Irish Journal of Medical Science (1971 -) (2019) 188:1033–1045
https://doi.org/10.1007/s11845-018-1919-6

ORIGINAL ARTICLE

Improving safety for medical students and patients during medical electives—a novel simulation-based course

Robert M. Maweni[1,2] · Robert W. Foley[1,3] · Micol Lupi[2] · Amy Woods[2] · Shahram Shirazi[1,2] · Vaughan Holm[2] · Stella Vig[2]

Received: 12 May 2018 / Accepted: 17 October 2018 / Published online: 29 October 2018

Abstract

Introduction The medical elective is a common component of undergraduate medical education in the UK and Ireland. These are often undertaken in varied hospitals and countries across the world, most of which are not related to their parent institutions, in order to explore specialties and regions of interest. However experiences are varied, with goals not always established beforehand, or indeed reached, when present.

Methods Using a novel 20-item, self-administered questionnaire distributed via social media to 436 medical students and doctors in the UK and Republic of Ireland, we sought to delineate common elective experiences and establish what procedures and clinical scenarios medical students commonly undertake and manage during their medical electives, in order to ascertain their confidence level with each of these tasks at the time of their medical electives. We also looked to determine if there are any adverse effects or events related to these situations. Following this, we developed a simulation-based course to address knowledge and skill gaps identified in the above fields. This course was delivered to two groups of medical students from St George's University London and King's College London medical schools by the same faculty over two separate afternoons.

Results We found that a significant proportion of medical students feel pressured to perform skills, which are beyond their competence level during their elective placements, putting both patient and student safety at risk. Our simulation course was successful in significantly improving key technical and non-technical skills, which would be useful for students during their medical electives.

Keywords Learning activities · Medical education · Medical electives · Patient safety

Introduction

The medical elective is a popular but under-researched and under-assessed area of undergraduate medical education. In the UK alone, 8000 medical students undertake medical electives annually. These electives may be domestic or international, clinical, or research-based. However, despite their popularity, there are no consensus guidelines on medical electives, with guidelines and assessments methods varying from institution to institution [1–3]. Such a state has led to a debate regarding whether medical electives are valuable learning experiences for medical students or simply a form of medical tourism, not dissimilar to voluntourism [4]. In order to combat this and to ensure medical students benefit from the elective experience, many medical schools have developed partnerships with other institutions in both developed and developing countries, whereby students undertake set elective modules at the host institutions with set objectives and outcomes [1, 4, 5]. However, this is not universal, with significant numbers of medical students having to organise their electives without institutional help and using websites such as The Electives Network [6]. Moreover, the situation regarding indemnity is ambiguous and is often left to the students to organise, with many host organisations not requiring evidence of indemnity and many students being advised to contact medical protection unions for advice and, potentially, indemnity [7–9]. Thus, given the vagueness of elective learning objectives and the potential for medical students to put both themselves and patients at risk, we sought to establish what clinical scenarios, procedural skills, and non-technical skills medical students

✉ Robert M. Maweni
r.maweni1@nuigalway.ie

[1] National University of Ireland, University Road, Galway, Ireland

[2] Croydon University Hospital, London, UK

[3] Addenbrookes Hospital, Cambridge, UK

commonly face during their electives. We enquired on whether they felt trained and competent to deal with these tasks and scenarios at the time of their elective and whether there were any adverse effects or events associated with any potential lack of competency and/or training. Once the knowledge and skills gaps were established in the fields above, we developed a simulation-based "medical elective suitcase" course, which was tailored to address these issues and better prepare medical students for their upcoming elective experiences.

Methods

Questionnaire design and distribution

A novel, fit for purpose, 20-item self-administered questionnaire was developed for the purposes of this study. It was developed in consultation with author SV (Consultant Vascular Surgeon and Foundation Programme Director), author VH (clinical skills and simulation lead), two clinical teaching fellows, and Foundation Year One doctors, at a District General Hospital, which hosts medical students from St George's University London and King's College London medical schools. It consisted of questions regarding elective experience, quantifying the clinical, procedural, and non-technical skills medical students encounter during medical electives. As well as establishing the above and baseline details including country of study, country of elective, duration, specialty, and setting of electives (i.e. rural vs urban), and it also explicitly asked whether or not the respondents had undertaken tasks, which they were not trained to manage and if any harm had come to patients being cared for in these situations. The ethical dimensions of this non-mandatory survey were explored, and no concerns were identified, with completion of this questionnaire was taken as implied consent to participate in this anonymous study. It was distributed to 436 students/doctors throughout the Republic of Ireland and UK via social media in the form of a SurveyMonkey link. It was not piloted.

Intervention—medical elective suitcase Course

Similar to the questionnaire, the course content was developed in consultation with authors SV, VH (clinical skills and simulation lead), two clinical teaching fellows, and Foundation Year One doctors, at the aforementioned District General Hospital. The course objectives decided upon were based on addressing the concerns of the survey results and can be found in Appendix Table 6. To meet these, the course combined workshops, small group practical skill sessions, and immersive simulation scenarios. Appendix Table 7 summarises each session. These were delivered to two separate groups of pre-elective medical students by the same faculty, on two separate afternoons—the first, a group of eight students in April 2016, and the second, a group of ten students in June 2016.

A pre-course survey was utilised to establish course participants' prior experience with simulation-based teaching along with the clinical skills and scenarios to be addressed on the course. The pre-course survey also sought to establish the respondents' confidence level with the above skills and scenarios, with respondents using a Likert scale to measure their perceived level of confidence with each skill and scenario. The course participants then filled in the same questionnaire after the course, as a post-course questionnaire, in order to establish any change in their level of confidence.

