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The Redevelopment of the New South Wales Remote X-ray Operators Licensing Course

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ABSTRACT

The NSW Remote X-ray Operators Licensing Course is for rural and remote general practitioners (GPs) and registered nurses (RNs) to obtain a limited x-ray licence to operate diagnostic x-ray equipment in communities where there is no radiographer available. Between 1994 and 2001 it was a five-day, intensive, face-to-face, non-award short-course conducted by the Discipline of Medical Radiation Science (MRS) from the University of Newcastle. The participants were taught basic radiographic technique and radiation protection through a logical sequence of lectures, tutorials and practical sessions. It included basic radiation physics and radiographic instrumentation, basic radiobiology and radiation protection, and routine radiographic positioning for some anatomical regions.

Problems with access and with the intensity of the educational experience for participants encouraged the MRS staff to secure funding from RHSET and NSW Health to redevelop the course into a more flexible mixed mode of delivery. The course content has not been changed appreciably. However, the new course structure integrates a six-week distance learning component with practical exercises and a two-day workshop, followed by completion of a short answer question final assignment. Participants are required to establish a working relationship with a nominated local radiographer and senior rural radiographers run the workshop, thus encouraging the development of a rural radiography support network. The course has been piloted successfully with participants performing at least as well as those in the old course. The course evaluation was very positive and it will continue to be offered in the new format.

Keywords: *rural radiography, remote x-ray operators, education*

INTRODUCTION

Since about mid-1994 the NSW Remote X-ray Operators Licensing Course, an intensive 5-day, face-to-face, non-award short-course, has been conducted by the Discipline of Medical Radiation Science (MRS) from the University of Newcastle. Up until the middle of 2001 the course had been delivered 16 times with 114 registered nurses (RNs), 28 general practitioners (GPs), one physiotherapist, one enrolled nurse and one army medical assistant having completed it. Over the years courses were held at Tamworth, Dubbo, Broken Hill and Wagga Wagga Base Hospitals and, on two occasions, at Royal Newcastle Hospital. Successful completion of the course entitled the candidates to apply for a limited x-ray licence from the NSW Environment Protection Authority (EPA), under the NSW Radiation Control Act 1990,[1] to perform chest, limb, shoulder and pelvis radiographs in rural and remote areas where or when no radiographer is available. The licence cannot be used in metropolitan areas (the Sydney, Newcastle, Illawarra and Central Coast metropolitan areas specifically being excluded) or " ... if a radiographer is at or on call for the health facility".

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In 2000/2001 the University of Newcastle received a Rural Health Support Education and Training (RHSET) grant from the Commonwealth Department of Health and Ageing to redevelop the course into a more flexible mode of delivery. The grant was complemented by project funding from The NSW Department of Health. This paper describes the changes that have been made to the mode of delivery of the course as a result of the project.

The original course

During the five days of the original course the participants were taught about basic radiographic technique and radiation protection through a logical sequence of lectures, tutorials and practical sessions. The course included instruction about:

- Basic radiation physics and radiographic instrumentation, including quality control and equipment maintenance;
- Basic radiobiology and radiation protection for both patients and staff; and
- Routine radiographic positioning for the upper limb and shoulder, lower limb and pelvis, and the chest.

Participants were required to attend from nine o'clock in the morning and often didn't complete the day's classes until eight o'clock in the evening, with breaks for meals and morning and afternoon tea. On the fifth and final day participants were required to sit a licensing test composed of three components, a written multiple choice and short-answer question examination, a radiographic assessment quiz and a practical positioning test, weighted as shown in Table 1 below. The table also shows the performance of the participants in each of the components.

From the results it can be seen that in general the participants performed well in the licensing test. It is also clear that, comparing the mean results overall, the GPs performed better than the RNs ($p<0.001$). Only five participants (all RNs) failed to pass the licensing test at their first attempt and of these three passed on their second attempt. One participant refused the opportunity to resit and the other failed again on the second attempt and then

Table 1: Results in the Remote X-ray Operators Licensing Course for participants between 1994 & 2001.

Test	Weighting	All Participants (n=145)		GPs (n=28)		RNs (n=114)	
Component	(%)	Mean (%)	C of V†	Mean (%)	C of V†	Mean (%)	C of V†
Written	30	71	0.24	86	0.12	69	0.22
Film Viewing	35	71	0.20	87	0.08	67	0.19
Positioning	35	77	0.17	82	0.13	75	0.17
Overall	100	74	0.16	85	0.09	70	0.15

† C of V = Coefficient of variation (SD/mean)

refused the offer of a third attempt.

