

A Novel Iterative-Learner Simulation Model: Fellows as Teachers

NANCY M. TOFIL, MD, MEd
DAWN TAYLOR PETERSON, PhD
KATHY F. HARRINGTON, PhD, MPH
BRIAN T. PERRIN, MD
TYLER HUGHES, MD
J. LYNN ZINKAN, MPH, BSN, RN
AMBER Q. YOUNGBLOOD, BSN, RN
AL BARTOLUCCI, PhD
MARJORIE LEE WHITE, MD, MPPM, MEd

Abstract

Background Simulation is an effective method for teaching clinical skills but has not been widely adopted to educate trainees about how to teach.

Objective We evaluated a curriculum for pediatrics fellows by using high-fidelity simulation (mannequin with vital signs) to improve pedagogical skills.

Intervention The intervention included a lecture on adult learning and active-learning techniques, development of a case from the fellows' subspecialties, and teaching the case to residents and medical students. Teaching was observed by an educator using a standardized checklist. Learners evaluated fellows' teaching by using a structured evaluation tool; learner evaluations and the observer checklist formed the basis for written feedback. Changes in fellows' pedagogic knowledge, attitudes, and self-reported skills were analyzed by using Friedman and Wilcoxon rank-sum test at baseline, immediate postintervention, and 6-month follow-up.

Results Forty fellows participated. Fellows' self-ratings significantly improved from baseline to 6-month follow-up for development of learning objectives, effectively reinforcing performance, using teaching techniques to promote critical thinking, providing constructive feedback, and using case studies to teach general rules. Fellows significantly increased agreement with the statement "providing background and context is important" (4.12 to 4.44, $P = .02$).

Conclusions Simulation was an effective means of educating fellows about teaching, with fellows' attitudes and self-rated confidence improving after participation but returning to baseline at the 6-month assessment. The simulation identified common weaknesses of fellows as teachers, including failure to provide objectives to learners, failure to provide a summary of key learning points, and lack of inclusion of all learners.

Nancy M. Tofil, MD, MEd, is Medical Director, Pediatric Simulation Center, Children's of Alabama, and Associate Professor, Department of Pediatrics, University of Alabama at Birmingham School of Medicine; **Dawn Taylor Peterson, PhD**, is Program Director, Department of Pediatrics, University of Alabama at Birmingham School of Medicine, and Director of Simulation Education and Research, Pediatric Simulation Center, Children's of Alabama; **Kathy F. Harrington, PhD, MPH**, is Associate Professor, Department of Medicine, University of Alabama at Birmingham School of Medicine; **Brian T. Perrin, MD**, is Resident Physician, UT/St. Thomas Midtown Hospital, Nashville, TN; **Tyler Hughes, MD**, is Internal Medicine Resident Physician, University of Alabama at Birmingham Huntsville Regional Campus; **J. Lynn Zinkan, MPH, BSN, RN**, is Nurse Educator, Pediatric Simulation Center, Children's of Alabama; **Amber Q. Youngblood, BSN, RN**, is Nurse Educator, Pediatric Simulation Center, Children's of Alabama; **Al Bartolucci, PhD**, is Professor Emeritus, Department of Biostatistics, University of Alabama at Birmingham School of Public Health; and **Marjorie Lee White, MD, MPPM, MEd**, is Medical Co-Director, Pediatric Simulation Center, Children's of Alabama, and Associate Professor, Department of Pediatrics, University of Alabama at Birmingham School of Medicine.

Funding: This study was funded by Kaul Pediatric Institute, University of Alabama at Birmingham.

Corresponding author: Dawn Taylor Peterson, PhD, Department of Pediatrics, 1600 7th Avenue South, CPP1 102, Birmingham, AL 35233, 205.638.7535, dawn.taylorpeterson@childrensal.org

Received February 26, 2013; revisions received May 29, 2013, and July 29, 2013; accepted July 30, 2013.

DOI: <http://dx.doi.org/10.4300/JGME-D-13-00067.1>

Editor's Note: The online version of this article contains an education feedback checklist and fellow self-assessment questionnaire used in the study.