Data analysis—questionnaire

The results of the questionnaire were transferred to a spreadsheet (Microsoft, 2010, Washington, USA) for descriptive statistical analysis. Two-by-two contingency tables were analysed, and Fisher's exact test was utilised to examine for statistically significant associations between respondent derived comfort levels and situations/procedures undertaken. A two-sided P value of < 0.05 was considered to be statistically significant.

Data analysis—medical elective suitcase

MINITAB 17 (Minitab Statistical Software, 2017) was used to conduct paired T tests on results of pre- and post-course data pertaining to course objectives set at the beginning of the course. A two-tailed P value of < 0.05 was considered to be statistically significant.

Results

Survey results

Respondent demographics

Table 1 contains a summary of cohort characteristics. One hundred ten individuals responded to the survey. Thirty-nine percent were house officers (FY1/interns), 19% were doctors more senior than house officer level, and the majority of respondents, 42%, were medical students. This represents a response rate of 25.2%. The majority of respondents (56%) attended medical school in the Republic of Ireland, followed by the UK (31%). Ninety-six percent of respondents undertook predominantly clinical electives, with 3% undertaking predominantly research electives. Sixty percent of respondents

Table 1 Survey respondent characteristics

	All (%)
Survey respondents	110
Current level of training	
Medical student	46 (42)
Foundation year 1/intern	43 (39)
Foundation year 2 or greater	21 (21)
Country	
UK	46 (42)
Ireland	64 (58)
Medical school year of elective	
Year 5	66 (60)
Year 4	39 (35)
Year 3	4 (4)
Year 2	1 (1)
Type of elective	
Clinical	106 (96)
Research	3 (3)
Mixed	1 (1)
Elective setting	
Urban	83 (81)
Rural	20 (19)

undertook their electives in the final year of their studies, followed by 35% who undertook them in their penultimate year of medical school.

The majority of electives were undertaken in the ROI and North America (Fig. 1), lasted 4 (34%) or 6 weeks (22%), and were in an urban (81%) rather than rural setting. Medicine was the most popular elective specialty (35%) with psychiatry being the least popular.

Elective experiences

All respondents took part in either clinical or non-clinical activity, with 54% of respondents carrying out one or more clinical activity that they felt was out of their competence level.

A fifth of respondents reported that they were placed in situations they felt they were not trained to manage during their elective, with adverse effects/events occurring in 15% of these cases.

Overall, 26% of respondents agreed that a period of training prior to their elective would have better equipped them for the experience, when considering current students alone, this rose to 40%.

Clinical procedures

Wound suturing (22%), venepuncture (36%), and venous cannula insertion (32%) were the most commonly performed with 27, 17, and 19% of respondents, respectively, reporting that they were uncomfortable performing these prior to commencing their electives. There was no statistically significant association between the performance of these procedures and whether students self-reported comfort with these tasks, with P values of 0.54, 0.36, and 0.77, respectively. The setting up of IV infusions was performed by 16% of respondents; however, 20% of respondents were uncomfortable performing this activity prior to their elective.

Fracture reduction (30%), dislocation reduction (29%), and plaster casting (28%) were the leading practical procedures that respondents were uncomfortable performing prior to their electives. These were performed by 10, 8, and 14% of respondents, respectively. The likelihood of performing fracture reduction was statistically significantly associated with comfort level ($p = 0.0129$); however, this was not the case for dislocation reduction ($P = 0.39$) and plaster casting ($P = 0.47$).

Clinical scenarios

Management of sepsis (26%), oxygen management (26%), and airway management with basic adjuncts (19%) were the most commonly encountered clinical scenarios. Twenty percent of all respondents were uncomfortable with the management of sepsis at this stage in their training, with a further 17 and 18% admitting the same about oxygen management and airway management with basic adjuncts, respectively. The relationship between self-reported comfort and likelihood of performing these tasks were not statistically significant, with P values of 0.06, 0.73, and 0.70, respectively.

Neonatal CPR (34%), operation of neonatal resuscitaire (33%), and management of post-partum haemorrhage (31%) were the leading clinical scenarios respondents were uncomfortable dealing with prior to commencing their electives. This was closely followed by paediatric CPR (30%) and the management of acute haemorrhage (25%). The management of pre-eclampsia/eclampsia (24%), of a broken nose (24%), and of shock /hypovolaemia (18%) also accounted for a large proportion of these responses.

Other skills

Clinical communication skills were commonly used, with 19% of respondents "breaking bad news" at some point during their elective. A further 25 and 11% of respondents collected and statistically analysed data, respectively. In regard to these, 19% of respondents were uncomfortable with breaking bad news, and 11 and 13% reported the same with the collection and statistical analysis of data at this stage in their training.

