Mixing Pre-clinical and Clinical Medical Students in Full Patient Simulation: Impacts and Outcomes

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**Abstract**

**Introduction:** Full patient simulation is an accepted learning modality in the final years of undergraduate medical education. Less explored is its applicability to the pre-clinical stages of the medical curriculum or as a medium for peer learning. To investigate these issues we conducted a simulation study involving mixed teams of pre-clinical and clinical medical students.

**Methods:** A sample of 52 medical students (27 year four, 25 year two) participated in one of six full patient simulation sessions. A mixed study design involving an online questionnaire and focus groups was used to assess the students’ perceptions regarding their recent simulation experience and the proposed addition of simulation into the preclinical stage of their medical curriculum.

**Results:** Focus group thematic analysis identified three major themes: non-technical skills, learning opportunities during simulation and simulation in the medical curriculum. The opportunity to practise team working and communication between different year levels was identified as a particular advantage. Questionnaire responses demonstrated an overall positive perception of the mixed year simulation experience.

**Conclusion:** This study demonstrates the unique peer learning opportunities created through combining pre-clinical and clinical undergraduates in full patient simulation. The positive impact of these sessions on students’ perceived acquisition of non-technical skills, specifically those of communication and team-working with colleagues of different skill levels, supports the incorporation of inter-year simulation into the undergraduate medical curriculum.

**Keywords:** Full patient simulation; Medical undergraduate; Peer learning

**Introduction**

Simulation training is increasingly accepted as an important component of the undergraduate medical curriculum.
worldwide (Friedrich 2002; Issenberg, McGaghie, Petrusa, Lee Gordon & Scalese, 2005; Salas, Weaver, Diazgranados, Lyons & King, 2009). Simulation modalities range from practising cannulation on model arms through to full patient simulation (FPS) using highly technical mannequins in recreated clinical environments (Maran and Glavin 2003). Alongside clinical skills, simulation has also been shown to enhance non-technical abilities such as team work and communication, a lack of which has frequently contributed to medical errors (Issenberg et al 2005; McGaghie, Issenberg, Petrusa & Scalese, 2010).

When designing undergraduate simulation programmes it is important to consider a number of factors, one of which is the year of study in which simulation is to be initiated. Traditionally simulation has been used and extensively studied during the clinical years of medical school. In this context, such training is often positively received by students with the majority believing it should become more prominent in their course (Gordon, Wilkerson, Shaffer & Armstrong, 2001; McMahon, Monaghan, Falchuk, Gordon & Alexander, 2005; Gordon et al 2006a). The addition of simulation to the early years of medical education is relatively recent but provides a potentially effective means of easing the transition between the classroom to clinical rotations, a situation which students have often found challenging (Radcliffe & Lester 2003; Prince, Boshuizen, Van Der Vleuten & Scherpobier, 2005; O’Brien, Cooke & Irby, 2007). The demonstration that simulation in the pre-clinical years aids such a transition supports its use in bridging the gap between theory and clinical practice (Gordon, Brown & Armstrong, 2006b; Okuda et al 2009; Halm, Lee & Franke, 2010). In contrast, others have suggested that a lack of communication and clinical skills in the early years of medical education may result in simulation being perceived as stressful and therefore detrimental to the pre-clinical student (Reedy, 2015). Consequently the extent to which simulation can be of educational benefit to pre-clinical students is currently unclear.

The composition of students involved in a simulation programme is another relevant factor to consider. Originally medical student simulation sessions were uni-professional. However, due to an increasing appreciation of the importance of interprofessional work and education, programmes have been developed encompassing students from allied healthcare professions such as midwifery and nursing (Holland et al 2013; Thomas, Reedy & Gill, 2014; Tofil et al, 2014). These sessions provide an effective means of developing communication skills between different team members, an important constituent to improving patient safety (Kennedy, 2001; Francis, 2013). In contrast there has been limited experience of mixing undergraduate medical students from different year levels in simulation sessions. Such a combination would not only create a peer learning environment but would offer the opportunity to practise communication between practitioners of different skill levels, the ability of which is again integral to safe medical practice (Mujumdar & Santos, 2014).

