

CHAPTER 7

A structured assessment of newly qualified medical graduates.⁹

Abstract

Introduction. While there is extensive published experience with the assessment of procedural skills in undergraduate students, this is limited in newly-qualified medical graduates at the time of entry to the pre-registration (internship) year. The few studies that have been published suggest that these skills are frequently deficient when objectively tested. We therefore chose to assess the competence of a group of South African medical graduates on entry to their pre-registration year.

Methods. A total of 58 graduates of South African medical schools were assessed. Each subject participated in a 7-station objective structured clinical examination (OSCE); 6 of these assessed individual competence in phlebotomy, intramuscular injection, female pelvic examination, bladder catheterisation, tracheal intubation and prescription writing, while competence in cardiopulmonary resuscitation was assessed in a seventh station in randomly allocated teams of 3 candidates. Candidates' opinions of their own competence was sought by questionnaire.

Results. There was a wide variation in competence between subjects and across the range of tasks studied. Mean scores ranged from 85.4% for phlebotomy to 55.3% for prescription writing. The average score across all stations was 67.5%, and no student obtained an overall cut score of 85% or more, which was established using a modified Angoff method. Subjects' assessment of their own performance was unduly optimistic; most believed that they had demonstrated competence despite clear shortcomings in technique. Objective scores for subjects who had been exposed to a structured skills laboratory were not significantly higher than for those who had not, although their self-assessed performance was indeed higher.

Conclusion. Most of the South African medical graduates who participated in this study were unable to satisfactorily perform technical procedures appropriate to the house officer on entry to the pre-registration year. This is in line with the conclusions of the few studies published in other countries. We suggest that the learning outcomes of undergraduate medical programmes should include an explicit statement of the competencies required for practice in the pre-

⁹ Burch VC, Nash RC, Zabow T, Gibbs T, Aubin L, Jacobs B, Hift RJ. A structured assessment of newly qualified graduates. Medical Education 2005; 39: 723-731.

registration year, and that these should be adequately taught and rigorously assessed before graduation.

Introduction

The ability to perform a wide range of diagnostic and therapeutic procedures competently is a core learning outcome of modern undergraduate medical curricula.¹ While the need to acquire these basic patient care skills is widely endorsed, authoritative educational guidelines often provide broad educational objectives alone^{2,3} and do not stipulate the specific practical skills medical students need to master prior to graduation. This has the consequence of producing graduates with widely variable competencies in the basics of actual patient care at commencement of clinical practice,^{4,5,6} a factor which may contribute to the stress of the first year of practice.⁷ A recent review of residency training in the United States reported that programme directors expected to provide significant supplemental instruction during the first three months of training to ensure uniform competence in basic patient care.⁸ Some countries, notably the Netherlands,⁹ and institutions such as Brown University,¹⁰ have developed detailed undergraduate medical education learning outcomes in an attempt to remedy this situation.

The South African Health Professions Council recently published guidelines outlining the educational objectives of undergraduate medical programmes at all South African universities.¹¹ Since these guidelines only provide broad educational outcomes for accreditation purposes, they are unlikely to promote a uniform standard of technical competence in the provision of basic patient care amongst newly-qualified graduates. To date, guidelines detailing the procedural skills competencies expected of South African medical students upon graduation do not exist. To determine the need for such guidelines, we undertook an objective study of the procedural skills proficiency of a cohort of newly qualified South African medical graduates on commencement of their pre-registration year. This is the first such published study in South Africa.

Methods

Subjects

All interns (pre-registration house officers [PRHOs]) assigned to 2 urban training hospitals in Cape Town, South Africa, were invited to participate in the study. These subjects had just completed their medical training at South African universities, having graduated approximately 3 weeks before the study. Subjects consented verbally to their inclusion in the study, and participant confidentiality was maintained throughout.

