Effective interprofessional simulation training for medical and midwifery students

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ABSTRACT

Introduction Good interprofessional teamworking is essential for high quality, efficient and safe clinical care. Undergraduate interprofessional training has been advocated for many years to improve interprofessional working. However, few successful initiatives have been reported and even fewer have formally assessed their educational impact.

Methods This was a prospective observational study of medical and midwifery students at a tertiary-level maternity unit. An interprofessional training module was developed and delivered by a multiprofessional faculty to medical and midwifery students, including short lectures, team-building exercises and practical simulation-based training for one obstetric (shoulder dystocia) and three generic emergencies (sepsis, haemorrhage, collapse). Outcome measures were interprofessional attitudes, assessed with a validated questionnaire (UWE Interprofessional Questionnaire) and clinical knowledge, measured with validated multiple-choice questions.

Results Seventy-two students participated (34 medical, 38 midwifery). Following training median interprofessional attitude scores improved in all domains ($p<0.0001$), and more students responded in positive categories for communication and teamwork (69–89%, $p=0.004$), interprofessional interaction (3–16%, $p=0.012$) and interprofessional relationships (74–89%, $p=0.006$). Scores for knowledge improved following training for medical students (65.5% (61.8–70%) to 82.3% (79.1–84.5%) (median (IQR)) $p<0.0001$) and student midwives (70% (64.1–76.4%) to 81.8% (79.1–86.4%) $p<0.0001$), and in all subject areas ($p<0.0001$).

Conclusions This training was associated with meaningful improvements in students' attitudes to teamwork, and knowledge acquisition. Integrating practical tasks and teamwork training, in authentic clinical settings, with matched numbers of medical and non-medical students can facilitate learning of both why and how to work together. This type of training could be adopted widely in undergraduate healthcare education.

BACKGROUND

Good interprofessional collaboration is important for safe, effective clinical care,[1] yet is often substandard or missing.[2] The WHO has advocated interprofessional training (IPT) for undergraduate healthcare students for many years, to address the problem at its foundations, before poor IP attitudes become entrenched.[3] In 2010, IPT was promoted in strategic reviews of both medical and midwifery education.[4 5]

Whereas it is well understood that undergraduate IPT is needed, what is not known is how to make it effective. A number of undergraduate IP initiatives have been described, but their evaluation has often lacked rigour[6–8] and their impact on attitudes and behaviours has been questionable. Undergraduate IPT has been pioneered in Canada, Australia, USA and Europe,[9 10] and in the UK it has been mandated by the Quality Assurance Agency, the General Medical Council (GMC) and the Nursing & Midwifery Council,[11] yet there is still evidence of poor IP working. Undermining behaviour is consistently reported in GMC and National Health Service (NHS) Staff surveys, with a significant proportion of this damaging behaviour occurring between different healthcare professional groups.[12 13]

In maternity care, team training for staff was introduced after evidence of poor team working came to light during the 2004 report of *Confidential Enquiries into Maternal Deaths*, and has been persistently highlighted in successive reports.[14] Practical team training has since been shown to be associated with significant improvement in clinical outcomes.[15–19] IP learning has been identified as one of the essential components of successful training programmes for postgraduates.[20] A pilot IP learning module for our maternity students appeared to be associated with some improvement in attitudes.[21] Learning from these experiences, we aimed to implement and evaluate a course for both midwifery and medical students.

Methods

This prospective observational study was conducted in the maternity department of a tertiary-level university hospital (North Bristol Trust). The clinical maternity team in this unit comprises doctors who specialise in obstetrics and gynaecology after completing foundation medical training, and midwives, who have completed a 3-year degree course or a shorter conversion course for qualified nurses. The unit receives medical students from the University of Bristol and midwifery students from the University of the West of England. Cohorts of medical students rotated through the maternity department every 2 months, and midwifery students were allocated to the maternity unit for clinical attachments during their degree.