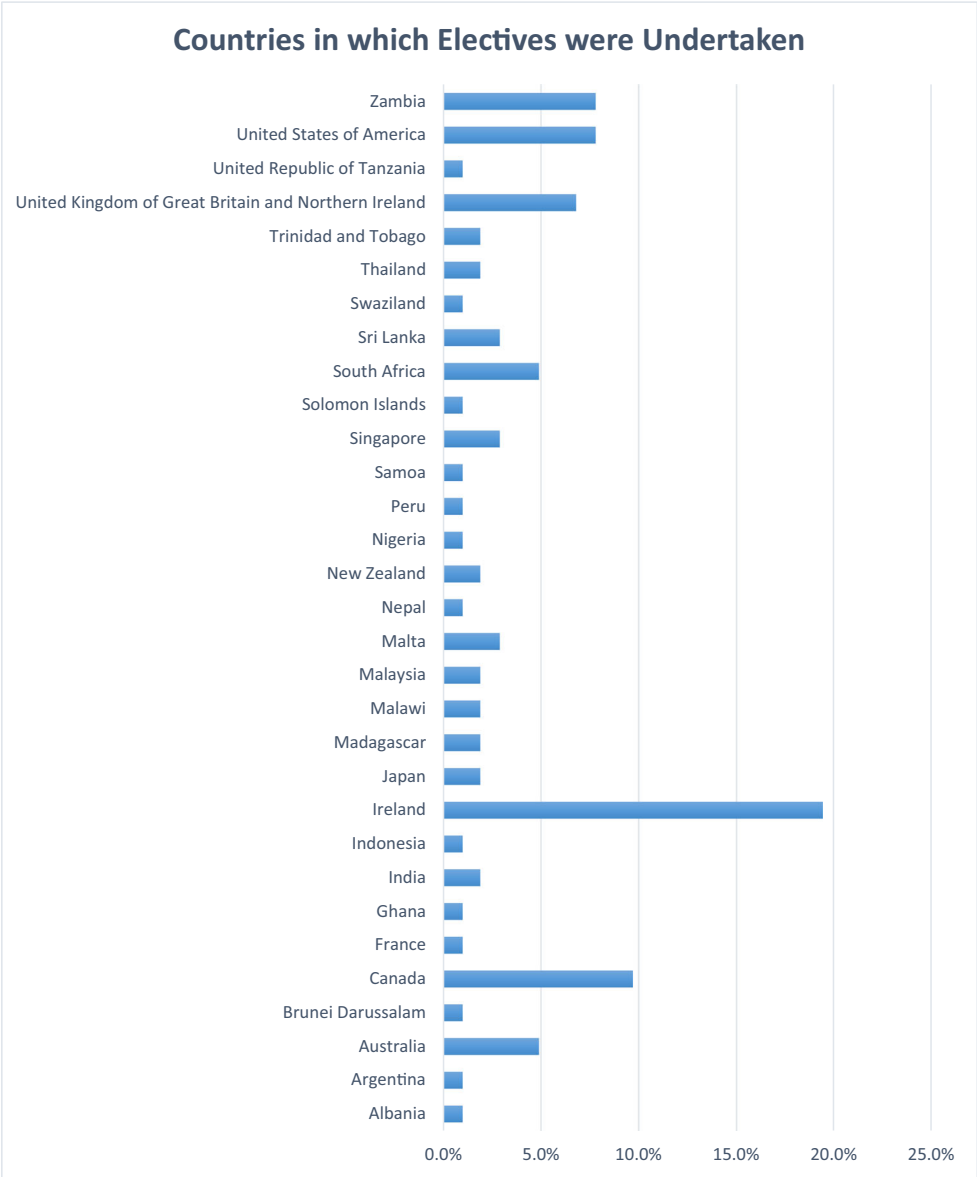

Fig. 1 Countries in which electives were undertaken

Course results

Course participants

Table 2 summarises the characteristics of course participants with Table 3 summarising their prior experience. Eight medical students attended the April course whilst ten students attended the June course. All candidates were fourth/penultimate year students, with 13 attending St Georges University, London and five attending King's College University, London. Ten of the course participants were male and eight were female. Most participants had completed rotations in Medicine, Surgery, Obstetrics and Gynaecology, Psychiatry, Paediatrics, and General Practice; however, only

Table 2 Summary of course attendees

	All (%)
Total attendees	18
Course 1	8 (44)
Course 2	10 (56)
Level of training	
4/5th year student	18 (100)
Medical school	
SGUL	13 (72)
KCL	5 (28)
Gender	
Male	10 (56)
Female	8 (44)

Table 3 Summary of participant prior experience

Prior experience	All (%)
Rotations completed	
Medicine	17 (94)
Surgery	17 (94)
O&G	16 (89)
Psychiatry	17 (94)
Paediatrics	16 (89)
Anaesthetics	7 (39)
General practice	14 (78)
Simulation sessions attended	
None	3 (16)
1–2	12 (67)
3–5	2 (11
6–10	1 (6)
> 10	0 (0)
Acutely unwell patients attended to	
None	7 (39)
1-2	6 (33)
3–5	5 (28)
6–10	0 (0)
> 10	0 (0)

39% had completed anaesthetics rotations. The majority of participants had previously attended simulation sessions, with only three not having attended any previous simulation sessions. Eleven participants had previously attended to acutely unwell patients, with the remaining seven having no such previous experience.

Course outcome

Course outcomes were based on self-reported confidence, in one's ability to perform clinical and non-technical skills, in the context of a medical elective, i.e. specifically applied to a team of strangers, in a different country and healthcare system. Non-technical skill questions were based on the Anaesthetics Non-Technical Skills (ANTS) framework as they were considered the most universally applicable to foundation doctors. Appendixes Tables 8 and 9 describe the exact questions used in the pre- and post-course questionnaires.

Paired *T* tests were conducted to compare pre-course and post-course survey responses to questions regarding participants' confidence with predefined non-technical and practical skills each section of the course was developed to improve.

Non-technical skills

With regard to non-technical skills (Table 4), there were statistically significant improvements in self-reported confidence in the ability to exhibit all elements of the ANTS non-technical skills.

