Abstract:

**Background**

Interprofessional simulation at the undergraduate level has been tested but is still very scarcely used due to curriculum and logistical issues. Over a 3-year period we have conducted extracurricular immersive simulation sessions for multiprofessional groups of final year healthcare students.

**Methods**

Following ethical approval, a series of scenarios requiring various combinations of healthcare professionals' inputs were designed for students attending the simulation sessions on offer. Another team of faculty were involved in the creation of a questionnaire to test students on discipline specific knowledge and about their perception of multidisciplinary working. Students recruited to the study were semi-randomly selected to either a control or experimental group which determined whether they completed the knowledge questionnaire prior to or after simulation exposure.

**Results**

Participants were 237 students from Adult/Children/Learning Disability/Mental Health Nursing, Paramedic, Radiography, Physiotherapy, and Pharmacy. Questionnaire data analysis showed that experimental group students reported a higher perceived level of knowledge of other professions and were more confident about working as part of a multidisciplinary team than control group students ($P<0.05$). Although positive for both groups, experimental group students expressed greater appreciation for pre-qualification interprofessional learning opportunities. The experimental group outscored the control group by 3.23 percentage points on the discipline knowledge questionnaire ($p<0.05$).

**Conclusions**

The study shows that even limited interprofessional simulation exposure enabled students to acquire knowledge of other professions and develop a better appreciation of interprofessional learning. Discussions during the debriefings highlighted the fact that interprofessional training is important and valued by students, especially if it is well contextualized and facilitated through the exposure to realistic scenarios.

## INTRODUCTION

Universally, healthcare education is still too often delivered on a uniprofessional basis, not reflecting the reality of everyday clinical practice. Since 2000, Interprofessional Education (IPE) has become a focal point in the UK (Chief Medical Officer, 2009; Department of Health, 2000, 2008; General Medical Council, 2009) and in international healthcare training agendas through national reforms and recommendations (Goble, 2004; Institute of Medicine, 2003, Mikkelsen Kyrkjebø, Brattebø, & Smith-Strøm, 2006; Rosen, 2008; World Health Organization, 1988, World Health Organization, 2010), not only for Continuing Medical Education (CME) but also in undergraduate healthcare education (Hallikainen, Vaisanen, Rosenberg, Silfast, & Niemi-Murola, 2007; Hoffman & Harnish, 2007; Lau, Dolovich, & Austin, 2007; van Soeren, Macmillan, Cop, Kenaszchuk, & Reeves, 2009). Although it is not formally proven, IPE is reported to have the potential to prevent barriers from arising between different professional groups (Ker, Mole, & Bradley, 2003) or to highlight those and help develop mutual respect among team members from different professions (Mikkelsen Kyrkjebø et al., 2006). An important element of safe and effective patient care is knowledge and understanding of other professionals' roles and skills within a team (MacDonald et al., 2010). As such this study showed that simulation is perceived a useful strategy to teach collaboration and problem solving among multiprofessional teams of students taking part in clinical scenarios (Titzer, Swenty, & Hoehn, 2012). This demonstrates the usefulness of simulation to promote the importance of team-based and interprofessional approaches to learning and healthcare delivery (Bradley, 2006). Based on feedback generally provided by medical and nursing students, the nurse - physician relationship is perceived to improve following simulation experience, so it is an educational activity that should be further exploited across all allied healthcare professions (Dillon, Noble, & Kaplan, 2009; Scherer, Myers, O'Connor, & Haskins, 2013). It is however acknowledged that further research is required to prove or disprove the merits of IPE and simulation-based education in improving collaboration among undergraduate healthcare students (Hoffman & Harnish, 2007, Hood et al., in press, Peate, 2013), and how this transfers into the real world post-qualification teamwork activities and impacts on patient outcome (Pollard, Miers, and Rickaby, 2012). There is a particular lack of studies reporting on interprofessional activities involving students from allied healthcare professions (Titzer et al., 2012).