We invited all medical and midwifery students attached to the maternity department from February to October 2012 to participate. At the time of the intervention, medical students were in their fourth year of medical school, and were nearing the end of their 8-week attachment in maternity, which included lectures and tutorials together with clinical experience in obstetrics and gynaecology. Midwifery students were in their second or third year of training, and were

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undertaking modules in high-risk/complex pregnancy having previously completed modules covering normal pregnancy and birth. The four clinical subjects chosen for the training intervention were part of the existing teaching programme for both groups of students.

Training

We designed a one-day training intervention focusing on four clinical topics; sepsis, maternal collapse, postpartum haemorrhage and shoulder dystocia. The training was divided into two structured sessions; background factual knowledge on clinical and teamwork topics, and practical teamwork training using simulation. Students were allocated into multiprofessional teams of 4–6 participants for all activities during the day.

The morning session included lectures, small group teaching and clinical skills demonstration for all clinical subjects, together with hands-on practice using manikins (for shoulder dystocia and basic life support). The content of the sessions was derived from national standards.[22 23] The afternoon session consisted of a rotation of four simulated emergency scenarios using high-technology and low-technology simulators (SimMom, PROMPT Birthing Simulator, MamaNatalie, ResusciAnne and patient actors). All simulated scenarios were followed by a structured oral debrief using observer checklists which focus on clinical tasks, teamwork and communication. All training scenarios were derived from an evidence-based maternity emergency training package for postgraduates (PROMPT Maternity Foundation scenarios for SimMom).[24] The training intervention was delivered on three separate occasions with separate cohorts of 24–32 students. All training days involved the same structure, content, setting and faculty.

Faculty

A multiprofessional group of midwives, obstetricians and anaesthetists implemented the training. All faculty members had experience in delivering IP obstetric emergency training for qualified staff using simulation and structured debrief.

Evaluation

We used the University of West of England (UWE) Interprofessional Questionnaire to assess IP attitudes of participants before and after training.[25 26] The design, validation and instructions for use of this questionnaire have been described previously.[25 26] It has previously been shown to have good internal consistency and reliability.[27] This questionnaire assesses student attitudes to IP working in four domains (communication and teamwork, exploring students' teamwork and communication skills; IP learning, describing students' attitudes to IP learning; IP interaction, exploring students' perception of interactions between different healthcare professions; IP relationships, addressing students' perceptions of their relationships with their peers and other professional groups) using Likert scales.[26] Total scores are calculated for each student in each domain and these aggregated responses are then categorised into positive, neutral or negative for each individual.

We assessed knowledge before and after training using multiple-choice questions (MCQs). Questions were selected from a large bank of unseen MCQs that had previously been validated, for content and discriminatory power, in a large randomised-controlled trial of obstetric emergency training for postgraduates.[28] The questions were reviewed for suitability for the students' curriculums (content validation) and to reflect updated clinical guidance. Six questions were modified to match the intended learning outcomes for undergraduate participants, for example, MCQs on advanced life support were replaced with questions on basic life support. In all 22 questions with five true/false stems on sepsis, maternal collapse, haemorrhage and shoulder dystocia were selected (total of 110 questions). The pass mark was set at 75%, reflecting university expectations of performance in these multiple choice questions.

Students completed the attitude survey 1 week before the IPT, and the first MCQ knowledge assessment under examination conditions at the beginning of the training day. All students repeated both assessments, with questions reordered, at the end of the training. The students had been made aware they would have a second test at the end of the day, however, specific answers to the questions were not given in the training material and there was no opportunity for students to discuss the assessment during the training day. The answers to the MCQs were not released to prevent contamination of subsequent cohorts. All responses were anonymous, masked for training status (before/after training) and marked with only the participant reference number. Two researchers (SE, SP), blinded to training status, independently loaded the raw attitude questionnaire responses into a Microsoft Excel spreadsheet, which transformed responses for negatively posed questions and calculated aggregate scores for each of the four domains. Two members of the faculty, blinded to training status, independently marked student MCQs according to a predetermined answer sheet. The same faculty members crosschecked the scores together and loaded them onto the Spreadsheet. Although no formal qualitative assessment of the intervention was performed students were invited to give anonymous free-text feedback comments on their overall opinion of the intervention, the optimal timing of this training and which element of the training they found most beneficial.