Table 4 Summary of ANTS improvement

Field	Outcome	95% CI for mean difference	*P* value
Task management			
	Planning and preparing	1.502, 3.498	$P < 0.000$
	Prioritising	1.517, 3.705	$P < 0.000$
	Providing and maintaining standards	0.399, 2.268	$P = 0.008$
	Identifying and utilising resources	1.125, 2.542	$P < 0.000$
Team working			
	Co-ordinating activities with team	0.181, 2.597	$P = 0.027$
	Exchanging information	0.007, 2.327	$P = 0.049$
	Using authority and assertiveness	1.047, 3.175	$P = 0.001$
	Assessing capabilities	0.732, + 2.2680	$P = 0.001$
	Supporting others	0.050, 1.950	$P = 0.040$
Situational awareness			
	Gathering information	0.210, 2.012	$P = 0.019$
	Recognising and understanding	0.437, 2.341	$P = 0.007$
	Anticipating	0.587, 2.524	$P = 0.003$
Decision-making			
	Identifying options	1.004, 2.551	$P < 0.000$
	Balancing risks and selecting options	0.399, 2.268	$P = 0.008$
	Re-evaluating	0.637, 2.474	$P = 0.002$

Clinical scenarios

Improvements in clinical skill are summarised in Table 5. With regard to managing acutely unwell patients, there were significant improvements in self-reported confidence with the ability to initiate the management of acutely unwell patients ($P = 0.02$), lead a team in the management of acutely unwell patients ($P < 0.01$), and communicate effectively and efficiently in teams managing acutely unwell patients ($P = 0.01$). However, this was not the case with recognising acutely unwell patients ($P = 0.07$), assessing acutely unwell patients ($P = 0.20$), and calling for help when appropriate ($P = 0.36$).

With regard to clinical medicine, there were improvements in identifying sepsis ($P < 0.001$), knowing the components of the sepsis 6 ($P = 0.01$), and instituting the sepsis 6 ($P < 0.01$). Improvements were further noted with the management of epistaxis ($P < 0.01$) and in managing acute haemorrhage ($P = 0.03$).

Participants reported highly significant improvements in self-reported confidence with resuscitating a child ($P < 0.01$), resuscitating a neonate ($P < 0.01$), getting venous access, and

Table 5 Summary of technical skill improvement

Field	Outcome	95% CI for mean difference	*P* value
Acutely unwell patients			
	Recognising acutely unwell patients	− 0.041, 1.152	$P = 0.066$
	Assessing acutely unwell patients	− 0.286, 1.286	$P = 0.197$
	Initiating management of acutely unwell patients	0.310, 2.579	$P = 0.016$
	Leading a team in management of acutely unwell patients	0.820, 2.736	$P = 0.001$
	Communicating effectively and efficiently	0.310, 2.024	$P = 0.011$
	Calling for help when appropriate	0.410, 1.077	$P = 0.357$
Practical skills			
	Inserting a male urinary catheter	0.109, 1.668	$P = 0.028$
	Inserting a female urinary catheter	0.057, 2.279	$P = 0.061$
	Venous blood sampling	− 0.682, 0.682	$P = 1.000$
	Setting up an IV infusion	0.510, 2.824	$P = 0.007$
	Inserting a venous cannula	0.004, 1.773	$P = 0.049$
Surgical skills			
	Hand-tying knots	0.833, 3.056	$P = 0.002$
	Instrument tying knots	0.644, 2.578	$P = 0.003$
	Simple interrupted suturing	0.687, 2.647	$P = 0.002$
	Continuous suturing	− 0.069, 2.180	$P = 0.064$
Clinical medicine			
	Identifying sepsis	0.849, 2.485	$P < 0.000$
	Components of sepsis 6	0.394, 2.050	$P = 0.006$
	Instituting sepsis 6	0.791, 2.432	$P = 0.001$
Clinical surgery			
	Management of epistaxis	0.791, 2.432	$P = 0.001$
	Managing acute haemorrhage	0.114, 1.997	$P = 0.030$
Clinical paediatrics			
	Fluid resuscitation of a child	1.692, 3.864	$P < 0.000$
	Access and blood taking in a child	1.968, 4.254	$P < 0.000$
	Resuscitation of a child	2.643, 4.690	$P < 0.000$
	Operation of a neonatal resuscitaire	2.823, 4.622	$P < 0.000$
	Neonatal resuscitation	2.202, 4.354	$P < 0.000$
Clinical obstetrics and gynaecology			
	Recognition of pre-eclampsia	1.695, 3.305	$P < 0.000$
	Management of pre-eclampsia	1.882, 3.673	$P < 0.000$
	Recognition of post-partum haemorrhage	1.040, 3.071	$P = 0.001$
	Management of post-partum haemorrhage	1.110, 3.335	$P = 0.001$

taking blood from a child ($P < 0.01$), and operating a neonatal resuscitaire ($P < 0.01$).

Self-reported confidence in the ability to recognise and manage pre-eclampsia as well as post-partum haemorrhage both improved significantly ($P < 0.01$; $P < 0.01$), respectively).

Clinical procedures

Participants reported improvements in confidence with their ability to insert a male urinary catheter ($P = 0.03$), insert a female urinary catheter ($P = 0.061$), set up an IV Infusion ($P = 0.01$), and insert venous cannulas ($P = 0.05$). We did not identify improvement with venous blood sampling ($P = 1$).

There was increased confidence in the ability to hand and instrument tie knots ($P < 0.01$ and $P < 0.01$, respectively). Improvement was also identified in simple interrupted suturing ($P < 0.01$) but not continuous suturing ($P = 0.07$).

Discussion

Our data shows that a majority of medical students choose international medical elective experiences, with only 25% undertaking their electives in the British Isles. This is unsurprising as the benefits of cross-border medical electives are legion. For the students and their home health-care system, it has been shown that students returning from electives demonstrate improved diagnostic skills, decision-making skills, personal development, and awareness of social determinants of health [5].

For the host nations, particularly those in the developing world, medical students on elective can be important health workers, often providing a stop gap for the "brain drain" commonly encountered in many of these areas and helping to partly address the global shortage of health workers. Unsurprisingly, developing countries have been shown to host as many as 40% of UK elective students, who on average spend between 6 and 12 weeks on their medical electives [1].