Introduction

Residents and fellows provide a significant amount of undergraduate clinical medical education. Yet, trainees have limited teaching experience and often no training. In an attempt to decrease this gap, resident-as-teacher programs are being incorporated into residency training.¹ These programs are designed around adult-learning theories, which advocate self-directed learning and readily applicable information.² Common elements among resident-as-teacher programs include discussion of basic teaching principles, resident-led teaching sessions observed by instructors and followed by a thorough debriefing, and success assessment through participant surveys.³⁻⁸ Inclusion of feedback strategies and leadership and communication skills help ensure a safe learning environment.⁹ Objective,

performance-based evaluations are recommended to provide summative feedback and guidance for residents as they continue to develop their pedagogic skills.¹ The impact of resident-as-teacher programs is far reaching, with benefits for medical students and positive results in patient care as well.¹⁰

High-fidelity patient simulation (HPS) can enhance resident and fellow training, but this method has not been widely adapted to resident-as-teacher training programs.⁴ HPS exercises typically begin with an introduction followed by learner participation in a staged scenario and end with an instructor-led debriefing. This structured environment aids instructors by facilitating close observation and opportunities for “teachable moments.” HPS sessions can be video recorded, providing a valuable source of feedback and meaningful evaluation based on measurable criteria.^{8,11–14}

We hypothesized that HPS would enhance a resident-as-teacher training program in our institution by allowing fellows to gain experience teaching residents and medical students while enabling close observation of the fellows leading sessions.

Methods

Structured Teaching Program

Our study included all pediatrics subspecialty fellows training at our institution between July 2009 and June 2011 whose fellowships were more than 1 year in duration. Fellows participated in a structured teaching program using HPS as a platform to conceptualize their standardized teaching encounter. Constructs and methods from social learning theory (SLT) were the basis for developing different modalities to systematically educate fellows about how to teach.¹⁵ This process encompassed several steps: (1) development of a standardized lecture emphasizing adult learning and teaching skills to be viewed by all fellows (SLT constructs: knowledge acquisition, vicarious learning, skills modeling); (2) development of guidelines for fellows to use in constructing a teaching case for simulation (SLT construct: outcome expectations); (3) providing an opportunity for the case to be simulated with the fellow in a teaching role for residents (SLT constructs: skills practice and self-efficacy); and (4) delivery of structured feedback by faculty (SLT constructs: feedback and reinforcement).¹⁵

The Institutional Review Board at the University of Alabama at Birmingham approved this study.

Standardized Lecture We developed a standardized lecture, organized into 5 main pedagogic concepts: (1) Malcolm Knowles’ adult learning theory²; (2) David Kolb’s experiential learning theory¹⁶; (3) a video depicting simulation to illustrate the complexity achievable in simulation; (4) a video showing the 1-minute preceptor or 5-step “microskills” teaching technique¹⁶; and (5) material

What was known

Residents and fellows frequently teach junior learners despite often having received little education and preparation for this role.

What is new

A simulation, in which fellows’ teaching abilities are assessed while teaching a case to junior learners, improved fellows’ self-perceived teaching skills.

Limitations

Outcomes are limited to self-reported gains in skills. Multiple resources required to implement this curriculum may be a barrier to broad adoption.

Bottom line

The simulation identified common weaknesses of fellows as teachers, including failure to provide objectives to learners, failure to provide a summary of key learning points, and lack of inclusion of all learners.

from the effective Bringing Education and Service Together program adapted for fellows.^{17,18} The lecture was delivered during a teaching conference and was video recorded so it would be available for fellows to view just before their teaching encounter. All fellows were required to review the video before their teaching experience unless they attended the lecture in the 6 months before the date of their teaching case.

Simulation Case Guidelines Constructing and demonstrating a clinical case study provided an applied learning opportunity for fellows. A standardized form, including learning objectives, was developed by an instructional design expert along with 2 of the authors. This template allowed fellows to choose a case they felt was important for general pediatricians. The paper-based case was reviewed with the simulation staff and adapted into a simulation scenario. The fellow also developed a brief teaching points presentation directed toward the case’s learning objectives.

Teaching Simulation Exercise The simulation exercise allowed fellows to demonstrate their teaching skills. The main premise of the program was to guide fellows functioning as teachers through appropriate learner orientation techniques, giving feedback, and capturing bedside and clinical “teachable moments.”¹⁹ This process was piloted on 2 fellows and adjusted to optimize clarity and content before full implementation. Each fellow individually came to the simulation center with the residents/medical students assigned to their service for that month to enact their case. Learner group sizes ranged from 2 to 12 and included varying levels (eg, medical students, interns, residents, and occasionally junior fellows). The fellow watched the learners enact the case from a separate room by using a live audio/video feed. The case scenario was immediately followed by a debriefing/teaching session

in which the fellow provided constructive corrective feedback, clarified confusing aspects of the case, and instructed the learners about the key teaching points. The case was recorded, allowing the video to be available for case discussion. The entire debriefing/teaching session was videotaped with copies given to the fellowship program director and to fellows for their learner portfolio.

