Small Group Tutorials in Radiology: a Pilot Study

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Abstract

Rationale: Radiology plays an integral role in the diagnosis and management of disease. As diagnostic images are frequently reviewed by junior doctors prior to the formal Radiology report being issued, it is essential that they are armed with the skills to correctly interpret pathological findings, especially out of hours. Effective radiology teaching is of considerable benefit to patients as critical findings are less likely to be missed or misinterpreted.

Methodology: Quantitative methods were utilised for data collection. Sampling was purposive as questionnaires were disseminated at the end of the series of small group tutorials. The response rate was 81.4% (228/280).

Findings: The data extracted from this research demonstrated the positive impact the change initiative had on the 228 participants. 91% of postgraduates and 84% of undergraduates rated the small group tutorials as either essential or very helpful. 100% of participants would like more radiology teaching with 85% preferring the small group tutorial format. Worryingly, 85% of junior doctor’s and 44% of undergraduates felt that their radiology training had insufficiently prepared them for the clinical duties of a junior doctor.

Conclusion: This research supports the implementation of small group tutorials in radiology into the medical undergraduate and postgraduate curriculum.

Keywords: Radiology Teaching; Small Group Teaching; Small Group Learning; Medical Education

1. Introduction

Diagnostic Radiology plays an integral role in the diagnosis and management of disease. It is regarded by many as the 'eye' of modern medicine with its use and basic interpretation forming a key component of the role of a junior doctor. However, many doctors do not have an appreciation of the appropriate use of radiology, surrounding radiation safety issues or viable alternatives in order to optimise patient care.

This research involved modifying the delivery of teaching from traditional didactic lectures to interactive small
group tutorials. It was postulated that small group tutorials in Radiology would provide final year students and junior doctors with the necessary skills to be able to request the correct investigation in the appropriate setting and to be able to identify medical/surgical emergencies, especially out of hours, using Radiological studies.

The impetus for this change initiative arose from several external and internal factors within the medical arena and the higher education sector alike. In particular, the ‘National Strategy for Higher Education to 2030’ report recommended focusing on learning outcomes so that graduates would obtain the core transferable knowledge, skills and attitudes necessary for a smooth transition into the workplace. Secondly, the paradigm of modern medicine has changed considerably over the last decade due to the incongruence between resources and demands placed on the healthcare system. For this reason, it is pertinent that we devise dynamic, creative and efficient ways of educating students so that future doctors can negotiate the challenging healthcare environment and become competent fluid practitioners.

2. Background

Medical education strives to arm doctors with the necessary tools to become competent, autonomous practitioners. However, this does not always translate into reality, especially when junior doctors are thrust into the working environment with all its demands, both clinical and non-clinical. Often, graduates can feel relatively comfortable with clinical tasks but are overwhelmed by the level of organisational and managerial skills required to manage patient caseloads. The shift from academic medicine at an undergraduate level to the reality of efficiently managing real life patients, a demanding workload as well as postgraduate exams can lead to stress and burnout. This raises the question as to whether one can improve the underlying teaching methods so that doctors can be more dynamic and resilient practitioners from an early stage. It is clear that there is a misalignment between the medical education continuum and preparedness for practice. This research aimed to bridge the gap with the addition of small group Radiology tutorials to the standard lecture-based curriculum in a bid to enhance the learning experience and make junior doctors more fluid in the clinical arena.

2.1 Radiology Teaching

The landscape of medical education is continuously evolving and the speciality of Radiology is no exception. Over the last century three distinctive educational reforms have occurred. In the first generation of medical education, curricula were mainly science based. Teaching methods evolved around the mid 20th century and saw the inclusion of Problem Based Learning (PBL). This signalled the beginning of the second generation of medical education. Moving forward to the present day, third generation curricula are ‘outcome or competency based’ and are focused on developing core professional competencies in tandem with an integrated scientific knowledge base. Radiology teaching is a prime component of competency-based education as it integrates several disciplines including Medicine, Surgery, Anatomy and Pathology, thus exemplifying an inter-professional multidisciplinary approach to medical practice.