With that said, it is important to consider the risk that medical students may pose to patient safety in these host countries. After all, as demonstrated in this present study, as many as 54% of medical students felt under pressure to carry out tasks, which they felt were out of the competence level during their medical elective. Nineteen percent of students felt that they were untrained to manage certain situations faced and these were at times associated with adverse events. The amount of harm caused is likely to be mitigated by the fact that many medical schools in the UK send their students to their electives after sitting their final examinations [1]; thus, it could be argued that although not officially registered with their respective medical councils yet, medical students at this point in their training should be able to display skills similar to those displayed by house officers/newly qualified interns. However, there is also extensive literature showing that newly qualified doctors and interns often lack adequate procedural skills and confidence, supporting the argument that medical students attending their electives potentially lack key skills required for ensuring maximal patient safety in a foreign environment—despite some of the identified skills, namely wound suturing, venepuncture, and IV Cannula insertion, being basic skills taught at the commencement of clinical rotations [10, 11].

The risk is however not only confined to the patients in the host countries; the students are also repeatedly putting themselves at risk. The fact that they are performing practical procedures such as venepuncture and venous cannulation whilst not being comfortable with the execution of such tasks is of particular concern, especially when considering the high prevalence of endemic blood borne viruses present in some of the areas in which these electives are undertaken. Unsurprisingly, studies have shown that significant numbers of students (8–25%) are exposed to blood borne viruses on elective, with a limited number of them (20%) taking post-exposure prophylaxis with them to their elective [12–14].

There are also the further medico-legal implications associated with performing practical procedures with low levels of confidence (as shown in this study), in that elective indemnity cover is subject to students not exceeding their level of qualification or competence [9]. This is highlighted by the fact that a fifth of survey respondents reported they were placed in situations they felt they were not trained to manage during their electives, with adverse events/effects occurring in 15% of these cases; a factor which may significantly contribute to personal stress and anxiety, especially when compounded by being in a foreign country.

The risks to patients and students do not solely revolve around the question of competence in performing clinical procedural skills. We also question whether medical students, at this stage in their training, simply lack the non-technical skills required to decline being placed in situations beyond their capabilities and comfort zones or, conversely, to handle the situations, which they are trained to manage efficiently. This is suggested by the lack of correlation between self-reported comfort and likelihood of performing certain tasks.

Non-technical skills are human factors defined as "general cognitive and social skills that allow (them) to … monitor the situation, make decisions, take a leadership role, communicate, and co-ordinate their actions within a team, in order to achieve high levels of safety and efficiency." They are considered separate to the procedural and clinical skills applied in the evaluation and management of clinical problems [15], but just as important. Though the development non-technical skills (Appendix Table 7) has become a core part of post graduate training [15, 16], undergraduate medical education has yet to embrace them to the point of designing specific modules for all medical students. Indeed, whilst some programmes for training medical students prior to commencement of electives are focused on ethics and procedural skills [1, 5, 17], we were unable

to find an example in the literature of one also focusing on non-technical skills. This represents a significant gap in pre-elective preparation as a certain level of clinical and non-technical skill may be expected in certain elective posts, not to mention when beginning foundation/intern training.

Although the importance of non-technical skills cannot be underestimated and there is a clear gap effectively training their students to master these skills, it is worth noting that our statement suggesting students lack non-technical skills based on the fact that we found no correlation between self-reported comfort and likelihood of performing certain tasks has its limitations. First of all, the comfort level reported is a self-assessment of each student's skills prior to their elective commencing. This may represent a recall bias since many of these respondents were qualified doctors who at the time of questionnaire completion would have been confident in performing many of these tasks. Secondly, overestimation of each student's skills can also have an effect on the type of response. Lastly, data around confidence levels and likelihood of task performance in this article was collected with the aim of researching the baseline relationships between comfort levels and the probability of tasks being carried out during one's elective, with the hypothesis that by increasing each student's skill level through a series of workshops prior to commencing an elective, student participation and task performance would improve. It was not collected to assess the level of non-technical skills demonstrated by the students.

We have, to this point, established that students run a high risk of putting themselves and patients at risk of harm by lacking the appropriate level of clinical and non-technical skills to manage certain clinical situations safely. This is very unfortunate considering that there is a wide range of literature suggesting that education, especially using simulation, can reduce the exposure to these risks. There are examples of simulation courses significantly improving medical students' non-technical skills [15, 18] and improving safety with practical procedures [14]. This lack of education is further aggravated by the lack of good practice guidelines provided by medical schools. In fact, a 2008 survey of UK medical schools found that only 65% of schools provided specific pre-elective training [3], with an earlier study indicating that only one medical school had identified aims for medical students in the elective period, though all provided counselling/training with regard to health and safety issues prior to elective commencement [4].

In this study, we attempted to address the issues around a lack of pre-elective training by setting up the medical elective suitcase course. The aim was to demonstrate that a programme focused on improving medical students' clinical and non-technical skills could better equip them to handle the challenges they will face working in foreign countries, environments, and health systems. This would ultimately lead to a more positive elective experience. A simulation-based model was used where possible; this is due to the overwhelming evidence highlighting the effectiveness of this mode of teaching in improving the management of acutely unwell patients by foundation doctors [19]. We also considered the fact that our medical students likely have a variety of learning styles, that is "preference for processing information in a particular way when carrying out a learning activity" or learning habits that allow individuals to benefit more from some experiences than others. These have been described by Honey and Mumford as four overlapping types—theorist, reflector, pragmatist, and activist, with Kolb describing a cycle of learning experiences composed of:

1. Reflective observation
2. Abstract conceptualisation
3. Active experimentation
4. Concrete experience

In this cycle, individuals of each learning style will prefer at one learning experience or the other—e.g. the pragmatists will prefer the active experimentation stage of learning [20–22]. Thus, we sought to develop content which would allow our students to experience all aspects of the learning cycle and improve their technical and non-technical skills. We thus chose simulation, as it allowed students to go, throughout the afternoon and each session, from reflective observation and abstract conceptualisation, to active experimentation and concrete experience and back again to reflection.