Structured Feedback An educational consultant and faculty member associated with the simulation center were present for each fellow teaching session. A structured, teaching behaviors–feedback checklist adapted with permission from a tool with some validity evidence by Morrison et al²⁰ (provided as online supplemental material) was used to evaluate fellow teaching performance. This adapted instrument was reviewed by educational and statistical consultants as well as the original author of the tool for content validity. Immediately after the fellow's teaching session, the educational consultant and 1 of the 2 physician-authors met with fellows to review their reflections of the case and provide feedback based on the completed teaching behaviors checklist. This structured feedback served as an additional learning opportunity to review key concepts in adult learning, identify strengths and weaknesses in the fellow's teaching performance, and provide guidance for improving teaching skills. Along with the learners' feedback of the teaching performance, this teaching behaviors checklist was used to develop formal written feedback and was provided to each fellow and his or her program director for inclusion in his or her learning portfolio. The same educational expert evaluated all of the teaching sessions.

Data Collection

Before listening to either the live or web-based teaching lecture, fellows completed a self-assessment of their current teaching knowledge, self-efficacy, and skills (provided as online supplemental material). Question content was developed by the evaluation team based on the objectives of the teaching lecture. Test items were reviewed by the educational consultant to assure the questions would appropriately assess learning. The fellows completed this same teaching self-assessment immediately after their simulated case/teaching session and again 6 months later.

Statistical Analysis

To assess the impact of the teaching simulation, we examined response categories pairwise over time using categorical modeling for percentage agreement, disagreement, and change from each time. We used the Friedman test for change overall and the Wilcoxon rank-sum test for pairwise differences for each pair of the 3 time points. We grouped the fellows' clinical specialty into dichotomous groups of invasive and noninvasive

specialties based on program director input. All tests were done by using SAS version 9.3 (SAS Inc, Cary, NC).

The educational consultant reviewed all completed checklist forms and anecdotal notes to identify themes using a standard qualitative approach that was adapted for the checklist context. The first 2 stages of qualitative analysis proposed by Thomas and Harden²¹ were conducted. Stage 1 involved coding observer comments based on patterns of meaning within the checklist category context. Stage 2 consisted of establishing descriptive themes from these patterns. A constant comparative method was used to examine data across checklists at the same time and reviewed after coding to ensure no themes were overlooked.²² Finally, themes were prioritized by frequency of coding on the checklists.

Results

Forty fellows participated in the study. Approximately half (52%) were women and 80% were non-Hispanic White. Less than one-fourth of participants had prior teaching experience, and none had a teaching degree. Over time, fellows showed statistically significant improvements in all self-appraised teaching behaviors as well as some self-efficacy factors and 1 knowledge item (which improved and then declined to baseline level; TABLE). There were no statistically significant learning differences between invasive and noninvasive groups except for 3 items: identification of a difficult learner who is not interested in content material or is having difficulty grasping a concept (3.51 versus 3.20, $P = .005$); use of a case study to teach general rules (2.29 versus 3.23, $P = .02$); and assessing the needs of the learner (4.65 versus 4.29, $P = .002$). All showed greater improvement in the invasive specialties. Learner feedback from residents and medical students was positive, especially focusing on the interactive and engaging teaching style of the sessions.

Themes emerged for both strengths and weaknesses in performance. Strengths generated reinforcement, while weaknesses generated recommendations for teaching improvement. The themes that represent more than 75% of the coded comments are identified by italics. Weakness themes included, in prioritized order, *failure to provide objectives to learners*, *failure to provide summary of key points*, *lack of inclusion of all learners*, lack of elicitation of underlying reasoning, and lack of appropriate constructive corrective feedback. Strength themes, also prioritized, included *provision of general principles*, *use of evidence*, positive reinforcement, encouraging participation, and identification of learning deficits. While some coded statements appeared in both strength and weakness themes (well done and not well done), they are listed for the overall theme by which they were most represented.

