Comparison between medical students' experience, confidence and competence

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Objectives This study was undertaken to determine whether or not breadth of clinical experience and student levels of confidence were indicators of competency on standardized simulator performance-based assessments.

Methods All students ($n = 144$) attending an educational session were asked to complete a 25-point questionnaire regarding specific clinical experiences and levels of confidence in their ability to manage patient problems. For enumeration of clinical experiences, students were asked to estimate the number of times a situation had been encountered or a skill had been performed. For level of confidence, each response was based on a 5-point Likert scale where 1 = novice and 5 = expert. Students then participated in a standardized simulated performance test. Median and range were calculated and data analysed using Spearman rank correlations. A *P*-value <0·05 was considered significant. Level of confidence data were compared to performance during clinical rotation and to marks in the anaesthesia final examination.

Results A total of 144 students attended the session, completed the questionnaire and participated in the standardized test. There were wide ranges of experience and confidence in the 25 listed items. Analysis of data showed good correlation between clinical experience and level of confidence. There was no correlation between clinical experience, level of confidence and performance in a standardized simulation test. Neither was there any correlation between level of confidence and clinical grades or written examination marks.

Conclusions Clinical experience and level of confidence have no predictive value in performance assessments when using standardized anaesthesia simulation scenarios.

Keywords Canada; curriculum; educational measurement; education, medical/ *methods; patient simulation; *professional competence; questionnaires.

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Introduction

Clinical rotations during the clerkship years are designed to allow students hands-on experience in order to enrich their knowledge and enable them to become competent in designated skills and medical management of patient problems.

Studies have suggested that in some circumstances, students do not receive adequate clinical exposure to problems and lack the opportunity to acquire skills necessary for competency as a doctor.[1,2] In anaesthesia, students can practise certain basic skills on healthy patients, but they cannot be allowed to manage critical events due to patient safety. This limits the educational experience.

Students rotating through anaesthesia at the University of Toronto are given extensive exposure to the disciplines of medicine, surgery, paediatrics, obstetrics and gynaecology before their rotation in our specialty. Many students have postgraduate degrees before entry into medical school and previous experiences vary widely. Whether this background affects subsequent performance in medical school assessments, however, is poorly understood and difficult to document.[3] As Stewart warns, terms such as 'confidence' and 'competence' should not be used synonymously.[4]

The high-fidelity patient simulator is now an integral part of the undergraduate curriculum at the University of Toronto. It offers the ability to simulate real-time

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Key learning points

Medical students' levels of confidence in the performance of specific skills and patient management problems are correlated to their clinical experience in these areas.

Neither clinical experience nor level of confidence can predict outcomes in standardized performance assessments.

Difference in educational experiences may account for these findings.

The lack of correlation between educational experience and outcomes on standardized assessments requires further exploration.

clinical events that can be standardized, repeated and videotaped for educational feedback and assessment purposes. The value of the simulator for these purposes has been widely recognized and the potential for its growth as an educational tool acknowledged.[5,6] Rare and critical events can be managed by relative novices without concern for patient safety. This process of experiential learning may be invaluable, supplementing student experiences in the operating room environment.

Students' perceptions of their ability often correlate highly with the degree of experience. However, competence, as assessed in examinations, has not reflected personal confidence or clinical experiences.[3,7,8]

The purpose of this study was to determine whether or not breadth of clinical experience and student levels of confidence were indicators of competency on standardized simulator performance-based assessments.

Methods

Once research ethics approval had been granted, all final year medical students at the University of Toronto ($n = 177$) were invited to participate in a 1-day educational session in the Anaesthesia Simulation Centre. Each student had spent 1 week in the operating room under the direct supervision of an anaesthesia faculty member before participation in the session. At the beginning of the educational day, students were asked to complete a 25-point questionnaire tabulating their prior experience and level of confidence in the performance and management of certain skills and clinical problems. They were asked to rate each item on a 5-point Likert scale for level of confidence, where 1 = novice, and 5 = expert. They were also asked to give an absolute number or an approximate estimation of experience for the number of times they had performed a task or been exposed to a certain situation (e.g. greater than 10 times). Checklist questions included items or management issues addressed in the simulated test scenario.

Following an orientation in the Simulation Centre, including the operating room, patient mannequin, anaesthetic machine and drug cart, each student undertook a test involving the management of a predetermined critical event using the simulated patient in the operating room. The event lasted approximately 5 min. A faculty member scored the students' performances on the test using a standardized checklist.