Assessment process

The study was conducted in late December 2002, a day prior to commencement of the internship year. Selected clinical tasks were assessed using a 7-station objective structured clinical examination (OSCE) format (Appendix H). Six stations assessed the ability of each candidate to perform tasks considered essential to the provision of basic patient care: phlebotomy; administration of an intramuscular injection of penicillin; bladder catheterisation;

female pelvic examination; oral endotracheal intubation, and writing of an out-patient prescription for twice-daily insulin. The final station assessed the ability of randomly allocated groups of 3 interns to initiate basic cardiopulmonary resuscitation (CPR) in a simulated cardiac arrest. The OSCE stations were designed by a group of senior clinicians who regularly supervise medical graduates during their internship and are familiar with the clinical tasks they are frequently required to perform. At each station printed instructions were provided. All activities were performed on commercially available manikins. A copy of the South African Medicines Formulary¹² was made available at the prescription writing station. Each station was of 7 minutes' duration.

Station assessors

Each station was supervised by a clinician trained in the use of numerically scored checklists.

Scoring criteria

Performance at each station was assessed using checklists (Appendix I). Each checklist item was scored numerically (0 = not performed, 1 = performed incorrectly, 2 = performed correctly). For 3 stations, checklists included an assessment of the number of attempts required to successfully site equipment in an anatomically correct position, namely placement of an endotracheal tube in the trachea, phlebotomy needle in a vein and catheter within the bladder. These items were scored using a separate scale (0 = no success after 3 or more attempts, 1 = success on the third attempt, 2 = success on the second attempt, 3 = success on the first attempt). Checklist items were weighted on a scale of 1-3 in accordance with a consensus decision as to their relative contribution to the overall success at performing the task. For each station, the weighted scores were then totalled and expressed as a percentage of the maximum possible score.

In addition to the aggregate measure of performance assessed by this method, we distinguished those checklist items essential for achieving basic technical success (such as the endotracheal tube correctly positioned within the trachea), which we termed **core** aspects of competence, and those items that contributed to the quality of performance of a specific clinical task (actions ensuring good quality of care, e.g. attention to hygiene, maintenance of sterile technique and patient comfort), which we termed **quality** aspects of competence. In a separate analysis we summed items flagged as core and quality separately and expressed each as a percentage of the maximum possible score for that category.

Definition of competence

For the purpose of the study, competence was defined as a minimum score of 85% for each of the stations in the OSCE. The cut score for each station was established using a modified Angoff method.^{13,14} Five senior clinicians, experienced in supervising junior medical staff, used the station checklists to calculate the minimum acceptable score expected of a new

graduate performing each of the tasks. The minimum acceptable score for individual stations ranged from 83% (injection station) to 89% (pelvic examination station). This produced an average score of 85% across the 6 individual stations. For the sake of simplicity, the minimum score for each individual station was also set at 85%.

Self-Assessment

At the conclusion of the assessment event all interns completed a questionnaire (Appendix J) in which they were asked to rate their performance for each of the 7 tasks using a 5-point Likert scale (1 = Did not know what to do or how to do the task, 2 = Knew what to do but could not do the task, 3 = Could do some of the task, 4 = Managed to do most of the task correctly, 5 = Managed to do all of the task correctly). This we interpreted as a measure of self-assessment of their own competence.

Data analysis

Data were analysed using the Statistica 6 software package (StatSoft Inc, Tulsa, Oklahoma, USA). Differences in performance between stations and between universities were assessed by 1-way ANOVA, and post-hoc comparisons were made with Tukey's honest significant difference. Student's t test was used to assess the difference between the core and quality scores recorded at each station, and between the ancillary and ABC scores at the resuscitation station, and differences between universities grouped into those which had offered skills laboratory experience and those which had not.

Results

Participants

All 58 interns assigned to the 2 training hospitals consented to participate and were included in the study. The study cohort included graduates from all 8 South African medical schools: the University of Stellenbosch (13); the University of Witwatersrand (12); the University of Pretoria (10); the University of Cape Town (8); the University of Natal (7); the Medical University of South Africa (4); the University of Transkei (3), and the University of the Free State (1). At the time of this study, the Universities of Pretoria, Stellenbosch and the Free State had already established skills laboratory programmes to which their students had been exposed, whereas the others were in the process of developing such programmes. The subjects were, therefore, further grouped into a high-exposure group (24 subjects) and a low-exposure group (34 subjects), depending on which medical school they had attended.

Performance by station

Results are summarised in Table 1. The mean score averaged across the 6 stations was 67.5%; no student achieved an average of 85%, defined as the minimum score for competence. Indeed, few students achieved 85% in any station. Performance varied significantly across the

various tasks ($p < 0.0001$). Mean scores were highest for phlebotomy and lowest for prescription writing.