TABLE	FELLOWS' TEACHING SELF-ASSESSMENT SIGNIFICANT CHANGES: BASELINE TO IMMEDIATE FOLLOW-UP TO 6-MONTH FOLLOW-UP ^a				
		Time ^b			(Time Period)
		1	2	3	P Value
A1	Develop learning objectives for teaching sessions	2.83	3.13	3.47	(1-3) .001 (2-3) .006
A2	Create a learning climate of mutual respect, trust, and collaboration	3.14	3.34	3.72	(1-3) .001 (2-3) .008
A3	Prepare a didactic presentation to teach critical information for a specific case	3.00	3.16	3.67	(1-3) .001 (2-3) .001
A4	Present a case in a concise and well-organized manner so that it teaches general principles	2.95	3.08	3.67	(1-3) .001 (2-3) .001
A5	Effectively reinforce the resident's positive performance	2.98	3.12	3.61	(1-2) .04 (1-3) .001 (2-3) .02
A6	Use teaching techniques that promote critical thinking and learning in a clinical setting	2.48	2.76	3.22	(1-3) .001 (2-3) .001
A7	Identify a difficult resident (eg, not interested, difficulty grasping concept)	3.07	2.94	3.67	(1-3) .001 (2-3) .001
A8	Engage a difficult resident (eg, not interested, difficulty grasping concept)	2.24	2.38	2.94	(1-3) .001 (2-3) .001
A9	Provide constructive corrective feedback	2.62	3.00	3.33	(1-2) .001 (1-3) .001 (2-3) .003
A10	Use a case study to teach general rules	2.83	3.16	3.69	(1-2) .02 (1-3) .001 (2-3) .001
B1	I am good at teaching residents/medical students	3.21	3.33	3.67	(1-3) .002 (2-3) .03
B5	Providing background and context is important for clinical teaching	4.12	4.54	4.44	(1-2) .005 (1-3) .03
C1	Assessing the needs of residents or medical students	4.40	4.74	4.56	(1-2) .008
C2	Using different teaching strategies for different levels of resident or medical student	4.40	4.62	4.64	(1-3) .02
C3	Soliciting resident's reasoning behind decisions	4.45	4.87	4.64	(1-2) .002
D6	<i>You've been asked to teach a small group of residents about acid/base disorders in children. You want to do this in a way that will facilitate retention by the residents. Which of the following methods would most likely result in better retention?</i> <i>a. Discussion, %</i> <i>b. Demonstration, %</i> <i>c. Didactic lecture, %</i> <i>d. Lecture with audio/visual, %</i>	59.5 19.0 9.5 11.9	46.2 48.7 5.1 0	80.6 16.7 2.8 0	(1-3) .03 (2-3) .004

^a Responses for "A" items: 1 = none, 2 = low, 3 = med, 4 = high; responses for "B" items: 1 = not at all, 2 = a little, 3 = some, 4 = a lot, 5 = very much; responses for "C" items: 1 = not at all important, 2 = a little important, 3 = somewhat important, 4 = fairly important, 5 = very important.

^b Time 1 is pretest; time 2 is immediate follow-up after the simulation teaching case; time 3 is 6-month follow-up.

Discussion

Fellows' attitudes and self-rated confidence improved significantly with this teaching program, and fellows continued to perceive improvements in their teaching skills at 6 months postintervention, indicating that our simulated teaching scenario was effective. Most existing resident-as-teacher programs use lecture and workshops as the primary

means of teaching residents to teach, which deprives the resident of the opportunity to practice and apply pedagogic skills.²³ Incorporating HPS into fellow teaching programs allows participants to have a more meaningful teaching experience by giving them the chance to apply and reinforce newly acquired skills and knowledge. Our study had similarities with that of Morrison and colleagues,¹⁸