IPE is defined as an educational episode when members of two or more healthcare professions engage in learning with, from, and about each other (Barr, Koppel, Reeves, Hammick, & Freeth, 2005) which aligns to the to the well accepted definition of IPE from the Centre for the Advancement of Interprofessional Education which also adds that it is "to improve collaboration and quality of care" (CAIPE, 2002). To that effect, the way a

simulation experience is facilitated has a strong influence on how much engagement actually happens between the various professions taking part in a joint learning activity. The CAIPE definition further clarifies that the term IPE include all learning in academic and work based settings, before as well as after qualification (CAIPE, 2002), when it would then often be referred to as “team training” and relate to a broader range of literature (Eppich, Howard, Vozenilek, & Curran, 2011).

## BACKGROUND

The institution where this study was conducted introduced a compulsory IPE module in the first and final year of most of its undergraduate healthcare programs since 2003. In 2005 it was decided to supplement the primarily didactic and project-based final year IPE module with an optional high-fidelity simulation-based component in order to enable students to experience multiprofessional teamwork by working alongside their peers from other disciplines in scenarios facilitated in a safe and controlled environment (Alinier & Montague, 2005). Every year between 2007/08 and 2009/10 up to 700 final students from a total of 10 healthcare professions undertook the final year IPE module. Student numbers by profession ranged from around 400 adult nursing students to much smaller cohorts such as the Learning Disability Nursing program with as few as 11 students per year as seen in other studies (Pollard, Miers, and Rickaby, 2012). The large student numbers combined with the complexity of organizing sessions involving several professions in a high-fidelity (very realistic) (Meakin et al., 2013) context using relevant and realistic scenarios encouraged us to only offer these sessions on a voluntary basis and conduct an evaluation study at the same time. Partial funding was granted by the UK Higher Education Academy – Health Sciences and Practice Subject Center and a Learning and Teaching Enhancement Award from the University’s Learning and Teaching Institute to support this study.

The piloting and development of this new IPE simulation strategy was part of an institutional vision and happened in parallel with the construction of a larger and purpose built clinical simulation center to better accommodate the large number of healthcare students and the anticipated increase in simulation activities across a range of professions within the University (Alinier, 2007).

The aims of the project were to:

1. Promote the use of clinical simulation across all the University’s healthcare programs to enhance the students’ learning opportunities.
2. Ensure a high level of activity in the new clinical simulation facilities by developing a program to facilitate interprofessional scenario-based simulation training for final year undergraduate healthcare students.

3. Provide an opportunity for students to observe aspects of the work carried out by other professionals and to interact with them when it is appropriate during a scenario and the debriefing.
4. Explore whether simulation improved trainees' perception about multiprofessional working, IPE, and knowledge of other healthcare professions' roles and skills using a quasi-randomized control group investigation on a convenience sample of students.

The project team was well aware of the potential obstacles to the successful implementation of IPE thanks to the experience of setting up the first year IPE module and researching the literature. The anticipated obstacles were: timetabling, faculty buy-in, varying student cohort sizes, physical and human resource limitations, and reluctance of some educators to change current educational practices (Barnett, Hollister, & Hall, 2011; Cooper, Carlisle, Gibbs, & Watkins, 2001; Oandasan & Reeves, 2005; Pecukonis, Doyle, & Bliss, 2008; Reeves, Goldman, & Oandasan, 2007; Thistlethwaite & Nisbet, 2007; Williams, French, & Brown, 2009).

## METHODS

A multiprofessional project team was setup to administer and deliver the project, with support from faculty staff from all professions involved. The project team was composed of the core IPE team, key faculty with scenario-based simulation experience, and other subject specialist faculty. The project was composed of nine key phases: negotiation with Head of Schools regarding access to students and faculty; institutional review board approval; promotion of the project to recruit faculty; faculty orientation to scenario-based simulation education, debriefing, and the project; design and validation of the multiprofessional scenarios; design and piloting of the evaluation tool; student recruitment to the sessions; delivery of interprofessional simulation sessions with data collection; and data analysis. All these aspects are covered in the subsequent sections of this paper.

To alleviate some of the expected obstacles we obtained permission from the institution to provide students with an official letter addressed to their clinical practice area so they could be excused for half a day in order to attend the IPE simulation sessions. For all students coming under the Nursing and Midwifery Council, this simulation-based educational experience could be counted towards the clinical practice hours that they have to accumulate (Nursing and Midwifery Council, 2007).