Scenarios and performance checklists

Three scenarios were scripted for use in the simulator, based on the learning objectives of the final year anaesthesia curriculum. The scenarios and the performance protocols were endorsed by undergraduate committee members as reflecting appropriate content for students at this level of training. The critical event used as a test was a subsection of one of the 3 scripted scenarios. Educational objectives in the scenarios included items such as recognition and management of: (a) hypertension, tachycardia and myocardial ischaemia; (b) hypotension, tachycardia and anaphylaxis, and (c) rapid sequence induction, hypoxaemia and endobronchial intubation. Standardized assessment checklists were used to evaluate students' performances in the simulated test scenario. For each of these scenarios, students' levels of confidence in managing the events tested in the scenario were averaged and correlated to final simulator test scores.

Students in the anaesthesia rotation were also evaluated by a clinical grade based on their performances in the operating room during their 2-week rotation, along with a short-answer written examination administered at the end of the rotation.

Faculty workshop

All faculty members participating in the simulation sessions attended a workshop in order to familiarize themselves with the study objectives. A medical educator facilitated the session and reviewed the checklist scoring system with the faculty members. Faculty members were advised to remind students to verbalize their observations and actions before the session began.

Previous research had demonstrated high interrater reliability between examiners on simulator checklist scores.[12] Because the same faculty members had been involved in the previous work, only one examiner was needed for each session.

Data

Median and range for the number of times a skill had been performed and the levels of confidence associated with it were tabulated. Correlations between the number of times performed and levels of confidence were determined for eight specific items comprising a part of the simulator test. The median level of confidence for items tested during the test scenario and total test scores were correlated. Finally, the correlations between level of confidence and clinical marks and level of confidence and written examination marks were determined. All correlations were performed using the Spearman rank correlation coefficient. A P-value of $< 0{\cdot}05$ was considered significant.

Results

A total of 144 students out of 177 (81%) attended the educational sessions. All attending students completed the questionnaire for a 100% return rate. The median and range for the number of times a skill was performed and level of confidence for those skills are summarized in Table 1.

There was a significant correlation between the number of times a task was performed and the perceived level of confidence for all tasks used in the analysis. (Table 2). There was a non-significant correlation between the number of times a skill had been performed, the level of confidence and simulator test scores (Table 3). The correlations between level of confidence and pre-test scores are illustrated in Fig. 1.

The correlation between the mean of the 25 items related to level of confidence and the final clinical mark was low ($r = 0{\cdot}078$, $P = 0{\cdot}37$), as was the correlation between the level of confidence and the final examination mark ($r = 0{\cdot}013$, $P = 0{\cdot}88$).

Table 1 Median and range for number of times a skill has been performed and level of confidence

		Number of times		Level of confidence*	
	Item	Median	Range	Median	Range
1	Administration of intravenous drugs	10	0–100	4	1–5
2	Anaesthetic gas machine check	1	0–10	2	1–5
3	Flow meter and vaporizer manipulation	2	0–30	2	1–5
4	Preparation of equipment for intubation	4	0–30	3	1–5
5	Rapid sequence induction	1	0–20	2	1–4
6	Cricoid pressure	1	0–20	2	1–5
7	Emergency management of tachycardia	1	0–10	2	1–5
8	Emergency management of hypertension	1	0–25	2	1–5
9	Emergency management of hypotension	1	0–25	2	1–4
10	Recognition of adrenergic response to intubation	2	0–10	2	1–5
11	Management of adrenergic response to intubation	1	0–10	1	1–4
12	Emergency management of hypoxaemia	2	0–15	2	1–4
13	Recognition of end-tidal CO_2 trace abnormalities	2	0–15	2	1–5
14	Endobronchial intubation	0	0–20	1	1–4
15	Endotracheal intubation	6	0–25	3	1–5
16	Mask ventilation	10	1–50	4	2–5
17	Assessment of hypovolaemia	5·5	0–50	4	1–5
18	Emergency management of hypovolaemia	2·5	0–5	4	1–5
19	Packed red blood cell transfusion	2	0–30	2	1–5
20	Management of transfusion reaction	0	0–5	2	1–5
21	Management of obese patients undergoing surgery	1	0–20	1	1–3
22	Emergency management of bronchospasm	1	0–30	2	1–4
23	Emergency management of anaphylaxis	0	0–6	1.5	1–4
24	Emergency management of myocardial ischaemia	2	0–20	2	1–5
25	Use of vasopressors and/or inotropes	1	0–20	2	1–4

* Level of confidence range 1–5, where 1 = novice, 5 = expert.