Statistical analysis

The sample size was pragmatic; all students attached to the hospital during the study period were invited to participate. We used the Wilcoxon signed-rank test to compare pretraining and post-training scores for the MCQ and IP attitude scores. We used McNemar's test to compare proportions of students responding positively in the IP attitude questionnaire before and after training, and the proportion of students attaining the pass mark for the MCQ test after training. We used the statistical package STATA (STATA/IC v12.1; StataCorp LP, College Station, Texas, USA) to perform all analyses.

Ethical approval

The study was approved by the research ethics committees at the University of Bristol (application no 111 226, approval 5 March 2012) and University of the West of England (application no HLS/12/01/20, approval 12 January 2012). All students received written information about the study and were free to participate or decline. All students signed consent forms on recruitment to the study.

RESULTS

Seventy-two (96%) of the 75 students attached to the maternity unit during the study period participated in the training and evaluation. Thirty-four medical students, and 38 midwifery students participated; student demographics are shown in table 1, demonstrating a representative sample of the student cohorts within both degree courses. Three students did not attend the training intervention due to sickness or other commitments. One student did not return the pretraining attitude questionnaire, and another pretraining questionnaire was not completed

Table 1 Participant demographics

	Medical students n=34	Midwifery students n=38
Age	(Range 22–33)	(Range 19–54)
≤24	22 (65%)	10 (26%)
25–29	11 (32%)	7 (18%)
30–24	1 (3%)	7 (18%)
35–39	0	8 (21%)
>40	0	6 (16%)
Gender		
Female	18 (53%)	38 (100%)

properly (less than 20% questions answered); these were excluded from the analysis (70 before/after pairs analysed). All 72 students who attended the training completed both pretraining and post-training MCQs, and all completed the feedback form.

Figure 1 demonstrates the median attitude scores for all students (with IQR) for the four attitude scales assessed in the questionnaire. Median attitude scores were positive before training for three of the four categories; *communication and teamwork*, *IP learning* and *IP relationship* domains, and these became more positive after training (p<0.0001 for all three attitude scales; figure 1). The median *IP interaction* score was negative before training but improved to neutral after training (p<0.0001; figure 1). Figures 2 and 3 demonstrate attitude scores for medical students and midwifery students, respectively. The proportion of students categorised as having a positive response was statistically significantly higher after training for *communication and teamwork* (69% before training to 89% after training), *IP interaction* (3–16%) and *IP relationships* (74–89%; table 2). Ninety per cent of participants already regarded IP learning positively before training, and this increased after training to 97%. Written student feedback on the training programme was uniformly positive. For example, a representative selection of comments identified by the study team from the anonymous feedback forms is shown in table 3; no negative comments were recorded by any participants.

There was a significant increase in knowledge after training. The median overall test score increased from 67% pretraining to 82% after training (p<0.0001; table 4). Median MCQ scores increased significantly in medical student and midwifery student groups after training (65–82%, and 70–82% respectively; p<0.0001 for both analyses). There was strong evidence of improvement of MCQ scores for all four clinical subjects taught (all analyses p<0.001; table 4). The proportion of students attaining the nominal 75% pass mark for the MCQ assessment increased significantly after training from 6% (n=2) to 100% (n=34) for medical students (p<0.001) and 32% (n=12) to 100% (n=38) for midwifery students (p<0.001).

DISCUSSION

Our study demonstrated that medical and midwifery students enjoyed training together, and that this IPT was associated with significant improvement in attitudes to IP working in parallel with significant improvements in factual knowledge. The feedback from the students about their experience of IP education was extremely positive, and uniformly so.

