

Impact of a Resident-as-Teacher Workshop on Teaching Behavior of Interns and Learning Outcomes of Medical Students

ANDREW G. HILL, MBChB, MD, FRACS, FACS
 SANKET SRINIVASA, MBChB
 SUSAN J. HAWKEN, MBChB, FRNZCGP, MHSc (Hons)
 MARK BARROW, MSc, EdD
 SUSAN E. FARRELL, MD, EdM
 JOHN HATTIE, BA, DipEd, MA(Hons), PhD
 TZU-CHIEH YU, MBChB

Abstract

Background Residents and interns are recognized as important clinical teachers and mentors. Resident-as-teacher training programs are known to improve resident attitudes and perceptions toward teaching, as well as their theoretical knowledge, skills, and teaching behavior. The effect of resident-as-teacher programs on learning outcomes of medical students, however, remains unknown. An intervention cohort study was conducted to prospectively investigate the effects of a teacher-training workshop on teaching behavior of participating interns and on the clerkship learning outcomes of instructed fourth-year medical students.

Methods The House Officer-as-Teacher Training Workshop was implemented in November 2009 over 1.5 days and attended by all 34 interns from one teaching hospital. Subsequently, between February and August 2010, 124 fourth-year medical students rated the observable teaching behavior of interns during 6-week general surgery clerkships at this intervention hospital as well as at 2 comparable hospitals serving as control sites.

Ratings were collected using an anonymous 15-item Intern Clinical Teaching Effectiveness Instrument. Student achievement of clerkship learning outcomes during this period was evaluated using a validated and centralized objective structured clinical examination.

Results Medical students completed 101 intern clinical teaching effectiveness instruments. Intern teaching behavior at the intervention hospital was found to be significantly more positive, compared with observed behavior at the control hospitals. Objective structured clinical examination results, however, did not demonstrate any significant intersite differences in student achievement of general surgery clerkship learning outcomes.

Conclusions The House Officer-as-Teacher Training Workshop noticeably improved teaching behavior of surgical interns during general surgery clerkships. This improvement did not, however, translate into improved achievement of clerkship learning outcomes by medical students during the study period.

Background

The role of the resident teacher has taken on significant meaning in the past 40 years.¹ It is now understood that medical students attribute one-third of their clinical

education to teaching from interns and residents^{2,3} and consider them to be important role models and mentors.⁴⁻⁶ Correspondingly, interns and residents report spending up to 25% of their time supervising, teaching, and evaluating medical students and junior colleagues⁷ and feel a strong responsibility to teach.^{8,9} Residents not only find clinical

Andrew G. Hill, MBChB, MD, FRACS, FACS, is Associate Professor at South Auckland Clinical School, Faculty of Medical and Health Sciences, University of Auckland, Middlemore Hospital, Otahuhu, Auckland, New Zealand; **Sanket Srinivasa, MBChB**, is Research Fellow at South Auckland Clinical School, Faculty of Medical and Health Sciences, University of Auckland, New Zealand; **Susan J. Hawken, MBChB, FRNZCGP, MHSc(Hons)**, is Senior Lecturer of Department of Psychological Medicine at School of Medicine, Faculty of Medical and Health Sciences, University of Auckland, New Zealand; **Mark Barrow, MSc, EdD**, is Associate Dean of Education at Deanery, Faculty of Medical and Health Sciences, University of Auckland, New Zealand; **Susan E. Farrell, MD, EdM**, is Assistant Professor at the Center for Teaching and Learning, Harvard Medical School, Harvard University; **John Hattie, BA, DipEd, MA(Hons), PhD**, is Honorary Professor of Education at University of Auckland, New Zealand; and **Tzu-Chieh Yu, MBChB**, is Research Fellow at South Auckland Clinical School, Faculty of Medical and Health Sciences, University of Auckland, New Zealand.

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Corresponding author: Andrew G. Hill, MBChB, MD, FRACS, FACS, South Auckland Clinical School, Faculty of Medical and Health Sciences, University of Auckland, Middlemore Hospital, Private Bag 93 311, Otahuhu, Auckland, New Zealand, 64-9.276.0076, a.hill@auckland.ac.nz

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teaching enjoyable but also consider it an important component of their own experience and education.^{10,11}

Resident-as-Teacher (RaT) programs have emerged as a means of improving resident teaching skills and have a number of positive effects,^{12–18} including improved attitudes and perceptions toward clinical teaching and improved teaching skills and behavior observable by medical students, peers, and senior clinicians. The effect of RaT programs on learning outcomes of medical students, however, has not yet been investigated, to our knowledge, leaving a considerable gap in our understanding of their overall effect.¹