There is much evidence in the literature to support the use of Radiology teaching in the medical curriculum in order to enhance student performance at both undergraduate and postgraduate level. The European Society of Radiology surveyed 27 European countries in order to evaluate Radiology teaching within academic institutions across Europe. The results of the study revealed several interesting trends. Of the 93 European teaching institutions surveyed, Radiology was a consistent part of the medical curriculum in every training year. Furthermore, the importance of Radiology was evident in the large proportion of allocated teaching hours ranging from an average of 65-89 hours in an academic year. This highlights the pivotal role of Radiology tuition in both
the preclinical (year 1-3) and clinical years (year 4-5) as it encompasses the skills required to investigate, diagnose and manage illness.

Despite the volume of evidence to support the mainstream integration of Radiology into the medical curriculum, there is a paucity of research in relation to the use of small group tutorials as a method of teaching Radiology. Small group tutorials are an interactive form of teaching with many studies reporting a strong student preference for teaching with interactive case based discussions. Malek et al reported improved enjoyment and concentration with significantly better learning outcomes when using case based teaching in Radiology. It is clear that educational strategies such as small group teaching, which actively engages students, helps to enhance motivation and foster critical thinking skills.

2.2 Overutilisation of Medical Imaging

Over utilisation is defined as the application of an imaging procedure where the result is unlikely to improve the patient outcome. Over the past decade, Radiology services and their costs have grown at twice the rate of other health care technologies such as laboratory procedures and pharmaceuticals. Although this growth reflects increasing applications for diagnostic imaging techniques such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET), a significant proportion can be attributed to overutilisation. Alarmingly, it is estimated that between 20-50% of all imaging procedures are unnecessary. This exposes patients to unnecessary radiation, inappropriately utilises hospital resources and significantly adds to the cost of health care.

There are several contributory factors to the overutilisation of medical imaging. Firstly, referring Physicians can have inadequate information about the patient and can often request an imaging procedure before checking previous imaging results. This leads to unnecessary imaging procedures and in some cases, duplicate exams. ‘ Appropriateness Criteria’, which act as a guide to requesting the most suitable imaging procedure, are widely available. However, there is a general lack of knowledge as to when to use and how to apply the criteria. Interestingly, approximately 80% of interns have never heard of the American College of Radiology Appropriateness Criteria (ACR-AC), yet junior doctors are the team members who most frequently request imaging studies. Radiology teaching at both undergraduate and postgraduate level is essential in order to convey the appropriate use of medical imaging, viable alternatives, associated risks and contraindications. This requires openness and collaboration between Radiology and other specialties in order to effectively deliver the ‘image gently, image wisely’ message.

2.3 Small Group Tutorials

Small group teaching is an educational strategy that may be used to deliver an educational program. It is useful as it allows students to clarify misunderstandings, test hypotheses and evaluate ideas in a non-threatening open environment. In recent years, many universities have incorporated small group tutorials into the medical curriculum as part of their curricular reform. However, there is a general paucity of literature examining its effectiveness as an educational intervention, especially within the speciality of Radiology.

In a recent article, Ferris discussed how there has been an increase in the popularity of small group learning in medical education as it provides a dynamic and collaborative forum for learning. Research has shown that students taught in this way retain more material for longer as it prepares learners to be independent thinkers, a vital skill in the fast changing world of medicine. In addition, students who engaged with small group tutorials are more motivated to learn, which in turn helps to promote the elaboration of knowledge and clinical productivity.
However, small group teaching demands finely tuned educational techniques, leadership, and a higher teacher:student ratio, which may prove costly in financial and logistical terms. Small group teaching has many advantages as an educational intervention when compared to other strategies such as large group lectures. Specifically, it encourages an in-depth understanding of a topic rather than superficial learning where the emphasis is on memorisation. It does so by being interactive and it has been shown to engage students in lively discussion and critical thinking. However, effective small group learning in medicine is not an easy undertaking and has many challenges associated with it. Essentially, the success or failure of the educational strategy depends on the teacher. For instance, those who are accustomed to lecturing may be less comfortable in the role as facilitator in small group settings. Often, this can lead to small group work deteriorating into mini-lectures. Other common difficulties include a lack of student participation, discussion dominated by a few students or an insufficient variety of activities in a session.