Table 2 Correlation of the number of times a skill has been performed with level of confidence

Item	r	*P*-value
Rapid sequence induction	0·63	<0·0001
Emergency management of tachycardia	0·57	<0·0001
Emergency management of hypertension	0·59	<0·0001
Emergency management of hypotension	0·70	<0·0001
Emergency management of hypoxaemia	0·70	<0·0001
Endobronchial intubation	0·73	<0·0001
Emergency management of anaphylaxis	0·49	<0·0001
Emergency management of myocardial ischaemia	0·62	<0·0001

Table 3 Correlation between the number of times a skill has been performed, level of confidence and test scores

	Correlation		Correlation	
	Number of times	*P*-value	Level of confidence	*P*-value
Test scenario 1	$r = 0·09$	0·57	$r = 0·67$	0·66
Test scenario 2	$r = 0·20$	0·21	$r = 0·19$	0·19
Test scenario 3	$r = -0·09$	0·57	$r = -0·09$	0·95

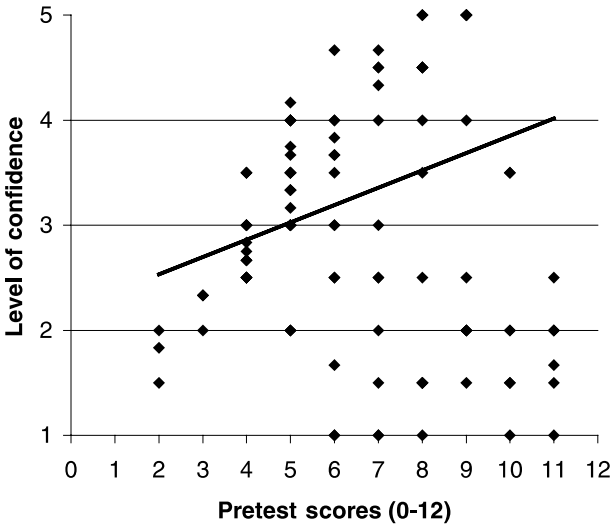

Figure 1 Correlation between Level of confidence and Pretest scores.

Discussion

The results of our study showed a significant correlation between the number of times a skill or procedure was performed and the level of confidence of the individual student. Fincher *et al*. also found a significant association between frequency of performance of bedside procedures such as venipuncture and blood cultures and students' self-assessed levels of competency.[1] Similar findings were elucidated when medical students' confidence and experience in caring for patients within a primary care clerkship were assessed. It was determined that hands-on clinical experience was a significant independent predictor and more important than any other variable for building students' confidence.[9]

The relationship between clinical experience or confidence and measured competence, however, is a complex one. The students in our study exhibited a wide range of clinical experience in different skills and management problems, with medians ranging from 0 to 100. However, there was no correlation between experience and performance assessments. In addition, there was no correlation between students' level of confidence and either clinical or written examination grades.

These findings are consistent with those of other investigators.[3,7,8,10] McManus suggested that the results of his study, which found little correlation between students' clinical experience and their results in final examinations, may reflect the lack of validity of the examination itself.[10] However, even when standardized examinations such as the Objective Structured Clinical Examination (OSCE) are used, little association is seen between clinical experience and OSCE scores.[3] Although first year medical students felt confident in their communication skills, Marteau found a negative correlation between students' judgement of their ability and videotaped assessment of their skills.[7]

The value of the simulator stems from its ability to provide reproducible, standardized, performance-based assessments. The simulator test used in this study was specifically designed to measure competency in discrete tasks and was based on earlier studies of simulator-based assessments.[11,12] It would seem logical that skills learned through patient contact and hands-on management should be evaluated using a performance-based assessment rather than a written examination.

This lack of correlation between confidence, experience and competence requires further exploration. Explanations for these findings may include: (a) the quality of the learning experience; (b) the quality and amount of supervision and feedback received during skill acquisition; (c) how important the students perceive the learning of the skill to be; (d) the enthusiasm of the instructor and student in the educational process, and (e) the validity of the performance assessment itself.[7]

