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Radiology knowledge in new medical graduates in New Zealand

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Abstract

Aims To establish the level of knowledge of new medical graduates in New Zealand about common radiological investigations and to assess their ability to request most appropriate, cost-effective radiological investigations for common clinical scenarios.

Methods A test was developed and administered in Waikato, Christchurch, Rotorua, Auckland, and Dunedin hospitals during the first month of new house officer year (November 2002).

Results Sixty-two first year house officers participated; 59 were New Zealand medical graduates (Auckland: 24 and Otago: 35) and 3 were from overseas institutions. The mean score for questions that assessed about risks involved in common investigations, including radiation, was 47% (95% CI: 45%–49%). The mean score for selecting the appropriate clinical investigations was 53% (95% CI 52%–54%). Most significantly, only 42% (95% CI 38%–46%) of the respondents thought they had adequate radiology teaching to work as house officers. The following percentage of the respondents never observed the respective examination during their medical school training: barium enema 72% (95% CI: 60%–82%); IVU 75% (95% CI: 63%–87%); US scan 25% (95% CI: 16%–37%); CT scan 20% (95% CI: 11%–32%); angiogram 16% (95% CI: 9%-28%); MRI 42%(95% CI: 30%–54%). The mean score for the practical knowledge about common investigations was 50 (95% CI: 48%–52%).

Conclusions Medical students report that they have limited exposure to radiology teaching during their medical school training. The test results suggest that medical school training enabled them to commence their probationary year with a 'just safe' level of radiology knowledge and skill.

In the current era of modern organ imaging, radiological investigations play a central role in patient management. However, although radiology has undergone significant changes during the last two or three decades, this has not translated fully into medical school curricula. Despite the enormous change in medical practice, radiology is still only taught as an adjunct subject in the final year (trainee intern year) medical school curricula rather than as one of the core subjects

Final year medical students (trainee interns) at the University of Auckland have a 'radiology elective week' as part of their curricula but there is no other organised formal radiology teaching. It is expected that Auckland students learn radiology from their attachments in medicine, surgery, general practice, psychiatry, and obstetrics & gynaecology during final year. At the University of Otago, there is also no organised radiology teaching during the final year (trainee intern) of medical school. Indeed, students are expected to learn by 'osmosis' from their attachments in other specialities.

The purpose of this study was to establish the level of knowledge of first year house officers in New Zealand (as a cohort group) about common radiological investigations as well as to measure their ability to request the most appropriate and cost-effective radiological investigations for common clinical conditions.

Methods

A test was developed and administered anonymously to a sample of first year house officers in 4 of 5 large training centres and at a provincial centre. The goal was to sample about 25% of the 2002 new medical graduate cohort group. The test was administered at Waikato, Christchurch, Rotorua, Auckland, and Dunedin hospitals during the first month of the new house officer year (November 2002) with the assistance of education co-ordinators at each centre.

To ensure national consistency in administering the test, co-ordinators were briefed on the purpose of the test and were asked to administer it during the first month of the new first year house officer intake.

There were four sections in the test (Appendix 1). The purpose of the first section was to determine how many first year house officers actually observed common radiological investigations during their medical school training. The second and third sections tested their practical knowledge and risks of these investigations. The fourth section tested their ability to select the most appropriate and cost-effective investigations for common clinical scenarios.

The content of the test was reviewed (for content and face validity and readability) by a group of academic clinicians: a consultant radiologist, a consultant physician, a consultant surgeon, and a medical education specialist

The test was validated among a group of graduating medical students at the Waikato Clinical School, University of Auckland in 2001. About 20 graduating students at the Waikato Clinical School took the test. The feedback about the standard of the test, suitability of the topics examined, and readability of the test was incorporated into the final form of the test. A mark scheme was prepared to ensure scoring reliability and fairness across marking answers for all the questions and all the candidates. The principal investigator was the only marker so that the inter-rater reliability was not an issue as there was no second marker.

Participation of the house officers was voluntary, anonymous, and consented and all participants were given 30 minutes to respond to the test without access to any radiological resources. Co-ordinators from each centre returned the completed tests to the principal investigator. Responses from all the centres were marked by the principal investigator and analysed at the Waikato Clinical School, University of Auckland using Microsoft Excel v10 software (Microsoft Corporation, Washington, USA).