Indeed, simulation-based medical education has been shown to achieve mastery standards, which translate to improved patient outcomes as well as improved skills and knowledge retention [23–25].

The course proved to have a positive impact in developing both students' non-technical and clinical skills. With respects to non-technical skills, it led to highly significant improvements in almost all elements of the ANTS non-technical skills framework [26]. We hope that the better acquisition of these skills will empower students to not feel pressured in engaging in practices, which are potentially unsafe for them and for their patients, as well as increase their confidence in task management, team working, situational awareness, and decision-making.

Confidence in performing core procedural skills and managing common clinical scenarios also improved. The effect of this must not be underestimated, given that these are all practical skills, which many survey respondents found they were called upon to perform during their electives and could have had a direct impact on patient outcome, e.g. being able to administer IV antibiotics and set up IV fluids for a septic patient could be lifesaving in a department lacking the human resources to do so or where normal human resources are overstretched at that time. The highly statistically significant improvements in clinical paediatrics and obstetrics and gynaecology practical skills are also worth noting as these were skills, which a large proportion of survey respondents indicated they felt uncomfortable performing prior to undertaking their electives. We also note that these improvements were still highly significant despite

most course participants having completed rotations in those specialties prior to undertaking the course (89% each). This is similar with surgical skills where 94% of course participants had completed surgical rotations but still found their skills significantly improved by the course. The surgical skill which did not improve significantly was continuous suturing, and the authors put this down to the course not allowing enough time to teach this more challenging skill and will remedy that at future iterations of the course. This is the same with orthopaedic tasks (fracture and dislocation reduction, plaster casting), which, despite featuring highly amongst survey respondents as tasks they felt uncomfortable performing prior to their electives, the course did not attempt to address due to lack of time. Thus, as part of the next steps in our research, we hope to be able to offer this course over a full day and include stations, which will teach orthopaedic skills and trauma management simulation stations, as trauma simulations have been shown to improve technical and non-technical skills when carried out appropriately [27]. Future research will also look at the correlation between self-reported confidence correlates with competence as judged by objective observers, as this will provide more information on the effectiveness of the course. This is important, as it has been shown that self-reported confidence and competence have not always been correlated with objective judgements of competence in the medical education sphere—though it has been shown to correlate in cases where participants received training such as ours, including amongst medical students [28–31]. This is particularly true of technical skills, where participants appear to have retain what they have been instructed [29, 32–35].

Limitations

We acknowledge some limitations to the present study. The response rate for this questionnaire was relatively low, and this study may be subject to non-response bias; however, the response rate likely reflects both the pragmatic design of this study, the use of social media, and the fleeting nature of social media posts. It may also reflect the relative novelty of medical electives, with significant numbers of the doctors who received the survey, perhaps not having undertaken medical electives during their medical training, and therefore, the survey was not directly relevant to them. We also acknowledge that a semi-qualitative approach to this work would have represented a more complete assessment of medical students' and doctors' views towards elective experiences; unfortunately, the study's design made this impractical. Furthermore, as recruitment was based on the willingness to participate, selection bias cannot be ruled out, nor can the possibility of recall bias be excluded, given that this was a questionnaire-based study, which may be even more significant for doctors reflecting on their competences as students. We also recognise that self-reported confidence in one's ability to perform a task may not necessarily represent ability to carry out that task.

Conclusion

Medical electives are an important aspect of undergraduate medical training. Such experiences are most beneficial when medical students are afforded the opportunity to become an active and participating member of a health care service provision team, which is often in a foreign country and environment. With that said, patient safety, regardless of the geographical location of the patient, has to be maintained. Steps must be taken to ensure that medical students undertaking medical electives are well prepared for their roles and that they do not pose a danger to themselves or patient safety. We propose a period of simulation training prior to commencement of the elective period, which would focus on refreshing clinical and non-technical skills to a high level as a method of preparation. A programme of pre-elective focused education, such as the medical elective suitcase, offers the opportunity to enhance the medical student elective experience and improve patient safety; it may prove to be a long-term, beneficial addition to undergraduate medical education.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix

Table 6

No.	Objective
1	Familiarise students with key ethical challenges faced on electives and a framework to use in situ
2	Familiarise them with occupational risks
3	Raise awareness of non-technical skills and human factors
4	Improve confidence, competence, and comfort levels with basic practical procedures
5	Give students a framework within which to assess acutely unwell patients in different specialties

Table 7

Station	Description
Ethics	This workshop used case-based discussions, taking four real-life, anonymised, ethically challenging cases from elective experiences of faculty members and allowing students to discuss the ethical questions in a safe and confidential environment. These cases were focused on the topics of informed consent, medical research, resource allocation, and vulnerable populations, with discussion also encompassing professionalism and probity. Students were allowed to reflect on the cases, discuss the ethical questions involved, and explore the options available to those involved in the scenarios in question. Students were also advised of resources from which to seek advice and support when encountering ethically challenging situations.
Non-technical skills	This comprised of a short lecture introducing human factors, followed by interactive case-based discussion focusing on the topics of team working, task management, situational awareness, and decision-making, as based on the Anaesthetists' Non-Technical Skills (ANTS). Students were encouraged to reflect on the individuals in the cases, as well as from their own experiences, and consider what, if any, non-technical skills, were displayed and how these could be improved.
Clinical procedures	Part-task trainers were used to simulate basic procedural skills—venepuncture, venous cannula insertion, setting up an IV infusion, urinary catheterisation. Experienced faculty members demonstrated each activity, observed students performing each task, and gave practical advice, whilst students repeated the activity and improved their technique
Surgical procedures	Simple task trainers were used, with experienced faculty demonstrating how to hand and instrument tie surgical knots, followed by simple interrupted suturing and continuous suturing. Experienced faculty members demonstrated each activity, observed students performing each task, and gave practical advice, whilst students repeated the activity and improved their technique.
Medical emergencies	Simulation scenarios using high fidelity mannequins and actors covering medicine (sepsis identification and management), surgery (management of haemorrhage stemming from epistaxis), obstetrics (identification and management of pre-eclampsia and post-partum haemorrhage), and paediatrics (neonatal resuscitation). Simulation groups were selected in such a way that ensured no two individuals in any group knew one another prior to the course. There was a standardised debrief period after each scenario focusing on clinical and non-technical aspects of each scenario.
Communication	Language barriers, team-working, and handover were built into simulation scenarios