There is a growing appreciation of small group tutorials as a valid educational tool in medical education. This is indicative of the shift from a traditional teacher centred approach to student-centred learning, which is characterised by independent thinking, active discussion and autonomous learning. However, small group teaching should be planned carefully and both students and teachers should be taught how to work with it.

3. Methodology

Quantitative methods were utilised for data collection. A survey was developed in order to ascertain how undergraduates and postgraduates perceived the pilot series of small group tutorials. The questionnaire utilised a combination of open ended, closed and scaled questions with an option for additional comments. The authors sampling was purposive as questionnaires were disseminated at the end of the series of small group tutorials. Total target population of 280 participants.

4. Results

The Kirkpatrick model of evaluation was used to evaluate the results:

4.1 Level 1 Reaction – Did the participants like the training?

The participants reacted positively to the training and it was very well received overall. They were enthusiastic about attending tutorials and were actively engaged during each session with lots of questions and lively discussion. 91% of postgraduates and 84% of undergraduates rated the small group tutorials as either essential or very helpful (Figure No.1).
Radiology teaching is currently mainly given at undergraduate level but the participants felt strongly that Radiology teaching should be given at both undergraduate and postgraduate level (Figure No. 2).

Both undergraduates and postgraduates understood the benefits of Radiology teaching and felt it would help them in their role as a junior doctor (Figure No. 3).
4.2 Level 2 Learning – What knowledge, skills and attitudes changed as a result of teaching?

It was rewarding to see how much confidence the small group tutorials gave the participants in their ability to correctly interpret Radiology and therefore utilise it more appropriately. For instance, only 20% of postgraduates felt able to interpret common CT Brain findings before the small group tutorials. However, with further teaching 100% of postgraduates felt they would be able to spot emergent diagnoses correctly on a CT Brain (Figure No. 4).

Similarly in the undergraduate cohort, only 52% felt confident in their ability to interpret a trauma series i.e. correctly identify a fracture. However, following the small group tutorials this figure increased to 90% (Figure No. 5).
The participants recognised the potential of online resources as a learning tool with 97% of postgraduates and 94% of undergraduates saying they would use an online series of tutorials (Figure No. 6).

4.3 Level 3 Behaviour – Did the participants change their behaviour based on what they learnt?

The clinical scenarios discussed during the tutorials were designed to represent real life circumstances and highlighted the integral role of Radiology in the management of medical and surgical cases. Throughout the series of small group tutorials the author emphasised the importance of critical thinking and self-directed learning as unfortunately, formal teaching for junior doctors is generally not a priority in the Irish healthcare system. All too often, it is not until junior doctors are ‘on call’ that they are acutely aware of the gaps in their knowledge base and how much they have left to learn. The small group tutorials sought to arm doctors with the skills to recognise emergency scenarios and take appropriate action. At the end of the teaching sessions, it was rewarding to see the motivation for studying Radiology shift from ‘passing the next exam’ at undergraduate level to ‘becoming a better doctor’ at postgraduate level (Figure No. 7).
4.4 Level 4 Results – Did the change in behaviour positively affect the organisation?

Participants welcomed the opportunity for additional teaching and were very satisfied with the small group tutorials. This was reflected in the fact that 100% of participants wanted more Radiology teaching (Figure No. 8).