Results

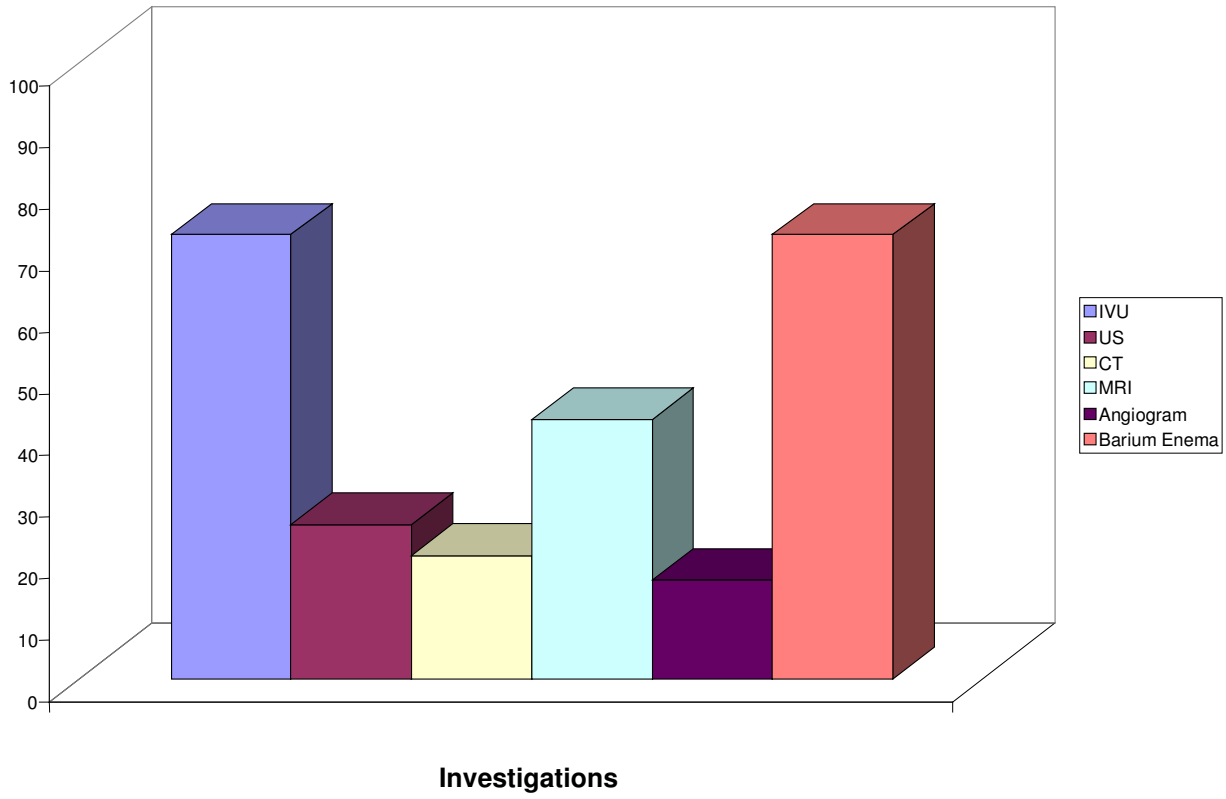
Sixty-two first year house officers participated; 59 (22% of total first house officers in 2002)[1] were graduates of New Zealand medical schools (Auckland 24 and Otago 35) and 3 were from overseas institutions. Six of the participants have done radiology selective (a period of 4 weeks for advanced study in a field of choice by students in their fifth year of medical school in the University of Auckland) or elective and three were involved in radiology research.

The following percentages of respondents never observed the respective examination during their medical school training (also see Figure 1):

- Barium enema—72% (95% CI: 60%–82%);
- Intravenous urogram (IVU)—75% (95% CI: 63%–87%);
- Ultrasound (US) scan—25% (95% CI: 16%–37%);
- Computed tomography (CT) scan—20% (95% CI: 11%–32%);
- Angiogram—16% (95% CI: 9%–28%);

- Magnetic resonance imaging (MRI)—42%(95% CI: 30%–54%).