Strengths and weaknesses

The study was structured to investigate the effect of this IPT module on attitudes using tools that had been previously validated in similar settings. Most previous studies of IP initiatives have relied on self-reported satisfaction and perception of learning rather than more objective measurements of educational impact,[6 7 29–31] or unvalidated psychometric tools.[7 32] In this study we used robustly validated assessment tools designed specifically for the evaluation of IPT initiatives including medical/midwifery students.[21 25 28] We are reasonably confident that the

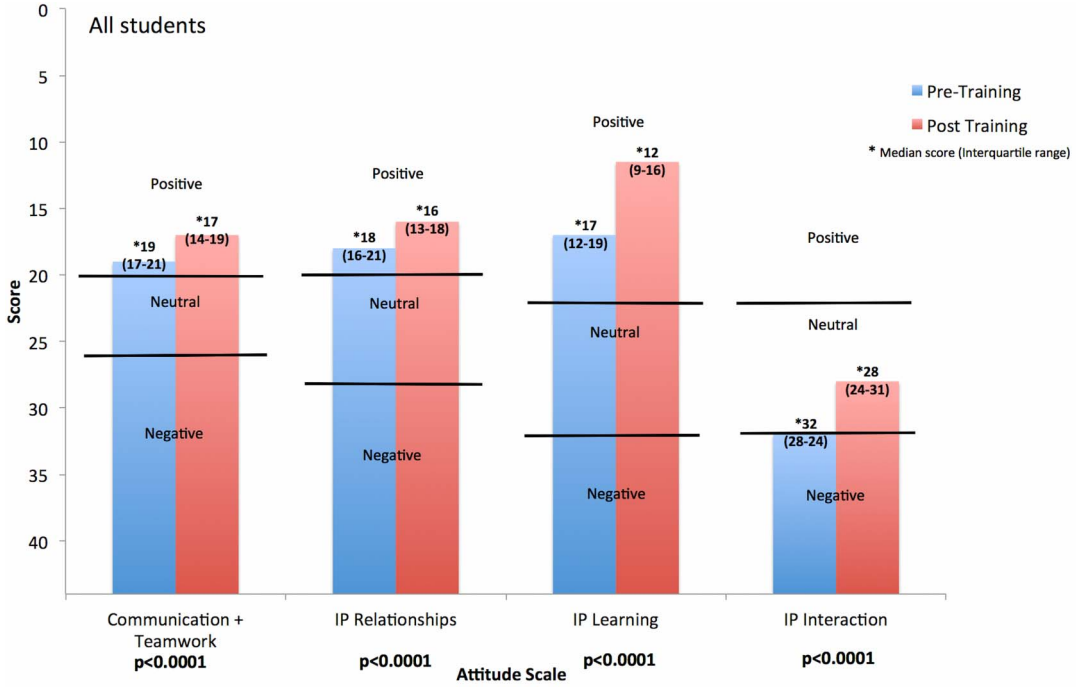

Figure 1 Interprofessional attitude scores before and after training for all students. Attitudes assessed using University of West of England Interprofessional Questionnaire.[25]