With respect to the quality of learning in medical school, a student who has experienced multiple negative encounters with a patient or instructor during the course of skill acquisition may be overly anxious and perform poorly in the assessment of that task. However, one would expect their level of confidence to be low if this were the case. Many students are sent to perform tasks and bedside procedures since more senior housestaff are busy and unable to attend to the patient. The student then must work through the management of the task without supervision or feedback about their performance. In addition, if a student does not perceive the skill or management of a certain problem to be an important educational goal, competency in that skill may be affected.[7] An enthusiastic, energetic teacher or facilitator may have more impact on a student's ability and eagerness to succeed than a faculty member with less enthusiasm. Characteristics of the individual tutor may play an important role in competency.[13]

In this study, the simulator performance test may have been too difficult for the students to manage. Although the test was designed and deemed appropriate for the relevant students' level of training by members of the department involved in undergraduate education, there is currently no gold standard for performance assessments in anaesthesia to which the simulator test could be compared. Investigators have shown that the validity of simulator performance tests requires some refinement and this fact could contribute to the lack of correlation between confidence and performance assessments as demonstrated by our findings.[12,14]

Specifically in our study, students were being evaluated in a 'foreign' environment. Although they gained some experience of similar drugs and monitors in the operating room, they had little or no experience of managing a clinical situation alone in an operating room setting. This lack of familiarity may have negatively affected performance despite the orientation session. However, despite their lack of familiarity with the setting, some students performed exceptionally well. Similarly, studies in other disciplines have consistently demonstrated a lack of correlation between experience and performance assessments.

Standardized, valid and reliable testing methods are necessary for the assessment of performance competency. Both the OSCE and simulation-based assessments have the potential to meet these criteria. Nonetheless, these assessment methods lack the ability to match levels of confidence and competence. It is therefore important to develop educational strategies by which students can accurately judge their capabilities. In turn, level of confidence would then predict competence.

Contributors

Both authors contributed equally to this paper.

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References

1 Fincher R-M, Lewis LA. Learning, experience, and self-assessment of competence of third-year medical students in performing bedside procedures. *Acad Med* 1994;**69**:291–5.
2 Taylor D. Undergraduate procedural skills training in Victoria: is it adequate? *Med J Austr* 1997;**166**:251–4.
3 Jolly BC, Joes A, Dacre JE, Elzubeir M, Kopelman P, Hitman G. Relationships between students' clinical experiences in introductory clinical courses and their performances on an objective structured clinical examination (OSCE). *Acad Med* 1996;**71**:909–16.
4 Stewart J, O'Halloran C, Barton JR, Singleton SJ, Harrigan P, Spencer J. Clarifying the concepts of confidence and competence to produce appropriate self-evaluation measurement scales. *Med Educ* 2000;**34**:903–9.
5 Gaba D, DeAnda A. A comprehensive anesthesia simulation environment: recreating the operating room for research and training. *Anesthesiology* 1988;**69**:387–93.
6 Fish MP, Flanagan B. Incorporation of a realistic anesthesia simulator into an anesthesia clerkship. In: Henson, L, Lee, A, Basford, A, eds. *Simulators in Anesthesiology Education*. New York: Plenum Press; 1998: 115–9.
7 Marteau TM, Humphrey C, Matoon G, Kidd J, Lloyd M, Horder J. Factors influencing the communication skills of first-year clinical medical students. *Med Educ* 1991;**25**:127–34.
8 Chatenay M, Maguire T, Skakun E, Chang G, Cook D, Warnock GL. Does volume of clinical experience affect performance of clinical clerks on surgery exit examinations? *Am J Surg* 1996;**172**:366–72.
9 Harrell PL, Kearl GW, Reed EL, Grigsby DG, Caudill TS. Medical students' confidence and the characteristics of their clinical experiences in a primary care clerkship. *Acad Med* 1993;**68**:577–9.
10 McManus IC, Richards P, Winder BC, Sproston KA. Clinical experience, performance in final examinations, and learning style in medical students: prospective study. *BMJ* 1998;**316**:345–50.

11 Morgan PJ, Cleave-Hogg D. Performance evaluation using the anaesthesia simulator. *Med Educ* 2000;**34**:42–5.
12 Morgan PJ, Cleave-Hogg D, Guest CB, Herold J. Validity and reliability of undergraduate performance assessments in an anesthesia simulator. *Can J Anesth* 2001;**48**:225–33.
13 Anderson DC, Harris IB, Allen S *et al.* Comparing students' feedback about clinical instruction with their performances. *Acad Med* 1991;**66**:29–34.
14 Devitt J, Kurrek M, Cohen M, Fish K, Fish P, Noel A, Szalai J. Testing internal consistency and construct validity during evaluation of performance in a patient simulator. *Anesth Analg* 1998;**86**:1160–4.

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