Table 8 ANTS question and details given to students in pre- and post-course survey

Question		Rate 1–10
Please read each of these statements carefully then select one option that best describes how confident are you in your ability to do the following in the context of your elective, i.e. in a team of strangers, in a different country and healthcare system?		
ANTS	Competence	Details
Task management	Planning and preparing	Developing in advance primary and contingency strategies for managing tasks, reviewing these, and updating them if required to
	Prioritising	Scheduling tasks, activities, issues, information channels, etc., according to importance (e.g. due to time, seriousness, plans); being able to identify key issues and allocate attention to them accordingly, and avoiding being distracted by less important or irrelevant matters.
	Providing and maintaining standards	Supporting safety and quality by adhering to accepted principles of medicine; following, where possible, codes of good practice, treatment protocols or guidelines, and mental checklists
	Identifying and utilising resources	Establishing the necessary and available requirements for task completion (e.g. people, expertise, equipment, time) and using them to accomplish goals with minimum disruption, stress, work overload, or underload (mental and physical) on individuals and the whole team.
Team working	Co-ordinating activities with team members	Working together with others to carry out tasks, for both physical and cognitive activities; understanding the roles and responsibilities of different team members, and ensuring that a collaborative approach is employed.

Table 8 (continued)

Question		Rate 1–10
Please read each of these statements carefully then select one option that best describes how confident are you in your ability to do the following in the context of your elective, i.e. in a team of strangers, in a different country and healthcare system?		
	Exchanging information	Giving and receiving the knowledge and data necessary for team co-ordination and task completion.
	Using authority and assertiveness	Leading the team and/or the task (as required), accepting a non-leading role when appropriate; adopting a suitably forceful manner to make a point; and adapting this for the team and/or situation
	Assessing capabilities	Judging different team members' skills and their ability to deal with a situation; being alert to factors that may limit these and their capacity to perform effectively (e.g. level of expertise, experience, stress, fatigue)
	Supporting others	Providing physical, cognitive, or emotional help to other members of the team.
Situational awareness	Gathering information	Actively and specifically collecting data about the situation by continuously observing the whole environment and monitoring all available data sources and cues and verifying data to confirm their reliability (i.e. that they are not artefactual).
	Recognising and understanding	Interpreting information collected from the environment (with respect to existing knowledge) to identify the match or mis-match between the situation and the expected state, and to update one's current mental picture.
	Anticipating	Asking 'what if" questions and thinking ahead about potential outcomes and consequences of actions, intervention, non-intervention, etc.; running projections of current situation to predict what might happen in the near future.
Decision-making	Identifying options	Generating alternative possibilities or courses of action to be considered in making a decision or solving a problem.
	Balancing risks and selecting options	Assessing hazards to weigh up the threats or benefits of a situation, considering the advantages and disadvantages of different courses of action; choosing a solution or course of action based on these processes.
	Re-evaluating	Continually reviewing the suitability of the options identified, assessed and selected; and re-assessing the situation following implementation of a given action.

Table 9 Practical skill questions and details given to students in pre- and post-course survey

Question Please read each of these statements carefully then select one option that best describes how well do you rate your ability to do the following?	Rate 1–10
Acutely unwell patients	Recognising acutely unwell patients
	Assessing acutely unwell patients
	Initiating management of acutely unwell patients
	Leading a team in management of acutely unwell patients
	Communicating effectively and efficiently
	Calling for help when appropriate
Practical skills	Inserting a male urinary catheter
	Inserting a female urinary catheter
	Venous blood sampling
	Setting up an iv infusion
	Inserting a venous cannula
Surgical skills	Hand-tying knots
	Instrument tying knots
	Simple interrupted suturing
	Continuous suturing

Table 9 (continued)

Question Please read each of these statements carefully then select one option that best describes how well do you rate your ability to do the following?	Rate 1–10
Clinical medicine	Identifying sepsis
	Components of sepsis 6
	Instituting sepsis 6
Clinical surgery	Management of epistaxis
	Managing acute haemorrhage
Paediatrics	Fluid resuscitation of a child
	Access and blood taking in a child
	Resuscitation of a child
	Operation of a neonatal resuscitaire
	Neonatal resuscitation
Obstetrics and gynaecology	Recognition of pre-eclampsia
	Management of pre-eclampsia
	Recognition of post-partum haemorrhage
	Management of post-partum haemorrhage