Furthermore, the majority of participants preferred the small group setting to the lecture format (Figure No. 9). These tutorials raised morale amongst junior doctors as it gave them confidence in their ability and enhanced their level of engagement with the organisation, which in turn should increase job satisfaction. This is of the utmost importance when trying to retain junior doctors within the organisation and the Irish healthcare system.
At a post graduate level, time for formal learning is a luxury and protected teaching time is often not afforded. The Buttimer Report in 2012 analysed the cost of providing protected teaching time for one half day a week for 2000 Non Consultant Hospital Doctors and estimated the cost at €14,894,400⁴⁰. The high cost involved in such an endeavour is appreciated; however, it is far less than the cost to the health service and the exchequer when almost 40% of doctors, whom the state has invested in, take their expertise to a more supportive foreign land⁴¹.

It is imperative that a positive learning environment is fostered in medical departments so that junior doctors receive appropriate teaching. In turn, this would lead to a high-quality service with less medical errors and less migration of junior doctors.

5. Discussion

Delivering Radiology teaching to junior doctors is an important task but one that is often overlooked. As diagnostic images are regularly reviewed by junior doctors prior to the formal Radiology report being issued, it is essential that we arm them with the knowledge and skills to correctly interpret pathological findings and spot emergent diagnoses, especially out of hours. Effective Radiology teaching is of considerable benefit to patients as critical findings are less likely to be missed or misinterpreted⁴¹. Similarly, the correct interpretation of basic Radiological findings prevents further inappropriate imaging studies from being requested, which in turn leads to less exposure to radiation and reduces hospital costs. It is therefore in the interest of both patients and the hospital to have well-educated junior doctors so that efficient and cost effective healthcare can be provided.

5.1 Student Preference of Small Group Tutorials

One of the most optimistic findings from the data extracted is that participants valued the interactive small group tutorials with 91% of postgraduates and 84% of undergraduates rating them as either essential or very helpful. This is in keeping with the current literature where interactivity has been highly valued by students, possibly due to the enhancement of problem-solving skills and stimulation of critical thinking⁴²,⁴³. The case-based discussions provided during the tutorials in this study were clearly the favourite teaching format with 85% of participants preferring small group tutorials on their own or in conjunction with lectures in comparison to lectures only. The participants' comments are a testimony to this (Figure No. 10).
Several other studies have reported similar findings with Zou et al. reporting that the majority of students preferred teaching with interactive dialogues, preferably in small groups with students volunteering to answer questions. However, a certain degree of basic knowledge is required to facilitate discussion and this may be more efficiently covered prior to small group tutorials in didactic lectures or via online resources. Furthermore, interactivity has been reported to lead to better learning outcomes through improved concentration, enjoyment and critical thinking. It is not surprising that there has been an increase in the popularity of small group learning in medical education as it provides a dynamic and collaborative forum for learning. Research has shown that students taught in this way retain more material for longer as it prepares learners to be independent thinkers, a vital skill in the fast changing world of medicine.

5.2 Desire for more Radiology Teaching

This study clearly demonstrated that final year medical students, Interns and Senior House Officers have an interest in radiology with 100% of participants wanting more teaching in this subject area. This positive reaction and willingness to engage with teaching is encouraging as the benefits of effective radiology tuition are exponential and have been demonstrated by several authors. Branstetter et al. highlighted how better informed medical students are more likely to request appropriate diagnostic tests when they become clinicians. This not only improves patient care but strengthens the relationship between radiologists and future clinicians.