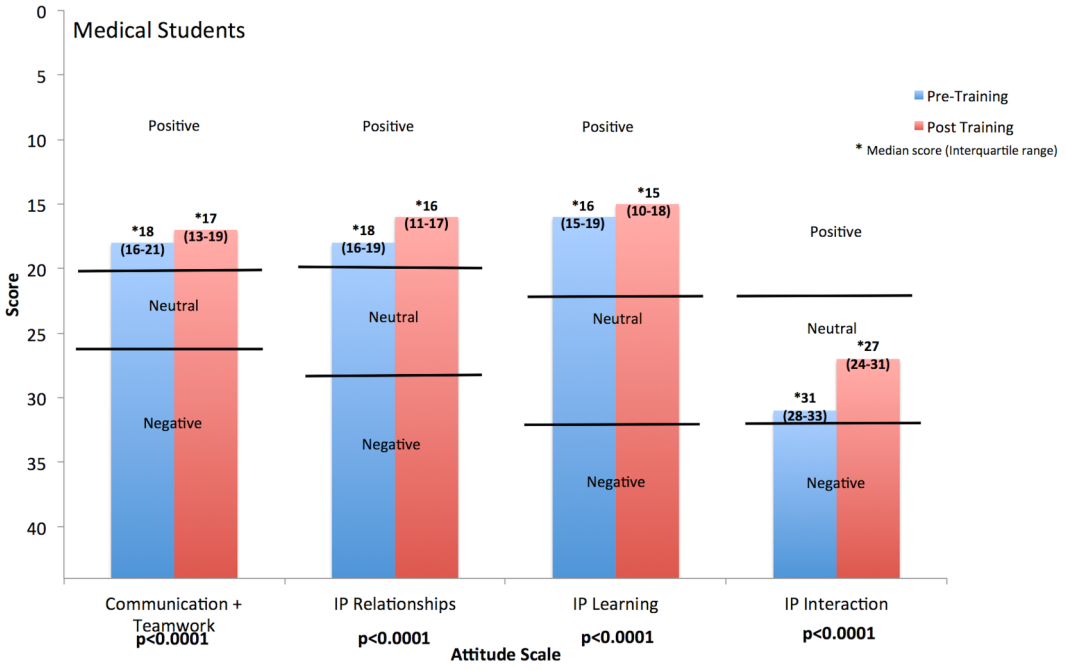

Figure 2 Interprofessional attitude scores before and after training for medical students. Attitudes assessed using University of West of England Interprofessional Questionnaire.[25]

observed improvements in student attitudes following training seen in this study represent a true effect. The study also benefitted from a very high participation rate, such that both groups include a representative cohort of students.

All training courses should be assessed using the four level evaluation model described by Kirkpatrick and Kirkpatrick.[33] Attitudes and factual knowledge represent level 2 in the Kirkpatrick model,[6] a higher level of assessment than participants' reaction (level 1). Higher levels (real patient care- level 3 and outcome—level 4) are very difficult to evaluate with undergraduate training interventions,[6 7 26 32] because participants are not yet working as licensed practitioners and often move to different geographical or clinical areas for employment postqualification. However, there is good evidence that IPT for qualified staff can have a positive impact on attitudes, [34 35] and is associated with improvement in clinical outcomes in maternity care.[15–17 34]