### Participants

Participants were undergraduate students from various healthcare programs at a British university. The students were recruited from the final year IPE module over three consecutive cohorts between 2007 and 2010. Other than possible faculty turnaround in

that period of time, none of the programs involved had any significant curriculum changes. The total population included 1885 students from various nursing specialties (Adult, Pediatric, Learning Disability, and Mental Health), radiography, radiotherapy, physiotherapy, midwifery, paramedic science, social work, and pharmacy.

Students were informed about the project via posters displayed around the University as well as email communications explaining the process, purpose, and potential benefits of taking part in the project and one of the associated simulation sessions. Students were explicitly told that participation in the project was totally voluntary and that they could freely withdraw at any point in time. This strategy was adopted in order to maximize recruitment to the study (Treweek et al., 2010).

Students volunteering to take part in the project were invited to register to one of a series of 4-hour simulation sessions on offer using a wiki page designed and managed through StudyNet, the University's online managed learning environment (MLE), for the IPE module. This allowed easier communication with the students from each cohort across the different professional groups.

**Scenario development**

At the onset of the project a bank of scenarios was developed for various combinations of healthcare professions based on the number of students in the individual programs. Each scenario was developed with input from experienced faculty from the relevant healthcare professions and cross-checked by other experienced faculty. The design of the scenarios made use of a template scripting the progress of the patient's health or mental condition as well as the dialogue for the actors potentially involved as illustrated in a published template (Alinier, 2011). The scenario template made also reference to the simulated environments in which the action was taking place as the patient care pathway progressed and gradually involved students from other professions. This often required the scenario to start in a household environment before progressing to a clinical setting. The scenario template used was in the form of a table. It had clear indications as to the professions that were intended to be part of the different sections of the scenario and their expected actions, a description of the patient condition with physiological parameters, script for the standardized patient or patient simulator operator when required, and clear information for any actor involved in the scene. The key learning objectives of each scenario were relevant for all participating students as they mainly addressed issues around communication, collaboration, patient assessment, teamwork, and some clinical skills. The scenario example graphically presented in Figure 1 shows how such objectives could naturally emerge and allowed peer observers and faculty to observe how they were tackled by scenario participants.

Based on the professions involved in the project and to reflect real life patient care pathways, it was judged necessary to develop some exclusion rules for the students' participation in the simulation sessions. For example, no session or scenario could involve pediatric and adult nurses together, or paramedics with radiotherapists, or radiographers and radiotherapists. In addition, each scenario was to involve a maximum of four professions that would become involve in the scenario as it progressed and when required (Figure 1). Two scenarios were developed for each preferred team combination so students would be exposed to two different patient cases during each session, once in a participative manner and once in an observational capacity. A similar approach was used successfully in a previous study (Alinier, Hunt, Gordon, & Harwood, 2006) as it was felt that students also benefit from observing their peers taking part in scenarios.

The scenarios were developed to run as "high-fidelity", in the sense that students were expected to act as qualified healthcare professional and hence not be prompted in their actions and decision making process by faculty, the environments used were realistic and provided the expected cues (Figures 2 and 3), and observers and students on "standby" were in other rooms of the clinical simulation centre. This point was clarified to the students as part of the introduction to each session. If necessary, scenarios could be "utilized" with minimal alterations and without changing the learning objectives even if students from one of the four required professions were not present by involving a faculty as a confederate to play the role of the missing profession.

**The Questionnaire**

The data collection tool developed for this study using a Delphi method with a panel of experienced faculty from various healthcare disciplines consisted of three distinctive components which could all be completed anonymously. The first part was a "pre-simulation experience questionnaire" (Q1) used to collect demographic information about the participants. It was also used to collect information about their previous experience of scenario-based simulation training and apprehension regarding various factors of the forthcoming simulation session they were about to engage in using a 5-point Likert scale (1=Strongly disagree to 5=Strongly agree).