For this reason, an interventional cohort study was designed to determine whether a teacher training workshop would improve the teaching behavior of interns (post-graduate year-1 house officers) and whether improved teaching leads to improved achievement of clerkship learning outcomes by the medical students under the interns' supervision. Preliminary evaluation of the workshop's effect found improvement in participants' attitudes and perceptions toward clinical teaching with increases in self-reported awareness of clinical teaching and confidence as clinical teachers.¹⁹

Methods

Workshop Curriculum and Implementation

The House Officer-as-Teacher (HOT) Training Workshop curriculum was developed in 2009 as a collaborative project between Harvard Medical School and the University of Auckland (Auckland, New Zealand). Aspects of this new curriculum were adopted from the curriculum of a RaT program commissioned by the Society for Academic Emergency Medicine (De Plaines, IL) for American emergency medicine residents.²⁰

New Zealand medical graduates do not receive formal teacher training during or after medical school, so the workshop curriculum was designed to introduce basic principles of clinical teaching to newly graduated interns who have no previous teaching experience. The workshop duration was 1.5 days. TABLE 1 outlines the learning objectives and instructional format of the workshop's 4 modules.

In November 2009, the HOT workshop was implemented as a pilot during the compulsory intern-orientation week at a teaching hospital in Auckland, New Zealand, and the attendance rate by interns was 100%. It was led by a chief workshop facilitator (S.F.) and 4 trained co-facilitators. On day 1, interns were introduced to the basic principles of clinical teaching and to the theoretical aspects of each learning module through a combination of short interactive lectures and large group discussions. Interns then had the opportunity to apply demonstrated teaching

What was known

Residents as teachers make significant contributions to the learning of medical students and junior colleagues, and spend a significant portion of their time in teaching and supervision.

What is new

A 1.5 day resident-as-teacher workshop produced improvements in medical students' ratings of intern teaching behavior compared to control institutions without the intervention.

Limitations

Small sample, single site study, lack of randomization, and inability to account for confounders, such as interns' clinical knowledge and inherent teaching ability.

Bottom line

Student reports of intern teaching suggested improved performance after the resident-as-teacher workshop. Objective structured clinical examination did not show any differences in general surgery clerkship learning outcomes for the site with the teaching intervention.

principles and methods to standardized clinical teaching scenarios constructed by workshop facilitators. Interns were divided into small groups of 6 or 7, and each intern had opportunities to role-play the clinical teacher and the medical student during reenactment of the scenarios. Workshop facilitators, attached to each group, provided encouragement, reinforcement of principles from the workshop curriculum, and timely feedback and ensured teaching exercises were conducted in a safe and supportive environment.

Day 2 of the workshop involved applying clinical teaching skills to simulated bedside-teaching scenarios. These scenarios used trained professional actors playing standardized patients and third-year medical students volunteering as real-life learners. Divided again into small groups to facilitate peer learning, the interns took turns role-playing the clinical teacher in these bedside-teaching scenarios. Each scenario was limited to 7 minutes to simulate the realistic time constraints of everyday clinical practice. Within the allocated time, interns had to address the patient's medical and nonmedical concerns and engage the student in a constructive learning discussion while navigating challenges when the needs of a patient and student clash. To further enrich the learning experience, interns were digitally recorded to allow for self-evaluation and self-reflection. Consistent with activities on day 1, interns again received peer and facilitator feedback while concurrently engaged in delivering feedback to fellow participants.

Study Design

This interventional cohort study was designed to investigate the effect of a teacher training workshop on the teaching behavior of interns and the clerkship learning outcomes of medical students who interacted with these

TABLE 1 THE HOUSE OFFICER-AS-TEACHER (HOT) TRAINING WORKSHOP CURRICULUM

Module 1: General Principles of Clinical Teaching

Goals and Objectives	Format
To introduce house officers to some general principles of teaching and learning in the clinical setting. The focus will be on the basic knowledge and skills for effective patient- and learner-centered clinical teaching: - Identifying one's knowledge and experience - Role-modeling self-directed learning - Assessing the learner's abilities, knowledge, and interests - Engaging and motivating learners - Setting realistic and attainable learning expectations - Effective use of questioning during teaching - Teaching in general concepts - Applying learning to broader clinical problems - Reinforcing prior learning as a basis for continued self-improvement House officers will reflect on their own prior learning experiences and identify positive and negative experiences that have influenced their learning. They will learn about and practice in small groups 2 methods of teaching: The Neher 1-min preceptor (5 microskills of clinical teaching)²² and SNAPPS (summarize, narrow, analyze, probe, plan, select).²³ Overall Objective: House officers will have an understanding of the general principles of clinical teaching sufficient to practice several new teaching skills in the clinical setting.	- Interactive lecture and role modeling: 40 min - Questions and answers: 20 min - Small-group work: 40 minutes - Debriefing: 20 min Total duration: 2 h