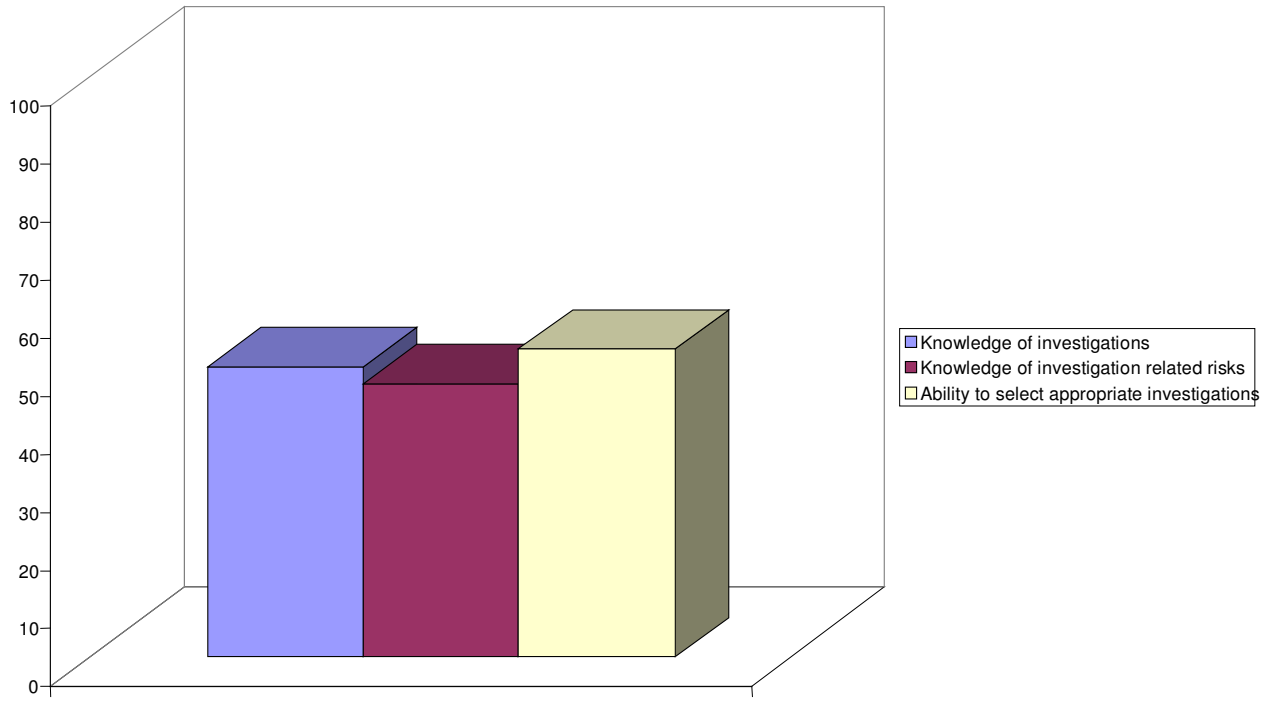
Figure 1. Percentages (vertical axis) of first year house officers having never observed selected radiological investigations as medical students



The mean score for practical knowledge about common investigations was 50% (95% CI: 48%–52%); for knowledge about risks involved in common investigations including radiation it was 47% (95% CI: 45%–49%); and for selecting the appropriate clinical investigations, the mean score was 53%(95% CI 52%–54%) (Figure 2).

Only 42% (95% CI 38%–46%) of the respondents thought they had adequate radiology teaching in their medical school training to work as house officers.

Figure 2. Mean scores (percentages) of first year house officers' radiology knowledge



Discussion

The ultimate aim of medical student radiology teaching is to produce a clinician who would be aware of the indications for, values, and limitations of radiology in the clinical management of patients.

In order to produce a clinician who can critically see the role of radiology in patient care, we need to provide a well-structured radiology teaching programme to our medical students especially to those in the final year (trainee interns) of medical school.

The practice of diagnostic radiology has changed considerably in both technique and application within the last 15 years. With advancement of technology, the practice of radiology includes not only conventional methods but new imaging processes such as multi-detector computed tomography (MDCT), and MRI.

In Australia, while the population has increased by 20% during the last 15 years, the use of diagnostic imaging services has doubled and the services rendered per 1000 population has increased by 80%.[2] The challenge for all medical educators is to educate the future medical profession about cost-effective application of new diagnostic and therapeutic imaging procedures.