The School of Medical Education at King’s College London (KCL) currently runs a FPS programme for final year medical students. Internal evaluation of these sessions is overwhelmingly positive with repeated requests for more simulation opportunities. In order to explore the potential expansion of the simulation programme at KCL and research the possible benefits of mixed year simulation, a pilot study was carried out involving both pre-clinical and clinical students in the same simulation session. This combination allowed for investigation into the perceptions of participating students regarding both the peer learning aspect of this unique combination and the potential impact such multi-year participation was considered to have on the student’s ability to work and communicate with colleagues at different levels of training.

**Method**

**Sample**
A total of 52 undergraduate KCL medical students from the fourth (n=28) and second (n=24) year participated. Students were recruited through an advertisement on the online medical school forum.

**Design**

The study was conducted on the medical school campus in March and April 2016. Each student attended a single simulation session. The study design is outlined in figure 1. Students provided written consent to complete an online questionnaire and to participate in an audio-recorded focus group following their simulation session. Students were informed that participation or non-participation would not affect the outcome of their degree in any way. The study received ethical approval from the King’s College Research Ethics Committee (Number: LRS15/162472).

**Simulation Session**

A total of six half-day simulation sessions were conducted over three separate days. Participant numbers per session ranged from five to ten students. Each session consisted of three 20 minute clinical FPS scenarios followed by facilitated group debriefings of approximately 20 minutes (Figure 2). Sessions commenced with a workshop to orientate students to the simulated clinical environment and to meet the FPS mannequin (Gaumard Hal). Students were briefed as to what they may be expected to do and how to call for help when needed. An ‘embedded practitioner’ was present throughout each session and acted as the equivalent of a nursing assistant.

The three scenarios followed the medical journey of a 78-year-old woman on a single hospital admission. In the first
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scenario the patient arrived in the Emergency Department with a community acquired pneumonia, in the second
scenario she sustained a neck of femur fracture following a fall on the ward and in the third she developed a
pulmonary embolism. Each scenario began with a maximum of two second year students performing an assessment
of the ‘patient’ including a short history and set of observations. When the student(s) felt the need for assistance they
had to call for help and handover verbally to one or two fourth year students. On arrival the fourth year student(s)
continued the clinical management together with the second year student(s). Each student participated in one
scenario and viewed the remaining scenarios in their session via a live video-link in another room.

![Diagram]

Students attend one of six FPS sessions
Each session involves a maximum of five second year and six fourth year students

Session begins with briefing and orientation to the ward and mannequin

First clinical scenario: Community Acquired Pneumonia (20 mins)
1-2 second year students and 1-2 fourth year students actively participate
Remainder of student group observe scenario via video-link

Whole group debrief (20 mins)

Second clinical scenario: Fractured Neck of Femur (20 mins)
1-2 second year students and 1-2 fourth year students actively participate
Remainder of student group observe scenario via video-link

Whole group debrief (20 mins)

Third clinical scenario: Pulmonary Embolism (20 mins)
1-2 second year students and 1-2 fourth year students actively participate
Remainder of student group observe scenario via video-link

Whole group debrief (20 mins)

Whole group Summary and Reflection (15 mins)
Following each session the students returned to the wider student group for the purposes of debriefing and discussion of the preceding scenario. A minimum of two experienced facilitators oversaw the debrief using the ‘Debrief Diamond’ structure (Jaye, Thomas & Reedy, 2015).

**Data collection**

**Questionnaire**

An online questionnaire was e-mailed to participants within 48 hours of their simulation session using the online survey software ‘SurveyMonkey’ (SurveyMonkey Inc, California, USA). The questionnaire comprised of ten closed and six open-ended questions exploring aspects of the students’ simulation experience and its applicability to the undergraduate curriculum.

**Focus Group**

After participating in the FPS the students were invited to attend one of six focus groups comprising of a mix of second and fourth year students. The size ranged from three to ten participants and was conducted by members of the research team. An interview schedule facilitated a semi-structured approach. Focus groups were audio-recorded and lasted approximately one hour.