The second questionnaire (Q2) was referred to as the "discipline-specific knowledge questionnaire". It consisted of 5 statements to determine students' views of multiprofessional working and interprofessional education using the same Likert scale, and a series of 40 True/False statements clustered in groups of four for the ten professions potentially taking part in the study. The use of a questionnaire with a True/False design to test knowledge is very easy and objective to score and has been used successfully in other studies (Dixon, 1994; Palmer & Devitt, 2007). The development of Q2 involved faculty from the various professions engaged in the IPE module and the statements were cross-examined by other experienced colleagues from

the same professions to ensure their validity, clarity, and correctness of the expected answers. The statements were formulated by a different team of faculty from those involved in the development of the multiprofessional scenarios to ensure they were generic rather than biased to address aspects of the scenarios.

The third component of the questionnaire was a “post-simulation experience evaluation questionnaire” (Q3) using again the same Likert scale. It was used to further encourage students to reflect on their simulation experience as well as collect feedback about various aspects of the simulation session from an observational and participative standpoint, having been exposed to two scenarios.

The successive use of the various questionnaires is illustrated in the session plan presented in Table 1. Q1 and Q3 are part of the generic simulation questionnaire used by the simulation center for most sessions and been approved by the ethics committee, while Q2 was especially developed for this study and considered separately by the Institutional Review Board.

**Study Design**

This study was designed as a quasi-randomized control group investigation as we used a convenience sample of students from a single institution. For each 4-hour simulation session, students’ semi-randomization to the control or experimental group was based on their order of arrival in the simulation center for the sessions as well as their profession to ensure equal representation in both groups. Control group students were requested to complete Q1 and Q2 before the start of the session, while experimental group students only had to complete Q1 at that stage.

At the start of each session, in addition to the information concerning the project the students could access on the MLE, they were briefed about the project, the format of the session, and what was expected of them during the scenarios in terms of their conduct and actions. As some of the students were from professions that had not yet been exposed to the simulation center, its equipment, and patient simulators, a 20-minute hands-on orientation period was built into the program of each session. This orientation was conducted using the 15 points of the Crisis Resource Management (CRM) concepts as prompts. For example, in the simulation environment, when referring to the use of cognitive aids, treatment protocols and guidelines would be shown to the students, and when pointing out they could “call for help” if necessary, the location of the phone and number to dial was pointed out to them. It was found to be a good way of introducing CRM concepts (Rall & Gaba, 2005) to the students whilst helping them to better “know the environment”.

Prior to starting the scenarios, students were split in two teams as illustrated in Table 1. No specific process was followed to create the teams other than trying to equally represent each profession across both scenarios. The only briefing students received about each scenario was to put it into context (i.e. “Paramedic team responding to an emergency call to a patient who…”, “Physiotherapist visiting a patient at home and here is the physician’s referral letter which indicates that…”). Observers (the other team) were requested to write their comments on a white board during the scenario so their points could be discussed after the debriefing, which is a key phase of any scenario-based simulation session (Gardner, 2013). A study using a 2-group, repeated measures, experimental design conducted by Shinnick et al. (2011) with nursing students demonstrated that debriefing is the most significant contributor to knowledge acquisition following high-fidelity simulation training. Fanning and Gaba (2007) have defined debriefing as a “facilitated or guided reflection in the cycle of experiential learning”. The debriefings were only facilitated by the faculty, hence encouraging scenario participants and observers to fully engage in a discussion about their experience in a chronological order, rather than being “conducted” whereby they might have only received direct feedback about their performance by faculty. As recommended by other educators (Jeffries & Rizzolo, 2006) that activity was allocated as least as much time as the simulation experience to ensure students derived the appropriate meaning from the experience, but also to allow time for the facilitators to identify and close gaps in the knowledge and skills of the learners (Raemer et al., 2011). The debriefers included a minimum of 3 faculty who represented the professions involved in the scenarios and who had received training in the debriefing process of high-fidelity scenarios. The debriefing objectives covered the clinical aspects of the scenarios, variation in practices between the different professions, teamwork, and interactions with the patients and relatives.

Each session concluded with a discussion of the overall simulation experience and multiprofessional team working. The students were then given the questionnaires whereby control group students only had to fill in Q3 while experimental group students had to fill in Q2 and Q3. It is on the basis of the control and experimental group students having filled in Q2 at different times in the session that the effect of this interprofessional simulation experience will be measured in relation to their knowledge of the roles and skills of other healthcare professionals and their perception about multiprofessional working and IPE.