Table 1. (A) Objective scores recorded for each task and (B) self-assessment scores for each task. The difference in means is significant ($p < 0.0001$). SD = standard deviation; CI = confidence interval for the mean. Self-assessed scores ranged from 1 (Did not know how to do task) to 5 (Could do all of the task correctly). Intermediate scores are defined in the text.

Task	(A) Objective score		(B) Self-assessed score		
	Mean (SD)		Percentage		Mean (SD)
	score	95% CI	achieving cut-off score	score	95% CI
Phlebotomy	85.4 (9.8)	82.8-88	56.9	4.5 (0.7)	4.3-4.7
Injection	69.6 (15.5)	65.5-73.7	19.0	4.1 (0.8)	3.9-4.4
Catheterisation	55.4 (25.8)	48.7-62.2	6.9	3.8 (0.7)	3.6-4.0
Pelvic	75.2 (10.9)	72.3-78.1	19.0	3.9 (0.7)	3.8-4.1
Prescription	55.3 (28.6)	47.7-62.9	17.5	3.4 (1.2)	3.1-3.7
Intubation	64.7 (18.8)	59.7-69.7	17.5	3.5 (1.2)	3.2-3.9
Average	67.5 (9.4)	65.1-70	0.0	3.9 (0.9)	3.8-4.0

Within each task, a wide variability of proficiency between subjects was also seen. The number of attempts required to successfully site a peripheral venous catheter, endotracheal tube or urinary catheter (Table 2) highlighted this finding.

Table 2. Breakdown of performance by the number of attempts required to successfully site a peripheral intravenous catheter, endotracheal tube or urinary catheter ($n=58$). This was assessed independently of the skill or dexterity with which the procedure was carried out

	Success at	Success at second	Success at third	Failed
	first attempt	attempt	attempt	
Phlebotomy	46 (79.3%)	8 (13.8%)	2 (3.4%)	2 (3.4%)
Endotracheal intubation	20 (34.5%)	14 (24.1%)	12 (20.7%)	12 (20.7%)
Urethral catheterisation	5 (8.6%)	14 (24.1%)	24 (41.4%)	15 (25.9%)

Comparing core and quality aspects of competence

The mean score for quality aspects (54.2%, SD 12.6, CI 50.9-57.6) were significantly lower than for core aspects (mean 72.9%, SD 10.6, CI 70.1-75.7) ($p < 0.0001$), and was significantly lower than that for core components for every station other than catheterisation. This is shown in Figure 1.

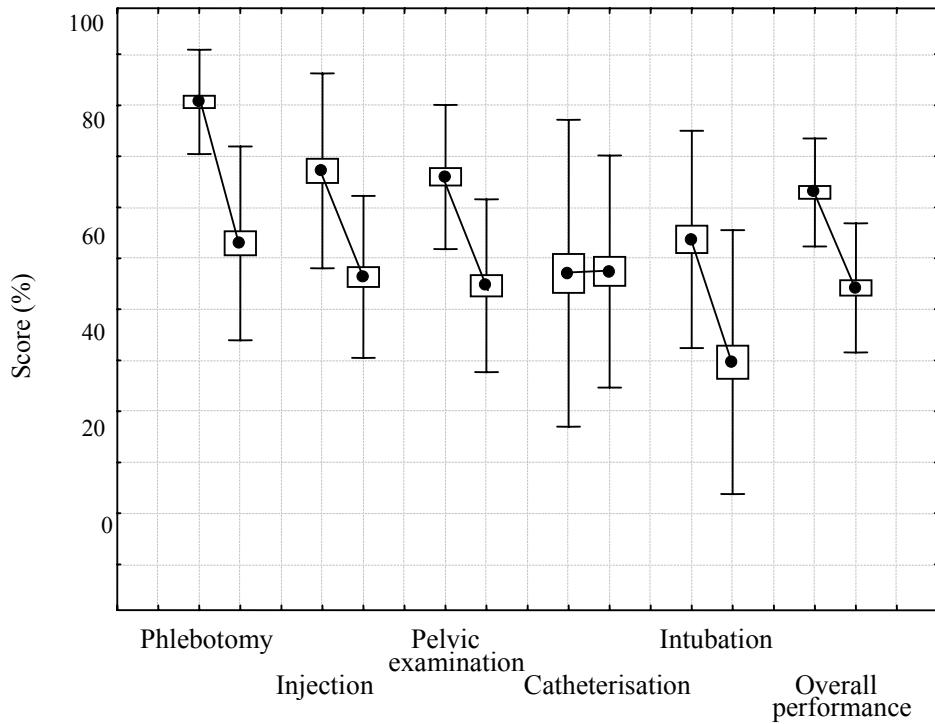


Figure 1. Comparison of scores for core and quality aspects for each of the individual stations.