5.3 Inadequacy of Radiology Teaching
The importance of teaching basic radiology to trainees is highlighted by the fact that nearly two-thirds of Interns are frequently expected to independently make preliminary interpretations of imaging studies. Despite the fact that many junior doctors receive formal radiology teaching as undergraduates, this training is often deemed to be inadequate by the trainees. Saha et al. reported low confidence levels in making basic diagnoses from chest radiographs or evaluating the position of lines and tubes, a common indication for imaging. This worrying trend was echoed in the findings of this study where 85% of junior doctor's and 44% of undergraduates felt that their radiology training had insufficiently prepared them for the clinical duties of a junior doctor (Figure No. 11). Perhaps the disparity in satisfaction rates between undergraduates and postgraduates can be attributed to the fact that undergraduates do not yet have a full appreciation of the integral role of radiology in the clinical tasks and responsibilities of a junior doctor. As the majority of curricula for teaching radiology are lecture based, adding educational strategies such as small group tutorials and E-learning would address these deficiencies and make radiology teaching more effective.

5.4 E-learning

In recent years many universities have reformed their medical curricula in order to cater for the needs and expectations of Generation Y. Modern day students are information rich but time poor and are using technology to embrace informal ways of learning, which enables them to take charge of their professional development. Radiology is no exception to this and the findings in this study highlight the need for online resources and blended learning programs with 97% of participants saying they would use online radiology tutorials if they were available. This phenomenon is not new and reflects the changing use of technology and the media in general amongst medical students and junior doctors of today who are digital natives. However, one has to ensure that E-learning tools are interactive, are of a high standard and conform to the requirements of the relevant training body. In recognition of the fact that E-learning is now a key component of both radiology training and continuing professional development, the Royal College of Radiologists in the UK developed a free online course that can be used to support and encourage learning.

As almost all cross-sectional imaging in the hospital setting is now digitally read, familiarising students with imaging software at an early stage is an important stepping stone to using Picture Archiving and Communications Systems (PACS) as junior doctors. The use of E-learning tools in addition to a didactic approach to Radiology teaching has consistently been shown to enhance learning and engage students as part of an innovative Radiology curriculum. Furthermore, it is valuable for both undergraduates and postgraduates as it improves Radiological knowledge and interpretation skills. For this reason, over 70% of European institutions currently use E-learning for Radiology teaching and it continues to grow in popularity. Furthermore, it is valuable for both undergraduates and postgraduates as it improves Radiological knowledge and interpretative skills.
Increasingly, medical education is embracing a blended learning method of delivering educational programs as it is more cost-effective and is associated with high levels of user satisfaction\textsuperscript{55}. Since the introduction of the European Working Time Directive, formal teaching time has decreased and an emphasis had been placed on substantial self-directed learning. By doing so, many institutions have adopted Vygotsky’s ‘Social Constructivism’ approach to medical education whereby students are given the scaffolding necessary to actively construct and refine their knowledge base while promoting independence and self-learning,\textsuperscript{56,51} It is evident that radiology education needs to become more blended in order to appeal to multiple learning styles. However, there is a role for multiple educational strategies i.e. lecture based, small group tutorials and e-learning, in a well-rounded curriculum that is designed to promote independent lifelong learning.

6. Conclusion

This research involved modifying the delivery of teaching from traditional didactic lectures to interactive small group tutorials. The participants valued the teaching, engaged with it and felt it would be helpful in their role as a junior doctor. Both undergraduates and postgraduates would like more radiology teaching, especially in the small group tutorial format and there is a need for online resources. This research supports the integration of small group tutorials in radiology into the medical undergraduate and postgraduate curriculum.

Take Home Messages

1. Effective Radiology teaching is essential so that pathological findings are not missed or misinterpreted.
2. Small group tutorials are interactive and student centred, which promotes critical thinking.
3. 91\% of postgraduates and 84\% of undergraduates rated small group tutorials as either essential or very helpful.
4. 85\% of participants preferred the small group tutorial format.

Notes On Contributors

Dr Helena A Ferris is a Specialist Registrar in Public Health Medicine and has completed a Masters in Leadership in Health Profession’s Education.

Dr Maria Joyce is a junior doctor.

Ms Jenny Hogan is Head of Training and Development, Department of Health Ireland and is undertaking a PhD.

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Appendices

Declarations

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

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