**Ethical Approval**

The overall study was submitted for consideration by the Institutional Review Board and granted approval before the involvement of any student. Informed consent was obtained in writing from all participants and confidentiality was maintained at all times with regards to the data collected.

## Data Analysis

The data from the three consecutive cohorts of students was collated and analyzed using the Statistical Package for Social Sciences version 16 (SPSS, Inc: Chicago, IL). Descriptive statistics were used to compare the demographic data for both study groups and some of the questionnaire results. Independent sample t-tests were performed for key questionnaires items and in addition paired-sample t-test for analysis of variance were performed for related pre/post-simulation experience items. The overall discipline-specific knowledge questionnaire results were calculated for the two study groups and mean scores compared using an independent sample t-test with an assumed level of significance set at 0.05. As we could only expect knowledge acquisition with regards to the three or four professions represented during the scenarios, only the results of the twelve to sixteen corresponding questions were analyzed over each session.

## RESULTS

The data was collected over 30 simulation sessions for a total of 237 students, but only 233 forms were collected as students who decided to attend a second session were not permitted to complete the questionnaires twice. This represents a 12.36% participation rate over three cohorts of students. The number of participants by profession and study group is presented in Table 2 while Table 3 reports on the demographic distribution of the two groups and results to the simulation experience questionnaires. The null hypothesis results of the ANOVA demonstrate that there is no significant statistical difference between the study groups, hence that they are representative of the same population, although this is not linked to academic or clinical performance. According to Q1 data, 45% of the students reported not being familiar with the concepts of clinical simulation, while 21% responded they were strongly familiar with it.

The paired sample analysis of generic pre/post-simulation experience presented in Table 4 shows a number of interesting and statistically significant trends in the students' perception such as not feeling as much pressure about performing "in front" of their peers and instructors as they thought prior to taking part in the simulation session. Students generally think that they benefitted even more than they expected from watching their peer taking part in a scenario. They also found it slightly easier to treat the mannequin as a real patient than first anticipated. Another finding, further supported by the group dependent analysis of the statements of Q2 (Table 5), shows that the students' positivism for taking part in simulation training as part of a multidisciplinary team has been significantly reinforced by the end of the session (Table 4).

Responses to the five Q2 statements are presented in Table 5 and show that there is a small yet statistically significant difference between the two study group ratings for four statements which were respectively scored by the control and experimental group

students as follows: I am confident about working as part of a multidisciplinary team (Control: 3.46, Experimental: 3.94); working as part of a multidisciplinary team would make me feel anxious (Control: 2.60, Experimental: 2.30); I feel I know what other professionals can and cannot do (Control: 2.99, Experimental: 3.27); interprofessional learning before qualification helps me become a better team worker (Control: 4.02, Experimental: 4.35) with 1=Strongly disagree to 5=Strongly agree.

In the other section of Q2, the results of accurate answers for the discipline specific knowledge questions for the control and experimental groups of students were respectively 72.69% (95% CI 70.64-74.73) and 75.92% (95% CI73.73-78.10) (Table 3) based on the 12 to 16 questions relating to the professions represented during each individual session. The overall mean score difference between the two study groups was small (3.23 percentage points) but statistically significant (p=0.03).

## DISCUSSION

The purpose of this study was to explore whether scenario-based simulation improved trainees' perception about multiprofessional working, IPE, and knowledge of other healthcare professionals' roles and skills.

Despite the anticipated barriers to the implementation of this study such as the timetable issues, the team managed to facilitate 30 sessions for a total of 237 students from 7 professions. The study groups were very comparable in terms of professions represented, gender, and age distribution (Table 3). Allocation of the students to the two study groups at the start of each session ensured an equal representation of each profession in both study groups and overall parity in numbers between them for comparative analysis. Allocation to the study groups in advance was considered but judged too unreliable as some students expressed interest to attend a session but ended up not coming.