The core score is shown as the first and the quality aspect as the second component of each pair. The central dot represents the mean, the box the extent of the standard error of the mean, and the whiskers the standard deviation. It is seen that quality scores are significantly lower than core scores for phlebotomy ($p < 0.0001$), pelvic examination ($p < 0.0001$), injection ($p < 0.0001$), intubation ($p < 0.0001$) and averaged across all stations ($p < 0.0001$).

Cardiopulmonary resuscitation

The mean score for the resuscitation station was 43.3% (SD 12.2%, 95% CI 37.2-49.4%, range 25.0-65.0%). The CPR task was further analysed in two components: the ABC, or technical tasks of establishing an *airway* and providing *breathing* and *circulatory* support, and the ancillary tasks of checking for spontaneous breathing and the presence of a peripheral pulse, summoning assistance, etc. For all groups the ABC components were performed less well than the ancillary tasks ($p=0.002$) (Figure 2).

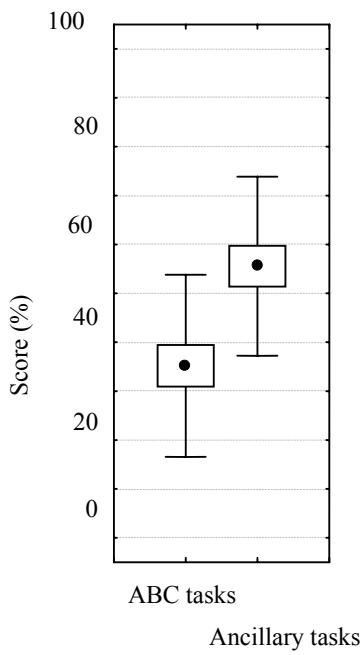


Figure 2. Comparison of scores for the ancillary aspects and the ABC procedure (airway, breathing and circulation) aspects for the CPR task. The central dot represents the mean, the box the extent of the standard error of the mean, and the whiskers the standard deviation. The ABC components were performed significantly less well than the ancillary aspects ($p<0.0001$).

Comparing universities

No significant variation in performance was observed across the 5 medical schools represented by at least 7 subjects ($p=0.11$). There was also no significant difference in score between the high-exposure group (mean score 66.0, SD 23.8, 95% CI 63.6-68.4) and the low-exposure group (mean score 63.4, SD 23.4, 95% CI 61.4-65.3, $p = 0.09$).

Self-assessment of competence

In all, 54 of 58 subjects completed the self-assessment questionnaire, indicating their own impressions of how they had handled each situation. Thus, over the OSCE, there were 332 self-assessments. The mean self-assessment scores are shown in Table 1. In 28.3%, subjects reported that they believed that they had performed all of the tasks correctly, in 43.1%, that they were able to perform most of the task correctly, in 20.8% that they could do some of the task, in 5.7% that they knew what to do but could not do the task, and in 2.1% that they did not know how to do the task at all. The order in which the tasks were ranked in terms of self-assessment of competence was approximately the same as the order returned by a ranking of mean objective scores and was, from highest to lowest: phlebotomy, injection, pelvic examination, catheterisation, intubation, and prescription writing. The difference in self-assessment scores between tasks was highly significant ($p < 0.000001$).

The self-assessment scores of the high-exposure group (mean 4.1, SD 0.9, 95% CI 3.9-4.2) are significantly higher than those of the low-exposure group (mean 3.8, SD 1.0, 95% CI 3.6-3.9) ($p = 0.002$). There were also significant differences in the mean scores self-reported by subjects from the different universities represented by at least 7 subjects ($p = 0.004$). The self-reported scores of the University of Pretoria subjects (mean 4.2, SD 0.8, 95% CI 4.0-4.4) are significantly higher than those of the Universities of Cape Town (mean 3.6, SD 1.1, 95% CI 3.3-3.9, $p = 0.004$) and Witwatersrand (mean 3.8, SD 1.0, 95% CI 3.5-4.0, $p = 0.04$).