The vast majority of today's medical student population will be physicians of general practice and non-radiology specialities, and will request a wide spectrum of radiology

investigations or procedures in their professional life. But there are no organised radiology teaching programmes for candidates in non-radiology training programmes in New Zealand. This underlies the importance of providing a basic knowledge of radiology to all medical students. Hence, radiology education should be appropriate and effective for a medical student who will soon to be a non-subspecialised junior medical officer.

One of the most important objectives for medical student radiology education is that junior doctors and general practitioners need to understand the value, indications, and limitations of radiological investigations.[3] In general, students need to know what information radiology investigations and procedures can provide with accuracy and what their limitations are. This will allow the future clinicians to have a meaningful discussion about the suitability of an investigation with the radiologists and use them as a resource. In addition, they are expected to obtain informed consent for the investigations explaining the tests and risks to their patients for noninterventional or noninvasive radiological investigations such as CT, US, and MRI. (This is usually done at the time of requesting the investigation rather than at the time of the examination performed in the radiology department.)

Informed consent is becoming increasingly important in the current medicolegal environment. To understand the above issues, ideally the student observes such an investigation or procedure during their educational experience at medical school. It is clear from our study that about 75% of respondents never observed a barium enema or IVU. This may be due to the declining use of these two tests due to their replacement by CT colonography and CT urogram.

Despite being very common imaging investigations, about 25% of the students never observed an ultrasound examination or CT scan. This is reflected in their low mean scores of 50% and 47% about the practical knowledge and risks of common radiological investigations and procedures, respectively. It is important, therefore, that medical schools design curricula that allow all students to have an opportunity to observe these common radiological investigations and to understand the benefit and risks.

To use imaging investigations appropriately and cost effectively, students need to be taught evidence-based imaging. Some of the examples of these evidence based guidelines include:

- Ottawa ankle rules which provide guidance about when it is safe not to request radiographs;[4,5]
- Diagnostic strategy of combining a pretest probability score and D-dimer test to clinically exclude lower limb deep venous thrombosis[6] without an ultrasound examination;
- Clinical criteria to rule out cervical spine injury after a minor trauma without radiographs;[7] and
- Clinical criteria to exclude head injuries after minor trauma without a brain computed tomography.[8]

This will encourage evidence-based practice in the use of established imaging guidelines.

Only 42% of the respondents agreed that they had adequate radiology teaching during their medical school training. This further elaborates the need for organised radiology teaching in our medical schools, especially in the final year (trainee intern). An integrated weekly radiology teaching with other speciality attachments throughout the final year of medical school would contribute enormously to the students' understanding of radiology and its role in day to day patient management. This along with the 'radiology elective week' would provide the practical knowledge adequate to work as house officers.

Assessment forms an integral part of learning processes. One of the oldest and most robust findings of educational research is that the assessment is the major influence on what gets learned. Examination results in practical areas do not always match the work based evaluations of students by those who work with them.[9] Hence both summative and formative assessment methods are necessary.

The summative assessment can take the form of a radiology Objective Structured Clinical Examination (OSCE) at the end of the student period of learning in the trainee intern year. It has been shown that students improved OSCE performance after additional clinical exposure.[10] This suggests that OSCEs would be suited for testing integration of radiological and clinical knowledge learned.

The formative assessment from radiologists and tutors throughout the radiology teaching can provide insight into aspects of professional competence including the ability to work in a team, attitudes, and commitment that escape attention of summative examiners. For a summative radiology examination to be most powerful, it needs to be incorporated into a student's final year of training (trainee intern year).

One limitation of this study is that only about 25% of the 2002 cohort of graduating final year medical students from New Zealand medical schools took part in this voluntary study, and this sample cohort represents a 'self selected' group of house officers—this may have skewed the results more favourably.

Providing a structured teaching programme and appropriate assessment in radiology in our medical schools is important, as radiology threads through patient care in almost every medical speciality.

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Appendix 1

Section One

Objective: We are trying to determine how many of you have actually observed the following radiological examinations/procedures performed.

Have you observed the following radiological procedures being performed during your medical course? Please tick the appropriate box.

	Examination./Procedure	**Never**	**Yes**
1.	Barium enema		
2.	IVU/Intravenous urogram		
3.	Ultrasound scan of pelvis or abdomen (not obstetric ultrasound)		
4.	CT scan of the head/chest/abdomen or pelvis with IV contrast.		
5.	Angiography		
6.	Endoscopic retrograde cholangiopancreatography (ERCP)		
7.	MRI		

Section Two

Objective: These questions test your practical knowledge of what actually goes on during the procedures commonly requested by clinicians.