**Data analysis**

Quantitative questionnaire responses were analysed using SPSS version 22.0 (SPSS Inc., Chicago, USA). Focus group audio recordings were transcribed verbatim. Answers from the open-ended questions and focus group transcripts were collated and underwent thematic analysis. An initial list of emerging themes was compiled by the research team. Themes were discussed, refined and a consensus was reached on three main themes. Transcripts were coded accordingly.

**Results**

**Quantitative Results**

The response rate for the questionnaire was 100% (n=52). Quantitative analysis of the responses to the closed-ended questions showed that 50 students (96.2%) rated the simulation session as a positive experience, no student considered it to be negative. A total of 40 (77%) students graded the peer learning aspect of the simulation as either ‘very’ or ‘extremely important’ and the majority reported that it had altered the way they approached the learning, observing and understanding of clinical practice (table 1). All students would include simulation in their curriculum (table 1) with the majority reporting they would commence such sessions during the pre-clinical years (n=42, 81%). Students varied with regard to how often they felt simulation should be provided ranging from weekly (n=11, 21%)
to once per rotation (n=6, 11%).

<table>
<thead>
<tr>
<th>Question</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has simulation changed the way you approach learning?</td>
<td>33 (63)</td>
</tr>
<tr>
<td>Has simulation changed the way you observe clinical practice?</td>
<td>46 (88)</td>
</tr>
<tr>
<td>Has simulation changed the way you understand clinical practice?</td>
<td>40 (77)</td>
</tr>
<tr>
<td>If you could redesign your current curriculum, would simulation be in it?</td>
<td>52 (100)</td>
</tr>
</tbody>
</table>

Table 1: Number (n) of students answering 'yes' to categorical questions relating to their simulation experience. Total respondents = 52 students.

**Focus Group Thematic Analysis**

A total of 38 (73%) students participated in a focus group. Thematic analysis identified three main themes: non-technical skills acquisition, learning opportunities during simulation and simulation in the medical curriculum.

**Non-Technical Skills Acquisition**

Two sub-themes were identified: Team-working and Communication.

*Team Working.* A positive experience of the team work aspect of the scenario was one of the most prominent areas discussed by the students. For some, this experience was the first time they had ever worked in a clinical team:

"It was interesting working in a team because you don't really get to do it as a medical student" (4\textsuperscript{th} year)

The inter-year approach was considered by both year groups to enhance the session with regard to the development of team working skills. Specifically, second year students felt reassured by the fourth year student’s presence and reported the opportunity to practise being led by more senior colleagues reflected the situation they will encounter on clinical placements. In contrast, fourth year students found the sessions enabled them to experience a leadership role, often for the first time:

"It was useful...to have to take the leadership role because...it kind of forced you to be in a position where you're actually doing something" (4\textsuperscript{th} year)

In this new capacity as ‘team leaders’, the fourth year students felt they had developed a greater understanding of team working especially with regard to the importance of ‘followership’ and closed loop communication. In each focus group fourth year students commented that they would like more teaching and practise on how to be effective leaders.

During four of the six focus groups a discussion developed regarding the perceived difficulties when delegating tasks to peers, a situation students cited little or no previous experience of. Specifically students reported feeling awkward in adopting a leadership role when teamed with a student from the same year level. Although this was perceived by
those involved in the scenario to result in a lack of leadership and subsequently sub-standard patient management, it was considered by the majority of students to demonstrate the importance of being able to delegate and take a leadership role in an acute clinical situation in order to ensure patient care.

Communication. Students from both years reported that simulation allowed them to practise and contextualise their communication skills in a realistic setting. In particular, second year students commented that practising patient handover was a beneficial part of the simulation session by providing them with an increased understanding of the importance of communicating a patient’s situation in a clear and succinct manner. Conversely, fourth year students reported that receiving the handover gave them a unique perspective from which to reflect on their own handover technique and consequently enabled them to identify aspects requiring improvement:

“Because it’s the first time we are being reported to, it made me think a little bit about why I’m giving the information that I’m giving when I’m giving other people information” (4th year)

Learning opportunities during simulation

Three sub-themes were identified: Application and consolidation of theoretical knowledge, Peer learning and Learning by practical application.