Discussion

To our knowledge this is the first published study in which the procedural skills of South African graduates have been objectively assessed at the point of entry into their pre-registration year. Using an objectively determined cut score of 85% as an indicator of proficiency, we found that none of the 58 participating interns obtained an average score equivalent to the required minimum. Although this cut-off score may appear high, we determined this using a recognised, objective method that drew on the experience and expectations of a panel of clinicians accustomed to working with junior staff. We stress the point that this was not a high stakes examination in which we set out to assess the soundness of interns' clinical judgement or their potential, but merely an assessment of whether, at the time of commencement of internship, their undergraduate training had adequately equipped them with practical skills such as phlebotomy and bladder catheterisation, which are indispensable to the house officer. Indeed, we believe that South African graduates have the advantage of a rigorous training in the key clinical skills of history taking, examination, diagnostic reasoning, the management of illness and the theory of medicine, all of which are rigorously assessed in the final professional examination, but we conclude that, at the commencement of clinical practice, they are insufficiently skilled to perform important clinical procedures without the benefit of additional training.

We suggest, therefore, that a significant gap exists between the actual and expected standards of procedural skills proficiency of South African interns at the time of commencing their pre-registration year. In addition, a marked variation in proficiency between tasks was observed; the number of subjects demonstrating competence varied from 57% for phlebotomy to 7% for bladder catheterisation. This provides further evidence that our graduates commence clinical practice with widely varying levels of proficiency for clinical tasks commonly required for the provision of basic patient care. These findings are, however, not unique to the South African context; similar findings have been demonstrated in other countries.^{5,8,15,16,17}

The limited ability of interns to write a correct prescription for commonly used medication, despite the availability of a reference text, was an unexpected finding. Despite it

being the least technically demanding task, it was very poorly performed. This further highlights the broad range of competencies new graduates are expected to demonstrate, and the discrepancy between the assumptions stakeholders make about the comprehensive nature of undergraduate clerkship-based learning and actual performance in the workplace.

Performance in the CPR station indicated that interns were not sufficiently skilled to coordinate and successfully initiate the components of basic life support. The mean score achieved for the A, B and C components of CPR was only 34%. This finding was even more surprising in light of the debriefing discussions, in which 69% of interns indicated that they had participated in similar exercises during the clinical years of their undergraduate training. Only 2% of participants had, however, received advanced cardiac life support training prior to graduation. Yet, interns are usually the first line of response to resuscitation emergencies in South African public hospitals.

There are several factors that need to be considered in assessing the implications of our study. The most important of these is validity. For ethical reasons, it is clearly not possible to perform such an assessment on live subjects, and we were therefore compelled to use simulators, which reflected the real-life experience of performing the procedure to a greater or lesser degree. We attempted to increase the validity of the experience by phrasing the instructions for each station in the form of a clinical vignette. The time spent at each station was short (7 minutes). We had, however, pre-tested the stations and found this time adequate to complete the required procedure comfortably. Overall, 47 of our 58 subjects reported that they did not experience anxiety as a result of the exercise, suggesting that time-stress was not a significant factor. There is a possibility that students who had not worked with simulators previously were placed at a disadvantage in terms of their unfamiliarity with the simulators. Indeed, we were able to demonstrate higher levels of self-confidence in the high-exposure group than in the low-exposure group. Yet objective scores were not significantly higher in those with previous exposure than in those without. Furthermore, technical success was only 1 aspect of our assessment, and key supporting factors such as correct recognition and assembly of equipment, hygiene and sterility were additionally assessed, and are aspects of these skills which are not simulator-dependent. Certainly, the low scores achieved for “quality” as opposed to “core” success would bear this out.

The increased self-confidence shown by subjects who had been exposed to skills laboratory training during their undergraduate years might reflect either an increased familiarity with the simulated environment, or genuine greater facility with the procedures (the desired outcome). Indeed, self-assessment scores were the highest in subjects graduating from the University of Pretoria, the first school in South Africa to establish a skills laboratory and which runs an active and well resourced programme of skills training. On this assessment, we were unable to distinguish between these. We are, however, concerned that those subjects who had

been exposed to some undergraduate training in technical skills failed to perform significantly better than their colleagues in our assessment. This suggests a need for careful evaluation of the validity of the teaching experience and of the retention of these skills beyond the final examination.