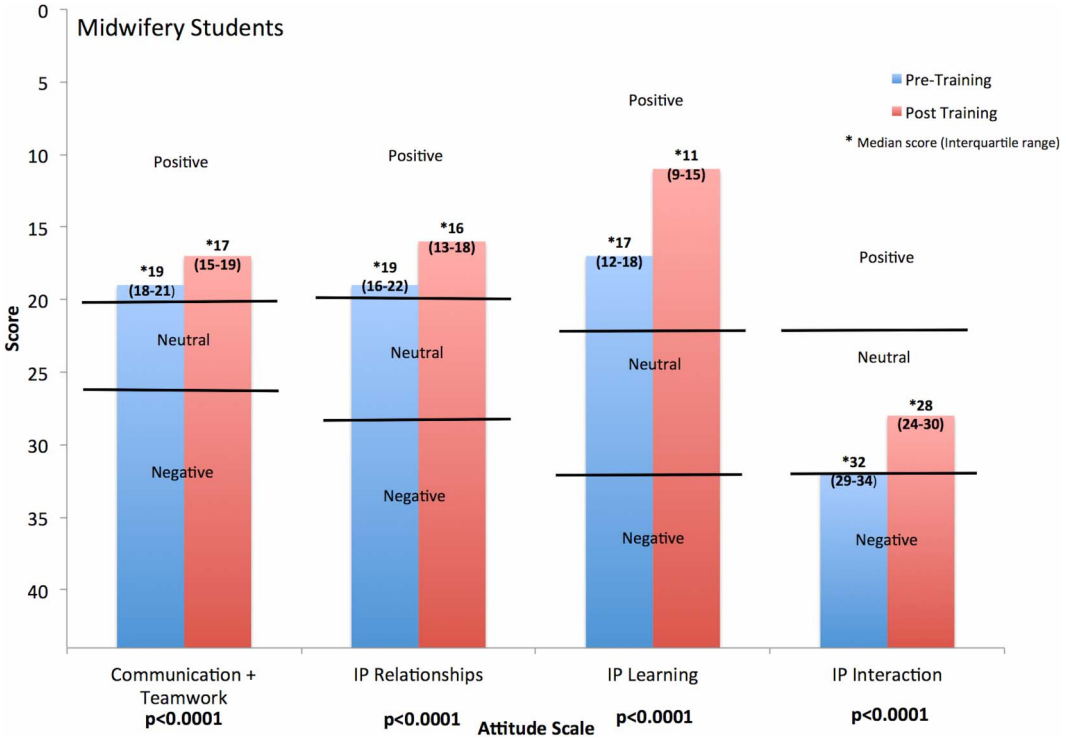

Figure 3 Interprofessional attitude scores before and after training for midwifery students. Attitudes assessed using University of West of England Interprofessional Questionnaire.[25]

Table 2 Participant responses by category before and after training

Attitude scale	Pretraining Responses n (%)	Post-training responses n (%)		McNemar Test
Communication and teamwork		Positive (89%)	Non-positive (11%)	
	Positive (69%)	44	4	p=0.0043
	Non-positive (31%)	18	4	
		Positive (97%)	Non-positive (3%)	
IP learning	Positive (90%)	62	1	p=0.125
	Non-positive (10%)	6	1	
		Positive (16%)	Non-positive (84%)	
IP interaction	Positive (3%)	1	1	p=0.012
	Non-positive (97%)	10	58	
		Positive (89%)	Non-positive (11%)	
IP relationships	Positive (74%)	51	1	p=0.0063
	Non-positive (26%)	11	7	

IP, interprofessional.

In common with other studies of undergraduate IP interventions[32] this study is limited by its simple pre/post-test design. Without a designated control group we cannot be certain that other external elements of the student curricula could be contributing to the demonstrated attitude changes. However, in our study the short interval to post-training assessments makes it likely that the demonstrated improvements resulted from participation in the IP module rather than another aspect of the students training. The short follow-up time itself could be regarded as a functional limitation, however, at least one other study of undergraduate IP simulation training has demonstrated no difference between attitude responses whether collected immediately, or delayed, post-training.[32] A qualitative assessment of the training may be useful, however, it may be useful to draw on lessons learned from similarly robust studies of training for qualified staff. Test-enhanced learning may also have contributed to improved knowledge scores following training,[36] although this is an integral part of the training package that is easily reproducible and should not detract from the observed improvements in knowledge. The observer effect may also have resulted in improved student performance in study tests, however, this is a consistent confounder that would have applied equally to pre and post-training assessments and is extremely difficult to remove from studies involving properly consented participants.

Findings in relation to practice

The primary outcome measure, IP attitudes, significantly improved after training. Before training students felt only