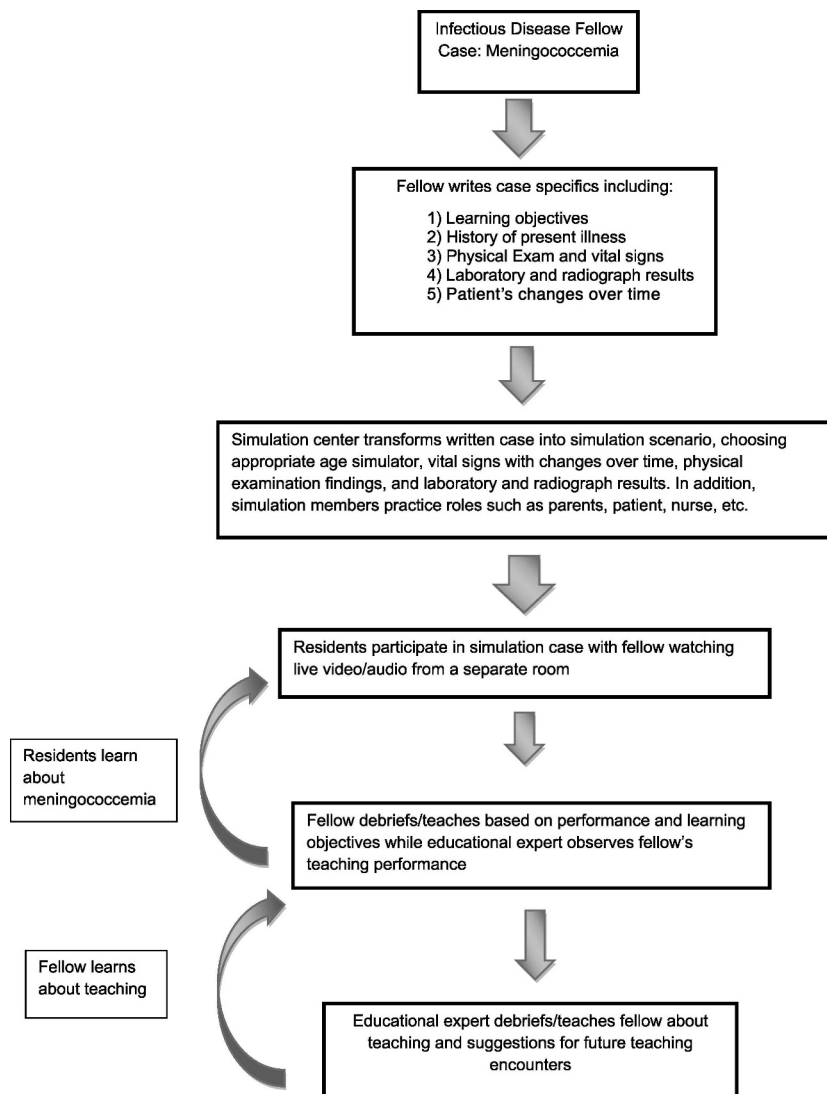


FIGURE | SIMULATION TEACHING CASE EXAMPLE

which incorporated similar active learning techniques with multiple role-modeling sessions and assessed learners with an observed structured teaching encounter. Both active learning methods resulted in improvements in teaching skills. Neither study assessed whether participants used learned teaching techniques long term. Although offered, no fellow returned for the optional second simulated teaching encounter. It is unclear whether this was due to their belief that their skills were sufficient, as suggested by many of their self-assessment responses, or due to other clinical time demands. As in other aspects of simulation, specifically cardiopulmonary resuscitation skills, there may be value in repeated practice with guided structured feedback between teaching sessions.²⁴ This is

the focus of our ongoing evaluation of simulation as a tool to teach how to teach. One unique aspect of this model is the complete cycle of learning that occurs. The FIGURE reflects this cycle of learning. This structure allowed faculty time and cost to be better justified as it was not just 1 fellow who was learning, but everyone involved in the simulation case. This model appears to be effective for all pediatrics fellows and could be applied to other fellowships as well.

The teaching program was well accepted by medical students and fellows and feasible within the usual educational structures for a wide variety of pediatrics specialty fellowships. The intervention required considerable resources which may reduce the ability of some settings to adopt or adapt this

approach. There was a minimal 1-time cost to create the teaching video, produce copies of it, and place it on the university website. The total simulation faculty time for each fellow was approximately 3 hours. Preparation of the case, including laboratory results, radiograph results, and preparing simulation support staff to “perform” the case, took 90 minutes. Observation of the simulation case and debriefing took 1 hour, and 30 minutes was allotted to provide feedback to the fellow. The educational consultant took 1½ to 2 hours per fellow, observing their teaching, providing immediate feedback following the case, and preparing the formal written evaluation. Each fellow spent approximately 3 hours in the program. Forty minutes were required to review the video, at least 1 hour was needed to prepare the case, and approximately 90 minutes were needed to watch the simulation, participate in debriefing/teaching, and receive feedback.

Our study has several limitations, including its nonexperimental design and lack of a control group. Outcome data are largely limited to fellows’ self-reported perceptions of improved skills and attitude about teaching. Finally, a single teaching/feedback session may not be enough practice for significant improvement to occur.

Conclusion

Fellows reported improved attitudes and self-rated confidence related to teaching after participating in a multilearner, multifaceted teaching skills simulation. The simulation identified common weaknesses of fellows as teachers, including failure to provide objectives to learners, failure to provide a summary of key learning points, and lack of inclusion of all learners.

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