One concern in interpreting our results is that the reliability of our 6-station OSCE is low (Cronbach's $\alpha = 0.34$). This affects our results by widening the confidence intervals beyond what would be obtained for a more reliable score. This happens because the lower reliability score contributes a larger amount of error variance to the observed score variance used in computing the confidence interval (observed score variance is considered to be the sum of true score variance and error variance). However, even with these wide confidence intervals, they still failed to overlap with the 85% criterion, which reinforces our concern that performance was indeed inadequate.

While the pre-registration year may itself provide the necessary opportunity to acquire the skills we have shown to be in deficit, the clinical learning environment is typically relatively unstructured and training in basic skills is often opportunistic, widely variable and critically dependent upon the quality of supervision and expertise of senior clinicians.^{18,19} Indeed, a recent survey conducted in a sample of South African district hospitals reported a significant skills gap among doctors with an average of 16 years post-qualification experience.²⁰ These data suggest that limited proficiency in patient care skills, detectable at graduation, may persist in the longer term.

The Health Professions Council of South Africa has recently introduced logbooks in which interns are obliged to record all procedures performed during their pre-registration year of service. While this may serve to audit skills acquisition during internship, it offers no check on quality or even proficiency, and is therefore unlikely to improve the procedural skills of interns to the same extent as exposure to formal skills training programmes.²¹

In 71.4% of cases, our subjects scored their own performance at 4 (representing the response "Managed to do most of the task correctly") or 5 ("Managed to do all of the task correctly"). The order in which the tasks were ranked in terms of self-assessment correlated well with the objective scores, suggesting that the subjects were able to rank their relative competence at the different tasks accurately. We were unable to compare individual self-assessment with actual score, as all responses were anonymised. Although these terms were not rigorously defined, our interpretation is that many of the interns considered their performance to have been acceptable, a finding in stark contrast with our external, objective assessment. This suggests a mismatch between objectively measured clinical performance and interns' perception of their own performance. Such a mismatch between self-assessment and objective assessment of clinical competence is well described in the literature.^{4,6,22,23} Part of the mismatch may arise from the subjects concerning themselves mainly with the technical aspects of tasks, and paying

less attention to the quality aspects of clinical tasks. It is possible that this reflects the emphasis of undergraduate skills training programmes. A further study would be required to determine the probability of this postulate.

Our sample represented approximately 2.5% of the South African medical graduates of 2002. Since interns are allocated by the national Department of Health to hospitals accredited for intern training by a process which does not include any reference to their undergraduate academic performance, we have no reason to believe that our sample was not representative of South African medical graduates in general. Our results suggest that all South African medical schools need to put measures in place to ensure that the training they offer results in proficiency in the workplace. Most undergraduate assessment processes focus on clinical examination and diagnostic reasoning skills, and formal assessment of procedural skills, such as those assessed in this paper, do not receive much attention.^{24,25} The adage “assessment drives learning” is as true of procedural skills as it is of any other domain of learning.

Our study demonstrates the need for a nationally defined list of core procedural skills in which all medical graduates should be proficient prior to commencing their internship, a recommendation already made elsewhere.^{16,26-28} A shift from opportunistically acquired procedural skills during internship to a nationally standardised undergraduate skills training programme is of paramount importance; medical schools should provide undergraduate training in patient-related procedural skills and should assess these in their qualifying examinations. The recent development of dedicated Skills Laboratories in South African medical schools makes this goal more easily attainable than previously.

At our own institution, our findings in this study have led us to introduce a mandatory skills training programme in core clinical procedures at the beginning of the pre-registration year. We have also introduced our undergraduate students to structured skills training, which will be repeatedly revisited between their third and final years of study. The role of nurse practitioners in the training of medical students is gaining momentum in the United Kingdom²⁹ and our own institution has identified major advantages in the use of nurse practitioners to teach basic clinical skills to medical students. Better use of this important source of educators in undergraduate procedural skills training programmes needs to be explored.

Acknowledgements

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