Table 3 Examples of participant feedback following training

When would this type of training be best held?	
Type of student	Comment
Medical	Every clinical rotation for medical students
Medical	Throughout and starting much earlier in the course. Regular training days like these would have been really helpful in our med/surg block in 3rd year
Medical	Throughout various modules during clinical placements, for example, emergency medicine
Midwifery	In 2nd and 3rd year. 2nd especially as we are in a high-risk placement with OSCES coming up and our developing practice is crucial for high risk
What was the most useful element of the training?	
Type of student	Comment
Medical	Experiencing a teamwork situation where everyone tried to fit to roles and work together in the situation—we have had barely any previous experience in these situations
Midwifery	The simulations within an IP team. It really helped identify what everyone could be doing and where some skill bases lay, for example, fluids—midwives, defibs—Drs!
Midwifery	Learning about different emergency scenarios and working together as a team
Midwifery	Understanding roles in an emergency and not being afraid to delegate
Midwifery	Trying out scenarios that have been discussed (theory) previously
Medical	Working alongside the midwife through the case scenarios. Nice to work in smaller groups with the same people throughout the day
Anon	Was really good doing role play very close to real life eg drawing up fluids
General feedback comments	
Type of student	Comment
Midwifery	Brilliant day—very useful to be able to practice in IP teams. Learning about other people's knowledge and roles and learning more about my own strengths and weaknesses in an emergency situation
Anon	Fantastic and useful day. Would love to do it again in another few months
Midwifery	I think it should be available in all trusts and to all students rather than just a small handful
Midwifery	Overall good training/skills day. Helped to make you aware of other professional roles
Medical	The (scenarios were) actually better and more realistic than previous sessions—this is where the multidisciplinary team element was most relevant
Medical	I felt that it was really excellent working with the midwifery students—really helps with multidisciplinary teamworking. It was a nice change to work with students from another discipline

IP, interprofessional; OSCE, objective structured clinical examinations.

Table 4 Student scores for knowledge assessment before and after training

	Pretraining (%)	Post-training (%)	p Value
Whole group (n=72)			<0.0001
Median	67.3	81.8	
Q1–Q3	61.8–72.7	79.1–85.5	
Medical Students (n=34)			<0.0001
Median	65.5	82.3	
Q1–Q3	61.8–70.0	79.1–84.5	
Midwifery Students (n=38)			<0.0001
Median	70.0	81.8	
Q1–Q3	64.1–76.4	79.1–86.4	
Maternal Collapse (n=72)			<0.0001
Median	64.8	88.7	
Q1–Q3	56.0–76.0	84.0–93.0	
Sepsis (n=72)			<0.0001
Median	74.9	82.3	
Q1–Q3	70.0–80.0	79.8–85.5	
Shoulder Dystocia (n=72)			<0.0001
Median	63.4	80.5	
Q1–Q3	54.3–74.3	77.1–85.7	
Haemorrhage (n=72)			<0.0001
Median	67.0	76.2	
Q1–Q3	60.0–73.3	66.7–83.3	

moderately positive about their personal communication and teamwork skills, as well as IP learning and their relationships with other professionals. Moreover, they felt very negative about IP interaction in clinical teams; responding negatively about professional stereotyping, hierarchy, co-operation and communication between healthcare professions. This pattern of responses has been reported previously in a range of other healthcare students, and is not unique to the maternity setting.[21 25–27]

In our study IP attitudes improved in all domains measured following the intervention, whereas previous studies of IPT interventions have not shown significant improvement[21 25 27 37] and in some studies attitudes have worsened following IPT.[26] Our results demonstrate that the need to address attitudes remains. Positive IP interaction underpins the ability of the clinical team to work together in all situations in all specialties. A greater understanding of this phenomenon, and the strategies that successfully target these IP relationships are therefore very important to clinical care.

The pretraining data in our study showed that most students already had some knowledge of the clinical topics, and there was no significant difference between medical and midwifery students. This starting level of knowledge probably allowed students to engage more fully in the training.[38]

The IPT module, with its focus on practical tasks in a (simulated) acute clinical context, provided an opportunity for medical and midwifery students to become familiar with their own and each other's roles within the clinical team, and to develop respect for each others' professional status, while supporting knowledge gain. The apparent authenticity of the experiences may have enhanced the effectiveness of training.[6 32] Unlike other studies that have used class-based discussion, video or online media to explore the roles of other healthcare professionals, this module immersed students in high-fidelity clinical scenarios. Much of the IPT was implicit and natural rather than overtly stated or forced. As observed in other training using undergraduate IP simulation,[32] students appeared to appreciate the value of the realistic simulated scenarios, and reported this as the most beneficial element of the intervention (see table 3).