Application and consolidation of theoretical knowledge. Simulation was considered by second and fourth year students in each focus group to aid learning by providing a context to the theoretical knowledge gained previously:

“When you learn it, you just learn a single bullet point guideline and it’s never … linked together whereas suddenly [you] have to integrate things and think” (4th year)

Peer learning. There was a general consensus from students in both years that observing their peers was beneficial. Specifically, students from all of the focus groups agreed that observing how fellow students performed in a clinical situation was useful in demonstrating that there is more than one ‘correct’ way to address a clinical situation:

“It showed the differences in ways that you can do things…you learn from others, others learn from you” (2nd year)

The majority of second year students reported being reassured and motivated when watching the fourth years with regard to their likely progress over the next two years:

“Seeing the fourth years just integrate all that knowledge together in a clinical setting…inspires you” (2nd year)

In contrast, many of the fourth year students reported being encouraged by seeing how far they had come since second year:

“The difference between how I felt in second year towards approaching a situation like that and now, it’s reassuring…I have learnt something in my clinical years” (4th year)

Learning by practical application. Twenty-seven of the students said that the opportunity to both practise and reflect upon their ability to carry out numerous technical skills to be an advantage of the simulation session. They generally commented that they felt more confident in putting these skills and knowledge into practise following the simulation session. Both year two and four students also reported that making their own independent decisions was a better way to learn than following instructions. For example, students commented that simulation was a useful means of demonstrating the importance of working within their limits, enabling them to decide when to call for help and subsequently understand that it is good clinical practice to do so.
A minority from both year groups reported that their performance in the simulated scenario was not as good as they had expected. All except one of these students acknowledged that such a situation had provided them with an opportunity to reflect upon this discrepancy and identify means of improving their clinical skills:

“We’ve realised that while we do know the basics…we weren’t quite as good at implementing it as we thought we would be and that’s something that we now know we need to work on” (4th year)

The remaining student explained how such a situation had left them feeling demoralised immediately after the simulation. However, following debriefing and later discussions with colleagues, they realised the positive value of the session and despite their initial reaction, were keen to repeat the experience in an attempt to improve their performance.

Simulation in the medical curriculum

In each focus group there was widespread agreement that a structured simulation program would provide an opportunity to reinforce and practise the skills taught throughout their course. With regard to the timing of simulation, there was a consensus amongst second year students that sessions should be initiated in the second year. In contrast, four fourth year students considered this to be too early, denoting a lack of clinical knowledge as a reason. None of the second year students agreed with this opinion, citing how beneficial the experience had been:

“As a 2nd year, I found it really useful. Even though we may not be clinically there yet…it just gives you a bit more confidence and scope to see where you’re going with what you’re doing” (2nd year).

Discussion

This study examined the views of undergraduate medical students following simulation with a mix of pre-clinical and clinical students. This novel education opportunity was positively received and revealed new advantages that can be obtained from the multi-level participation of pre-clinical and clinical students in a single simulation with regard to the development of non-technical skills and peer learning.

The multidisciplinary nature of healthcare means that team working is an essential skill for medical professionals and yet the exposure of students to clinical situations where such skills can be developed is highly variable (Salas, Diazgranados, Weaver & King, 2008; Banerjee et al, 2016). Previous research has demonstrated the benefits of inter-disciplinary simulation in enhancing team working between different specialties (Yule, Flin, Paterson-Brown & Maran, 2006). However within disciplines there also exists a hierarchical structure, for example the relationship between junior and senior doctors, which requires individuals to take on followership or leadership roles. The present study sought to simulate this latter situation by combining second and fourth year students. This mixture was well received by the participants and revealed some interesting insights. Specifically, peer instruction enabled second year students to take part in the management of a patient via a followership role whereas fourth year students were provided with the unique opportunity to experience a leadership role. It may be argued that leadership skills are effectively developed through practise and consequently simulation provides an ideal medium in which to do this. In addition, during the scenario with two fourth year students present there was often uncertainty with regard to who should take the lead culminating in perceived poorer patient management. This suggests a subconscious expectation for a single person to lead, discounting that there are often team members with comparable experience and therefore in a position to adopt the leadership role. Learning how to work together in these situations requires experience (Middleton, 2013) which, in the absence of real life clinical opportunities, may be provided through multi-level
simulation sessions.