Module 2: Bedside Teaching

Goals and Objectives	Format
To expand on the knowledge and skills introduced in module 1 and apply them to teaching encounters that include a patient, house officer teacher, and student learner. House officers will learn how to set the stage for a bedside teaching encounter, use general principles of clinical teaching in order to teach with a patient at the center of the learning experience, and reinforce learning after such teaching encounters. House officers will be introduced to the "Twelve Tips to Improve Bedside Teaching."²⁴ The benefits to the learner of bedside teaching will be discussed, including observation and appreciation of traditional professional skills (history-taking, physical examination techniques applied to diagnostic acumen, communication skills, ethical patient interactions, empathy, and promotion of patient participation in their own care). The challenges to bedside teaching will be explored and methods for overcoming these discussed and practiced. Patient-centered teaching scenarios will be used for house officers to apply and practice bedside teaching skills. Overall Objective: House officers will have an understanding of, and basic confidence in applying principles of bedside clinical teaching.	- Interactive lecture and role modeling: 40 min - Questions and answers: 20 min - Small-group work: 40 min - Debriefing: 20 min Total duration: 2 h

Module 3: Giving Effective Feedback

Goals and Objectives	Format
- To introduce house officers to the goals and principles of formative feedback as an essential component of assessment and improvement in the cycle of learning. - To engage the learner in self-reflection to enhance the effectiveness of feedback. The benefits and challenges of applying various methods of feedback delivery will also be discussed. House officers will reflect in small groups on their own prior experiences with feedback and use prepared case scenarios to practice, observe, and reflect on feedback delivery methods. Overall Objective: House officers will have an understanding of the goals and principles of delivering effective feedback, sufficient to be able to deliver feedback in a safe and effective manner.	- Interactive lecture and role modeling: 40 min - Questions and answers: 20 min - Small-group work: 40 min - Debriefing: 20 min Total duration: 2 h

TABLE 1 CONTINUED

Module 4: Teaching Effective Discussion Leading and Lecturing	
Goals and Objectives	Format
To provide house officers with a background understanding of the challenges involved in, and the basis of effective small group discussion leading and lecture preparation and delivery. House officers will work individually, using teaching topics of their own choice to draft outlines for teaching the topic to both small groups and large groups, emphasizing lecture-style deliveries for the latter. They will then work in small groups to practice the skills of leading small-group discussions and delivering mini-lectures. Within small groups, house officers will use the skills of feedback, discussed previously in module 3, to generate group discussion and help their peers to improve teaching skills. Overall Objective: House officers will have an understanding of the general principles of teaching in small-group discussion settings and be familiar with methods of effective lecture preparation and delivery.	1. Interactive lecture: 20 min 2. Questions and answers: 10 min 3. Small-group work: 20 min 4. Debriefing: 10 min Total Duration: 1 h

interns. The intervention cohort was made up of all 34 interns from an Auckland, New Zealand, teaching hospital where the pilot HOT workshop was implemented, whereas the control cohort consisted of 70 interns from 2 other teaching hospitals in the same city. The 3 hospitals were similar in size and facilities and offered comparable clerkship learning opportunities for medical students. Medical students from the University of Auckland are assigned to all 3 teaching sites for the 6-week fourth-year general surgery clerkship. The clinician-student ratio at each hospital is similar, and assignment is based on student

preference and position availability. Student work schedules were also similar at each hospital because all learning activities during the clerkship are standardized across teaching sites.²¹

Assessment of Workshop Impact

To compare the teaching behavior of interns from the 2 study cohorts, fourth-year medical students were asked to rate the effectiveness of intern-led teaching at all 3 teaching hospitals between February and August 2010. At the completion of their general surgery clerkships, 124 fourth-year students were asked to anonymously complete a 15-item Intern Clinical Teaching Effectiveness Instrument (BOX 1), rating the effectiveness of observable teaching behavior displayed by the interns with whom they interacted. Participation by the medical students was not compulsory.