Please consider the following statements about radiological investigations. Answer the statements as True or False or I Don't Know with a tick in the appropriate box.

	Investigation	**True**	**False**	**Don't Know**
1.	Plain films are the only imaging modality used during barium enema.			
2.	After barium enema, patients are routinely advised to drink plenty of water to avoid constipation.			
3.	Hepatobiliary ultrasound is routinely undertaken with the patient lying on their right side.			
4.	A full bladder is required for transabdominal pelvic Ultrasound scan,			
5.	During CT scanning, the patient is advanced through the scanner on a movable platform, rather than the scanner moving over the patient.			
6.	It is typically difficult for a patient to keep still during the time required to perform CT scanning.			

7.	A patient usually requires heavy sedation for ERCP.			
8.	ERCP usually takes over an hour to perform.			
9.	MR scanning usually takes longer than CT imaging of the same body area.			
10.	Patients often complain of muscle aches after MR imaging.			
11.	During screening mammography compression of the breast is used for all patients.			

Section Three

Objective: These questions test your knowledge of the risks involved in procedures.

Please tick in the appropriate box.

	Investigation	**True**	**False**	**Don't Know**
1.	The risk of bowel perforation is higher with barium enema than with colonoscopy.			
2.	All patients undergoing intravenous urogram (IVU) need to be warned that they may feel a hot and burning sensation after injection of IV contrast.			
3.	A common risk of angiography is puncture site haematoma.			
4.	Duodenal perforation occurs in 5% of patients undergoing ERCP.			
5.	Radiation exposure is higher from intravenous urogram examination than from CT scan of the same area.			
6.	Radiation exposure for an abdominal plain film is more than for a chest plain film.			
7.	Radiation exposure for a lumbo sacral plain film is less than for a plain chest film.			
8.	There is significant radiation exposure to foetus of a pregnant women who has a chest plain film.			
9.	There is some radiation exposure to a patient who has a pelvic ultrasound.			
10.	MRI is contraindicated for a patient who has intracranial vascular clips as a result of recent aneurysm repair.			

Section Four

Objective: To test your ability to request the most appropriate and cost effective investigation for the following clinical scenarios:

A	Plain abdominal radiograph	G	Intravenous pyelogram
B	Nuclear Medicine scan	H	Plain chest radiograph
C	CT scan	I	Plain spinal radiograph
D	MRI scan	J	ERCP
E	Ultrasound scan	K	Angiogram
F	PET scan	L	Mammogram

Scenarios:

1. 10 days after a knock to the head during rugby a 25 yr old male complains of being unable to concentrate during lectures because of drowsiness and headaches. General neurological examination is unremarkable.
2. A 55 yr old woman with a history of left mastectomy for breast carcinoma has presented acutely with a transverse fracture of femur. The injury happened as she got up from a chair. Plain radiograph shows a fracture.
3. 25 yr old female who is 16 weeks pregnant complains of loin pain and tenderness since the previous day.
4. A 35 yr old man is brought to the emergency department after a car crash. His neck is being held in a hard collar and he complains of right arm weakness. A plain radiograph shows a fracture of the left humerus in the subcapital area.
5. A 55 year old hypertensive man presents to the emergency department with excruciating chest pain radiating to the back which started 6 hours previously. The blood pressure in the left arm is 170/110 and in the right arm is 145/95. An ECG and cardiac enzymes are normal.
6. A 40 yr old housewife presents to you complaining of a 6 month history of low back pain. The neurological examination in the lower limbs is normal. Your first radiological examination would be.
7. A 50 yr old man presents with fever and flank pain of 3 days duration. He has a past history of renal colic. He has acutely deteriorating renal function tests.
8. A 25 yr old male patient on steroids and with a past history of Crohn's disease presents to the ED with a 2 day history of right iliac fossa pain and fever. Your examination reveals tenderness and guarding in the right iliac fossa.
9. A 60 yr old female with a history for sigmoid colon carcinoma and metastatic disease presents with 3 days of pain in the right calf and right calf swelling.
10. A 35 yr old man recently discharged from hospital following pancreatitis due to gallstones presents with epigastric pain and fever.

Please complete this table:

Scenario	Most appropriate investigation	Tick if you do not know
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		