Consistent with previous research, the ability to practise communication skills was also cited by students as an advantage of simulation (Aboumatar et al, 2012). However, in the current study, the presence of two year groups enabled students to specifically gain experience related to communicating with colleagues possessing different skillsets. Particularly singled out by both second and fourth year students was the opportunity to practise delivering and receiving a handover to students of different levels of seniority. This learning experience is important as an effective clinical handover has been widely demonstrated to reduce patient harm (British Medical Association, 2004).

Simulation has predominantly been reported to enhance the participant’s motivation to learn (Gordon et al, 2010). In the present study similar sentiments were expressed by the students. In contrast to previous research, such motivation appeared to be related to the novel use of mixed year groups and subsequent observation of their peers. Specifically, second year students reported that observing how much their fourth year counterparts knew and were able to do provided them with an insight into how they might progress and subsequently motivated them to learn. Conversely fourth year students, upon seeing how far they had come since second year, were reassured as to their current trajectory and felt motivated to continue and improve areas of weakness. This student reflection would not occur in the absence of mixed year groups.

Whilst the introduction of simulation to the pre-clinical stages of medical training has previously been disputed (Gordon et al, 2010; Swamy et al, 2014; Acton, 2015), in this study the majority of students supported the addition of simulation to the pre-clinical medical curriculum. Some fourth year students did raise concerns as to whether the knowledge base of pre-clinical students was substantial enough for them to participate in the scenarios. However this was a minority view and was not supported by any of the year two students. The finding that most students from both years would like simulation at least once per rotation highlights their enthusiasm for this teaching modality.

There were several limitations to this study. It was set in a single medical school and therefore further research is required to explore if similar results are found in other settings. The inclusion of a self-selected group of students raises the possibility that only students who perceive simulation to be an effective learning method participated leading to potential bias of the results towards a positive view of the experience. This was also many of the participants' first FPS experience at the studied institution which may have increased their enthusiasm for this teaching modality. The mix of students in each scenario was not standardised so that each scenario either had one or two second and fourth year students, a potential confounding factor with regard to the students’ FPS experience. However, this variety produced rich discussion in the focus groups of the most effective student mix with a consensus of the ideal being one second and one fourth year student.

**Conclusion**

This study explored students’ perceptions of FPS sessions involving pre-clinical and clinical year groups. The overwhelmingly positive response and request for further simulation by both pre-clinical and clinical students is consistent with previous findings (Agha, Alhamrani & Khan, 2015; Paskins & Peile, 2010; Gordon et al, 2001) and understandable given the high value students place upon clinical exposure. However, the unique peer learning experience and opportunity to manage an acute clinical case with colleagues at different levels highlights the additional educational advantages that occur by combining year groups. It is the research team’s belief that the role of simulation should be expanded and become an integral part of medical education from early in the curriculum as to enable students to develop the skills they will require throughout their medical training and subsequent career. In light of this, our institution aims to introduce a simulation programme extending from year two onward as a means of supplementing the didactic and clinical teaching students currently experience.
Take Home Messages

Notes On Contributors

AE, LT, and CB conceived this study. AE was involved in gaining ethical consent, data collection, analysis and preparation of the manuscript for publication. JS was substantially involved in the analysis of quantitative and qualitative data and co-authored the manuscript. CB was involved in facilitating simulation sessions and data collection. LT was involved in gaining ethical consent, coordinating and contributing to the data collection and the early stages of data analysis.

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Appendices

Declarations

The author has declared that there are no conflicts of interest.

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