The Intern Clinical Teaching Effectiveness Instrument was adapted by the investigators from a validated tool originally developed by Copeland and Hewson.²⁵ This instrument was constructed to evaluate the effectiveness of teaching in a wide variety of clinical settings. Each of the instrument's items is a detailed statement describing a specific teaching skill, and those skills are rated using a 5-point Likert scale. Modifications were made so that it would be appropriate for use by New Zealand-trained interns. These included removing the terms *Socratic questions* and *view box*, and substituting the term *interview* with *history-taking*. Comparison of teacher ratings was first made on a hospital-to-hospital basis to investigate for intersite differences. Ratings from the 2 control hospitals were then combined into one inclusive control group and compared with ratings from the intervention hospital.

A centralized, surgical objective structured clinical examination (OSCE) was used to measure student achievement of clerkship learning objectives during the study period. This clerkship assessment was attended by all fourth-year medical students in 2010. The OSCE is made

BOX 1 THE INTERN CLINICAL TEACHING EFFECTIVENESS INSTRUMENT^a

1. The interns establish a good learning environment (approachable, enthusiastic, etc).
2. The interns stimulate me to learn independently.
3. The interns allow me autonomy appropriate to my level/experience/competence.
4. The interns organize time to allow for both teaching and patient care.
5. The interns offer regular feedback (both positive and negative).
6. The interns clearly specify what I am expected to know and do during the attachment.
7. The interns adjust teaching to my needs (experience, competence, interest, etc).
8. The interns ask questions that promote learning (clarifications, probes, reflective questions, etc).
9. The interns give clear explanations/reasons for opinions, advice, actions, etc.
10. The interns adjust teaching to diverse settings (bedside, operating room, emergency room, etc).
11. The interns coach me on my clinical/technical skills (history-taking, examination, procedural, etc).
12. The interns incorporate research data and/or practice guidelines into teaching.
13. The interns teach diagnostic skills (clinical reasoning, selection/interpretation of tests, etc).
14. The interns teach effective patient and/or family communication skills.
15. The interns teach principles of cost-appropriate care (resource utilization, etc).

^a Items were rated on a 5-point Likert scale (1 = never/poor, 2 = seldom/mediocre, 3 = sometimes/good, 4 = often/very good, 5 = always/superb).

up of 11 written stations and 4 clinical skills stations. Written stations entail short-answer questions about a clinical scenario, and clinical skills stations involve demonstration of history-taking and physical examination skills under direct examiner observation. The OSCE is graded on 230 marks (110 marks from the written component; 120 marks from clinical skills component).

The external validity and internal reliability of the surgical OSCE has previously been confirmed,²¹ giving it credibility as an accurate measure of student learning achievements during the fourth-year general surgery clerkship. Furthermore, OSCE scores from 2005 to 2008 have been statistically similar across all 3 teaching sites.²¹ For the current study, student OSCE results from the intervention hospital in 2010 were compared with those from the control hospitals to determine whether implementation of the HOT workshop advanced intern teaching skills leading to improved student learning at the intervention site.

A priori power analysis was performed using historic OSCE grades (mean = 172; SD = 17) to give study investigators an indication of sample size sufficiency. For this study to detect a minimally significant difference of 5% in OSCE scores (effect size of 0.5) between the 2 study arms with significance criterion equal to 0.05 and power of 0.95, 16 medical students would be required in each arm. The study received ethics approval from the University of Auckland Human Participants Ethics Committee.

Statistical Analysis

Intern-led teaching ratings collected using the Intern Clinical Teaching Effectiveness Instrument were compared using a multivariate analysis of variance (MANOVA) test after exploratory factor analysis was performed using the maximum-likelihood method. The MANOVA with a post hoc Scheffe test was used to compare the ratings on a hospital-to-hospital basis. Internal reliability of this data set was established by calculating Cronbach α coefficient. Student OSCE results were compared using independent sample *t* tests. All statistical tests were performed using the Predictive Analytics software statistics program, version 18.0 (SPSS Inc., Chicago IL).

Results

The HOT workshop was attended by 34 interns, and with the exception of 3 interns, participants were all graduates of New Zealand's 2 medical schools. There were 22 men and 12 women, and their ages ranged from 23 to 42 years.