There are several challenges to providing effective IPT in healthcare including the different needs of the participating student groups.[4 11 38] Our intervention focused on four clinical areas with direct relevance to all students, including generic healthcare topics (sepsis, haemorrhage and collapse). Sepsis and haemorrhage are common causes of severe morbidity and mortality across all disciplines throughout the world, and the skills learnt in the management of these clinical emergencies in a maternity setting are directly transferrable to other areas of medicine and nursing. The intervention is reproducible, using low-technology but high-fidelity simulation that minimises costs and is feasible to adapt for a variety of settings.

We hypothesise that if undergraduate trainees were exposed to repeated IP opportunities to practice working as a team in clinical scenarios, the improvement in attitudes towards IP interaction that was seen in our study could continue further. Students themselves identified a need and desire for a more sustained curriculum of IP education, with several students requesting similar modules in all clinical rotations, and at all stages of training (see table 3). Previous reviews of student feedback following IPT have also recommended increased exposure to such opportunities.[7] The optimal timing and frequency has been debated, but it is known that professional stereotyping begins from a very early stage in healthcare workers careers.[6] It has therefore been proposed that providing early and sustained opportunities for collaborative training may help to nurture positive attitudes and aid the transition from undergraduate learning to multiprofessional working postqualification[39]; from *learning* as a team, to *working* as a team, effectively and safely, for the benefit of healthcare across the broad clinical spectrum.

Key observations from training

We overcame a number of logistical challenges in the development and implementation of this undergraduate IP programme. Similar obstacles have been reported by other authors[32 38] including difficulties with recruiting students and faculty from multiple institutions, conflicting timetables and separate training campuses. There must be equal commitment to the IP training programme from all of the participating institutions for these challenges to be successfully addressed.

The active components of successful postgraduate training programmes associated with improved clinical outcomes in obstetrics have previously been reported.[20] Some features of the undergraduate intervention mirrored the experiences of postgraduate training. The teaching faculty for both undergraduate and postgraduate programmes consisted of experienced, multiprofessional facilitators[38] working within an established course format.[40]

Other features were specific to the undergraduate setting; training teams consisted of balanced numbers of medical and midwifery students in order to avoid professional dominance by any one group, something that has hindered previous IP interventions.[38] The faculty noticed that students were role agnostic at the beginning of simulations and required additional specific briefing on professional roles and responsibilities before and after simulated scenarios in order to maximise learning potential.

We believe that multiprofessional faculty, the standardised course format, balanced student numbers and basic team roles briefings are vital to the success of our undergraduate IPT

module. Importantly these key components should be easily reproducible in other units, and in other clinical specialties.

CONCLUSIONS

Good IP teamwork is associated with better clinical care and outcomes but is often deficient and engrained. Improving IP working during undergraduate training is important.

This practical undergraduate IPT module was both feasible and popular, benefiting all students equally irrespective of profession and institution. Enjoyment of the module and active learning both seemed to be especially supported by the use of team-based simulation. There were meaningful improvements in the IP attitudes of student participants alongside consistent improvements in knowledge. Improvements in IP attitudes after multiprofessional postgraduate training have been associated with improvements in quality, safety and outcomes. Undergraduate IPT modules should be similarly constructed, and implemented for all future healthcare professionals to benefit patients.

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Contributors SEE designed the study, collected and analysed the data and wrote the paper. EL contributed to data analysis. SP, CW, JM, SD, GL, EH and TD contributed to study design, data collection and editing of the manuscript. RF contributed to writing the manuscript. DS contributed to study design, data analysis and writing of the manuscript.

Competing interests SEE and DS are members of the PROMPT Maternity Foundation (PMF), a charitable foundation for training in obstetric emergencies, with no financial gains from the charity. CW is the senior research midwife for PMF and her salary is partially funded by the charity. TD is a trustee of PMF, with no financial gains. He also acts as a paid consultant for Limbs & Things and Ferring. None of the other authors have any interests to declare.

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