

What were the strengths of the sessions? (n = 24)

"direct focused feedback with junior [residents]/senior [residents]"
 "the feedback afterwards and the thinking on one's own during the scenario in a protected environment"
 "enjoyable, evaluation-free, safe, instant feedback, realistic scenarios, just enough pressure to remember the lessons...These sessions are invaluable"

What should be done differently in future sessions? (n = 17)

"An increase in "clinical" case time by 2–3 minutes"
 "more time for debriefing, more evenly split time [between clinical management and debriefing]."
 "time them so I can attend them when I am on wards and not just ACR! [ambulatory care rotation]"

Discussion

The results of our program demonstrate that learners found the sessions to be effective, using residents as facilitators was one of the strengths of the program, and that there is demand among interns for simulation training. Mounting evidence has shown that simulation is an effective learning tool.¹² However, implementing high-fidelity medical simulation poses several challenges, particularly in large IM programs, such as recruiting sufficient faculty and keeping within resident work hour limitations.¹³ Our pilot program sought to address these barriers. By recruiting second- and third-year IM residents to serve as session facilitators, we reduced the number of faculty needed to staff the sessions. A model for this exists in the field of emergency medicine, where residents have served as simulation facilitators.¹⁴ Holding the sessions during a time slot that was protected from clinical duties allowed interns to participate without sacrificing time spent on patient care or other educational activities. The positive learner perception of the pilot program was comparable to new simulation curricula in other disciplines, such as pediatrics, anesthesiology, obstetrics and gynecology, surgery, and emergency medicine.^{15–20} Finally, we were able to evaluate the level of learner interest in a simulation program before investing the resources necessary to implement a similar mandatory program. A comparable program with mandatory attendance for a class of 75 interns would require approximately 60 sessions with 4 to 6 learners at each session.

Our experience suggests that interns have a strong interest in simulation training. Although this was a voluntary pilot program, almost 50% of the first-year class attended at least one of the voluntary sessions despite a busy intern schedule. A return rate of 42% of first-time participants was also encouraging because a large number of interns did not have the opportunity to attend additional sessions because of scheduling conflicts such as inpatient rotations. The results of this pilot program led to the implementation of a mandatory simulation curriculum for the 2011–2012 academic year.

There were several lessons learned during the process of designing and implementing the simulation curriculum. Cases ran best with 2 to 3 learners interacting with the mannequin. When more than 3 learners were assigned to 1 mannequin, having 2 learners observe their peers during the case management portion and participate in the debriefing was well received by the learners. Adding complicating factors to a case (such as introducing aortic stenosis into the atrial fibrillation scenario) was more difficult than expected for the learners. Rather, it was more effective to administer straightforward cases and leave complicating factors for discussion during the debriefings. Time management was

challenging because learners typically had more questions during the debriefings than time allowed. To address this, some facilitators referred the learners to medical literature resources to help answer their questions. Finally, more interns attended sessions during the first 4 months of the program, suggesting that these sessions were most valued in the beginning of the academic year.

Our pilot study has several limitations. Voluntary attendance creates selection bias because learners may have been more motivated to be active participants in the sessions, thus contributing to a better small-group learning environment than if the program were mandatory. Furthermore, we could not determine whether any of the 8 interns who were surveyed twice completed more than 1 survey, which may have added to the favorability of the ratings given the selection bias inherent in a voluntary program. Our survey data only reflect learner perception because we did not objectively evaluate the effect of the simulation program on the interns' clinical skills. Finally, the results reflect our experience at a single IM residency program, which may limit the generalizability of our findings.

Conclusions

Our experience during the pilot phase of a medical simulation program for IM interns demonstrates that the sessions were valuable to their learning and that a simulation curriculum can be offered on a voluntary basis because there is interest among interns in this type of experience. With the addition of junior and senior residents as facilitators, such a program can reach many learners within the resource constraints faced by large residency programs.

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