A total of 101 Intern Clinical Teaching Effectiveness Instruments were collected from 124 medical students during the 7-month study period (response rate of 81%). A Cronbach α coefficient of 0.95 confirmed the instrument's

BOX 2 FACTOR MATRIX: EFFECTIVENESS OF INTERN CLINICAL TEACHING

Instrument Item: "The Interns..."	Factor 1
Adjusted teaching to my learning needs	0.851
Teach effective communication skills	0.836
Teach diagnostic skills including clinical reasoning	0.811
Adjust teaching to diverse settings	0.797
Organize time to allow for teaching	0.796
Ask questions to promote learning	0.783
Give clear explanations/reasons	0.763
Offer regular feedback	0.756
Coach clinical/technical skills	0.743
Stimulate independent learning	0.742
Establish a good learning environment	0.718
Clearly specify learning expectations	0.707
Incorporate research data and/or practice guidelines into teaching	0.696
Teach principles of cost-appropriate health care	0.695
Allow appropriate autonomy	0.653

internal consistency, and maximum-likelihood factor analysis demonstrated that 58% of the total variance among the instrument items could be explained by a single underlying factor. All instrument items were found to contribute meaningfully to this analysis (BOX 2).

There were 99 fully completed sets of teacher ratings, and significant differences were found between those collected at the intervention hospital and those at the control hospitals (Wilks λ = 0.603, $F_{15,83}$ = 2.662, P = .002). TABLE 2 demonstrates that ratings for all the items were significantly different between the intervention hospital and control hospitals, and effect sizes ranged from medium to high (0.47–1.20). There were no significant differences between the 2 control hospitals.

Surgical OSCE grades of the same 124 medical students demonstrated no statistically significant interhospital differences. There were also no differences when grades from the intervention hospital were compared with combined grades from the 2 control hospitals (TABLE 3).

Discussion

To our knowledge, the current study is the first to formally investigate the effect of an RaT program on medical student learning outcomes, and no immediate improvements were demonstrated despite observable progress in teacher behavior. The effectiveness of teachers is commonly evaluated by students in tertiary and professional educational institutions, including medical schools and teaching hospitals. In general, these teacher ratings are reliable and comparable with other measures, such as teacher self-evaluations, peer ratings, and student learning outcomes.²⁶ The psychometric properties of various clinical teacher rating instruments have been described,²⁷ and their reported benefits include provision of consistent feedback to teachers and program directors and facilitation of

TABLE 2 MANOVA ANALYSIS OF INTERN CLINICAL TEACHING EFFECTIVENESS INSTRUMENT RATINGS: INTERVENTION SITE VERSUS CONTROL SITES

Instrument Item: "The Interns..."	Rating, Mean (SD)		P Value	Effect Size
	Intervention Site N = 40	Control Sites N = 59		
Organize time to allow for teaching	3.6 (0.93)	2.5 (0.92)	< .001	1.20
Clearly specify learning expectations	3.3 (0.88)	2.5 (0.88)	< .001	0.90
Offer regular feedback	3.6 (0.82)	2.7 (1.03)	< .001	0.87
Ask questions to promote learning	3.7 (0.66)	2.8 (1.04)	< .001	0.87
Coach clinical/technical skills	3.4 (0.89)	2.6 (0.98)	< .001	0.82
Adjust teaching to my learning needs	3.7 (0.79)	2.9 (1.01)	< .001	0.79
Teach diagnostic skills including clinical reasoning	3.6 (0.90)	2.8 (1.05)	< .001	0.76
Give clear explanations/reasons	3.8 (0.77)	3.1 (0.94)	< .001	0.74
Teach effective communications skills	3.6 (0.85)	2.8 (1.08)	< .001	0.74
Establish a good learning environment	4.2 (0.74)	3.5 (1.08)	< .001	0.65
Stimulate independent learning	3.7 (0.76)	3.1 (0.94)	< .001	0.64
Incorporate research data and/or practice guidelines into teaching	2.9 (0.94)	2.3 (1.04)	.006	0.58
Allow appropriate autonomy	4.0 (0.82)	3.4 (1.08)	.007	0.56
Teach principles of cost-appropriate health care	2.9 (0.98)	2.4 (0.89)	.005	0.56
Adjust teaching to diverse settings	3.6 (0.78)	3.1 (1.07)	.006	0.47

^a Numeric ratings correspond to descriptions (1 = never/poor, 2 = seldom/mediocre, 3 = sometimes/good, 4 = often/very good, 5 = always/superb).

research to investigate variables affecting teaching effectiveness. These rating instruments have been extensively used in the assessment of RaT programs.¹

The Intern Clinical Teaching Effectiveness Instrument was modified from a tool developed by Copeland and

Hewson²⁵ with psychometric properties that include reliability, content validity, and criterion validity. This instrument accurately discriminated between residents who had attended the HOT workshop and those who had not, and its validity was highlighted by the comparison analysis that matched the largest effect sizes to instrument items describing teaching skills emphasized during the HOT workshop.