References

1. Banerjee A (2010) Medical electives: a chance for international health. J R Soc Med 103(1):6–8
2. Dowell J, Merrylees N (2009) Electives: isn't it time for a change? Med Educ 43(2):121–126
3. Banerjee A, Banatvala N, Handa A (2011) Medical student electives: potential for global health? Lancet 377(9765):555
4. Miranda J, Yudkin J, Willott C (2005) International health electives: four years of experience. Travel Med Infect Dis 3(3):133–141
5. Moran D, Edwardson J, Cuneo C, Tackett S, Aluri J, Kironji A et al (2015) Development of global health education at Johns Hopkins University School of Medicine: a student-driven initiative. Med Educ Online. 20(1):28632
6. The electives network: helping medical students plan the perfect elective [Internet]. Electives.net. 2017 [cited 29 November 2017]. Available from: http://www.electives.net/
7. Medical indemnity—choosing your medical elective [Internet]. British Medical Association. 2017 [cited 29 November 2017]. Available from: https://www.bma.org.uk/developing-your-career/medical-student/choosing-your-medical-elective/medical-indemnity
8. Indemnity for your elective—the MDU [Internet]. Themdu.com. 2017 [cited 29 November 2017]. Available from: http://www.themdu.com/for-students/your-elective/indemnity
9. Pocket guide to planning your elective [Internet]. Medicalprotection.org. 2017 [cited 29 November 2017]. Available from: http://www.medicalprotection.org/docs/default-source/pdfs/Booklet-PDFs/pocket-guide-to-planning-your-elective.pdf?sfvrsn=4
10. Barr J, Graffeo C (2016) Procedural experience and confidence among graduating medical students. J Surg Educ 73(3):466–473
11. Elnicki D, Fagan M (2003) Medical students and procedural skills. Am J Med 114(4):343–345
12. Smith P, Drummond C, Woolley I (2006) Occupational exposures experienced by medical students during overseas electives. Australian Infection Control 11(4):123–133
13. Hunter J, Sulkin T (2012) Potential exposure of medical students to blood borne viruses on medical elective and the use of HIV post exposure prophylaxis. J Infect 65(2):185–187
14. Reid M, Biller N, Lyon S, Reilly J, Merlin J, Dacso M et al (2014) Reducing risk and enhancing education: U.S. medical students on global health electives. Am J Infect Control 42(12):1319–1321
15. Kodate N, Ross A, Anderson J, Flin R (2012) Non-technical skills (NTS) for enhancing patient safety: achievements and future directions. Japanese Journal of Quality and Safety in Healthcare 7(4): 360–370
16. Agha R, Fowler A, Sevdalis N (2015) The role of non-technical skills in surgery. Annals of Medicine and Surgery 4(4):422–427
17. Margolick J, Kanters D, Cameron B. Procedural skills training for Canadian medical students participating in international electives. Canadian Medical Education Journal. 2015 [cited 29 November 2017];6(1):23–33. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4563617/pdf/cmej0623.pdf
18. Martinou E, Chindambaran R, Krishnasamy G, Johnson A, Donnell J, Vig S et al (2015) Simulation in undergraduate medical education: designing a programme to improve medical students' non-technical skills. Int J Surg 23:S102
19. Cachia M, Pace Bardon M, Balzan G, Tilney R, Micallef J, Balzan M (2015) Simulation training for foundation doctors on the management of the acutely ill patient. Adv Med Educ Pract.:657
20. Osborne A, Hawkins S, James A, Pournaras D, Pullyblank A (2012) Training in current medical education: surgeons are different from their medical colleagues. The Bulletin of the Royal College of Surgeons of England 94(7):242–245
21. Mumford A, Honey P (1992) The manual of learning styles, 1st edn. P. Honey, Maidenhead
22. Kolb D (1984) Experiential learning, 1st edn. Pearson Education, Upper Saddle River
23. McGaghie W, Siddall V, Mazmanian P, Myers J (2009) Lessons for continuing medical education from simulation research in undergraduate and graduate medical education. Chest 135(3):62S–68S
24. Barsuk J, Cohen E, McGaghie W, Wayne D (2010) Long-term retention of central venous catheter insertion skills after simulation-based mastery learning. Acad Med 85:S9–S12

25. Barsuk J, McGaghie W, Cohen E, O'Leary K, Wayne D (2009) Simulation-based mastery learning reduces complications during central venous catheter insertion in a medical intensive care unit*. Crit Care Med 37(10):2697–2701
26. Flin R, Patey R, Glavin R, Maran N (2010) Anaesthetists' non-technical skills. Br J Anaesth 105(1):38–44
27. Sullivan S, Campbell K, Ross J, Thompson R, Underwood A, LeGare A et al (2018) Identifying nontechnical skill deficits in trainees through interdisciplinary trauma simulation. J Surg Educ 75(4):978–983
28. Barnsley L, Lyon P, Ralston S, Hibbert E, Cunningham I, Gordon F et al (2004) Clinical skills in junior medical officers: a comparison of self-reported confidence and observed competence. Med Educ 38(4):358–367
29. Roizen M (2006) Impact of educational intervention on confidence and competence in the performance of a simple surgical task. Yearbook of Anesthesiology and Pain Management. 2006:282–283
30. Chen S, Chen S, Lee S, Chang Y, Yeh K (2017) Impact of interactive situated and simulated teaching program on novice nursing practitioners' clinical competence, confidence, and stress. Nurse Educ Today 55:11–16
31. Stewart R, Hauge L, Stewart R, Rosen R, Charnot-Katsikas A, Prinz R (2007) A CRASH course in procedural skills improves medical students' self-assessment of proficiency, confidence, and anxiety. Am J Surg 193(6):771–773
32. Fincher R, Lewis L (1994) Learning, experience, and self-assessment of competence of third-year medical students in performing bedside procedures. Acad Med 69(4):291–295
33. Barrett S, Zapka J, Mazor K, Luckmann R (2002) Assessing third-year medical students breast cancer screening skills. Acad Med 77(9):905–910
34. Ault G, Sullivan M, Chalabian J, Skinner K (2002) A focused breast skills workshop improves the clinical skills of medical students. J Surg Res 106(2):303–307
35. Peyre S, Sullivan M, Peyre C, Towfigh S (2006) A surgical skills lab elective can improve senior medical student confidence prior to surgical internship. J Surg Res 130(2):248–249