The most significant results of this study relate to the marked difference in attitude between the two study groups. The experimental group students responded to all five statements relating to multiprofessional working and interprofessional education more positively than control group students. This is in agreement with the findings from a study by Hood et al. (in press) who found that students with prior IPE exposure held a significantly more positive attitude towards this kind of activity. As stated by Freeth and Nicol (1998) "Successful interprofessional learning can provide a model for effective, collaborative working" (p.455). Although limited in time, this interprofessional simulation exposure seems to have impacted the students' interprofessional cultural competency, which has the potential to break down barriers between health professions cultures (Hamilton, 2011). Discussions during the debriefings highlighted the fact that

interprofessional education is important and valued by students once they have experienced it in the form of an immersive scenario tackled without faculty support, yet facilitated in a supportive environment. As found in other studies such experience helped the students clarify their own role as well as the role of other care providers, and most importantly, understand the contribution that effective interprofessional team working can make to the delivery of safe and high-quality care (Freeth & Nicol, 1998; General Medical Council, 2009).

This study has a number of limitations, some of which can be easily addressed by researchers should a similar study be conducted again. Firstly, from a sample perspective, the results are derived from a limited convenience sample from a single higher education institution over a period of three years. Students had limited or no prior exposure to interprofessional simulation, some professions were poorly represented, and these elements can strongly bias the results. Volunteer students may already have a high belief in the advantage of IPE work and most had prior exposure to simulation hence were likely to positively answer subjective questions and reduce potential differences in the results presented in Table 4 and table 5. Secondly, the sensitivity and reliability of Q2 would have been greatly improved if it had contained more questions about each profession whilst only requiring students to address the questions regarding the professions actually represented among the students present during a given session. Having determined a baseline score for both study groups could have also contributed to confirming the findings of this study with regards to the difference in acquisition of knowledge with or without interprofessional simulation exposure. Although modest, the outcome of the overall intervention contributed to enhancing student's knowledge of each others' role with is an important factor of a functional team delivering patient care (MacDonald et al., 2010). Thirdly, due to team composition varying between sessions, the questions over which each student was assessed varied, which resulted in effect in comparing results over slightly different makeup of questions, although they were of a similar level of difficulty, and each variation was completed by a very similar number of students from each profession. Fourthly, an increased dose of simulation provided by one or more additional sessions for the experimental group may have contributed to increasing the validity and gap between the results of the two study groups. Lastly, with a larger sample, a second experimental group of students could have been created to tackle a third assessment point immediately post-scenario to determine the effect of the debriefing. Unfortunately this study cannot determine how this educational experience impacted on the students' clinical practice and patient outcome.

## CONCLUSIONS

High quality education often comes at a cost, and this is especially true of high-fidelity or immersive simulation sessions whereby a relatively high ratio of faculty to students may

be required to run high quality interprofessional education sessions where we ensure that relevant healthcare professions are presented among the faculty. The results of this study show that they are modest yet noticeable differences between the groups' responses to the statements and questionnaire results. Some of these differences may have been reduced due to the effect of a convenience sample with some prior simulation exposure, but they are statistically significant. This study showed that through a limited exposure to a scenario-based simulation experience, the positivism of students with regards to different aspects of multidisciplinary learning and working has statistically significantly improved. In addition students from the experimental group have achieved higher scores on the discipline specific knowledge questionnaire. This proves that it helped them gain knowledge regarding the professions involved in the scenarios and hence further demonstrates the benefits of interprofessional scenario-based simulation education supported with appropriate debriefing. Linking this type of activity to actual changes in clinical practice and in terms of patient safety or patient outcome is a project the researchers aspire to whilst although being conscious of the challenges to put this in place with such a highly mobile workforce.


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Figure 1: Example of a multiprofessional scenario with representation of the logistics to involve the various students in multiple environments.

Figure 2: Scenario taking place in the household environment with a simulated patient.

Figure 3: Scenario taking place in the Emergency Department of the simulation center.

Table 1: Interprofessional simulation session timetable with assignment of the study group participants.

Table 2: Number of students from each profession in the control and experimental groups of the study.

Table 3: Demographic information relating to both study groups and results of the simulation experience questionnaire and independent t-tests.

Table 4: Results of paired-sample t-test for related questionnaire items between pre/post-simulation experience (with 1=Strongly disagree to 5=Strongly agree).

Table 5: Responses to the questionnaire 2 statements with regards to students' view of multidisciplinary team working and interprofessional learning (with 1=Strongly disagree to 5=Strongly agree).