In a recent systematic review,¹ 4 other studies have investigated the effect of RaT programs on interns. Of these, 2 had similar follow-up durations to the current study.^{14,28} Edwards et al¹⁴ described the effect of an RaT workshop on student evaluation of intern teaching skills at Louisiana State University School of Medicine. Using the Clinical Teaching Assessment Form,²⁹ third-year medical students rated 9 aspects of intern-led teaching. Interns who had attended the workshop received significantly higher scores for 4 of the items than did residents who had not attended. These items described the interns' *knowledge*, *organizational skills*, *demonstration of clinical skills*, and *overall teaching effectiveness*.

TABLE 3 FOURTH-YEAR GENERAL SURGERY CLERKSHIP OBJECTIVE STRUCTURED CLINICAL EXAMINATION (OSCE) RESULTS, FEBRUARY TO AUGUST 2010

	OSCE Mark, Mean (SD)	
	Intervention Site	Control Sites
No. of students	48	76
Written questions (n = 110 marks)	79 (11)	80 (11)
Clinical skill (n = 120 marks)	96 (7)	96 (8)
Total (n = 230 marks)	175 (16)	176 (17)

Putting aside potential criticisms of the HOT workshop's curriculum and delivery methods, there remain several additional considerations: which confounding factors could potentially contribute to student OSCE grades, can intern-teacher training programs instantly improve student learning outcomes, and if attainable improvements had been made, was the OSCE the most appropriate method of evaluation?

A number of potential confounding factors need to be considered. These are either intrinsic to student participants or extrinsic, that is, related to intern teachers and the clinical teaching environments. Although medical students were not randomized to the participating hospitals, study investigators felt confident that the cohorts were matched based on previous data.²¹ Potential confounding factors related to intern teachers include differences in their clinical knowledge and skills and prior teaching experience. Unfortunately, the first factor is difficult to exclude. Although New Zealand medical graduates do not routinely receive recognized training in clinical teaching during or after medical school, senior medical students may gain random ad hoc teaching experience before internship.

Because all 3 teaching hospitals are in the same city and are of similar size, study investigators were assured that the clinical workload, patient demographics, available specialties, and clinician-student ratio at these sites were comparable. They were, however, unable to control for interhospital differences in effectiveness of student teaching conducted by more senior clinicians.

Consideration should also be given to the possibility that RaT programs for interns may not necessarily bring about immediate changes to student learning. Like RaT programs, faculty development programs for senior clinicians also improve teaching skills and increase student satisfaction.³⁰ It is rational to believe that improving the pedagogic skills of clinicians promotes learning by medical students. However, there is only limited evidence suggesting that the effectiveness of clinical teaching perceived by students can positively affect their performance and learning outcomes.^{30–32} Medical students are characteristically individuals with profound capacity to adapt and self-motivate, likely possessing the ability to achieve assessed learning outcomes, regardless of the teaching they receive. Even the best clinical teachers may, therefore, have only a minor role in student learning.

Furthermore, the study findings may be explained by a possible mismatch between the clinical skills and knowledge taught to students by surgical interns and those examined by the surgical OSCE, which is based on the clerkship's formal curriculum. Residents and interns teach a significant proportion of the "informal" clinical curriculum, where skills and knowledge are focused on the day-

to-day aspects of patient management (procedural skills, patient communication, task prioritization, among others).³³ A thorough understanding of the teaching contributions made by residents and interns is needed before effectiveness of their teaching can be truly determined.

The RaT programs are likely to have medium- and long-term effects, which remain unexplored. Previous research has highlighted the effect of resident-initiated bedside teaching, skills coaching, and role modeling on self-evaluated "preparedness to practice" of final-year medical students.^{34–36} Mentoring by residents and interns is also known to influence future career choices of medical students, particularly attracting them to surgical specialties.^{37–39} How RaT programs influence these subsequent student outcomes has yet to be documented.

Conclusions

The HOT workshop improved reported clinical teaching behavior by attending interns. However, there were no demonstrable improvements in measured clerkship learning outcomes by the medical students supervised by the interns. Before further research can be conducted to investigate the effectiveness of resident- and intern-led teaching, the contributions made to the clerkship learning environment by these clinical teachers must be better defined and coupled with an understanding of how to accurately and reliably evaluate their effect on student learning.

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