The course was generally very well received, the average evaluation score being 6.8 out of 7.0 (Very good = 7, Poor = 1) in answer to the question "How would you rate the course overall?" However, in spite of the good course evaluation, it became apparent to the teaching staff that there were a number of flaws in the mode of delivery. These can be summarised as follows:

- The course was too intensive. In order to cover the material adequately participants attended about 35 hours of tuition over four consecutive days, followed by a licensing test on the fifth day. While the course incorporated a variety of teaching techniques, it did not allow for participants to reflect on the material they were presented with, much of which was new to them.
- The course did not allow for differing rates of learning among the participants, the whole group being driven along at a pace dictated by the teachers rather than the students. This was not an ideal learning environment. There was little time to give individual attention to those participants whose knowledge base was lacking, which may in part explain the different mean scores for the doctors and nurses.
- No mechanism existed to promote a culture of continued learning. It was strongly suspected that the course was an isolated learning experience about radiography for many of the participants. While it achieved the goal of getting the participants licensed, it did not ensure that they would continue to produce good quality radiographs afterwards. Staff believed that it was necessary to establish a radiographic support network and yet the University lacked the resources to maintain contact with the remote operators on a regular, long-term basis.
- The course did not make use of the expertise of local rural radiographers. In order for the remote x-ray operator program to be sustainable over the long-term local radiographers should be part of the teaching and learning process. In this way it is possible that the radiographers will be acknowledged for their expertise, they will gain skills in teaching and supervision, and they will be encouraged to provide ongoing support to their local remote operators.

In addition to these concerns, the Rural Doctors Association of Australia (RDAA) had repeatedly requested that the course be redeveloped to incorporate a "mixed-mode" of delivery. The principal concern was that the course should be more accessible to GPs who find it difficult to get away from their practices for five consecutive days. The same could be said of the RNs with the shortage of staff in the health facilities that are the target of this program. Although the MRS staff at the University of Newcastle appreciated the problem and could see the need for the redevelopment of the course in a more flexible mode of delivery, the resources to undertake that task were not available until RHSET and NSW Health funded the course conversion.

THE AIM OF THE PROJECT

The application for funding was submitted to RHSET in 2000 and the project began in July 2001. The complementary NSW Health funding was received in about October 2001 and the final report was submitted to both funding bodies and other supporters in September 2002.

The aim of the project was to develop new teaching and learning material so that GPs and RNs from parts of NSW where no radiographer is available could gain better access to training in limited-licence radiography. As a result it was hoped that the project would help enhance radiographic services available in these rural and remote communities. In addition, it was intended to encourage the development of a rural radiographic support network whereby radiographers could provide advice, support and continuing education to limited-licence remote x-ray operators. The goals of the project, as listed in the original funding application, can be summarised as follows:

- To improve access for GPs and RNs to education, training and support in plain film diagnostic radiography commensurate with the NSW licensing conditions.
- To create high quality educational material suitable for external delivery thus reducing the time course participants have to spend away from their clinical duties/practices.
- To make it possible for successful course participants to obtain a limited x-ray licence by gaining accreditation for the new course from the NSW Radiological Advisory Council.
- To consult with key stakeholders, including the NSW Department of Health, the NSW Branch of the Australian Institute of Radiography and the NSW Environment Protection Authority.
- To work in partnership with rural radiographers so that local diagnostic radiography support networks would be encouraged.
- To trial and evaluate the new course in a pilot and provide feedback to stakeholders.

STRUCTURE AND CONTENT OF THE NEW COURSE

The structure of the new course is based upon a mixed mode of delivery that integrates the use of distance learning material, in order to develop the knowledge aspects of the participants learn-

Table 2: A typical timeline for completion of the redeveloped Remote X-ray Operator Licensing Course.

Unit	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6		Week 7
A							Two-day	Finish
B							weekend	final
C							workshop	assign't
Test						Part 1	Part 2	Part 3

ing, with practical exercises and a workshop, which develop the requisite radiographic skills. The course has three components, the distance learning modules, a two-day workshop and an assignment, which are described below.

The course content is broken down into three units:
Unit A – Principles of Radiographic Imaging introduces the fundamental physical principles underlying the production of x-radiation, the basic components of general X-ray equipment and the concepts of image production;
Unit B – Radiobiology and Radiation Protection aims to develop the participants' understanding of the rationale for radiation protection and to the principles of best practice in radiation protection of both patients and staff; and
Unit C – Basic Radiographic Positioning develops the participants' basic knowledge and skills in routine positioning techniques used in general radiography of the upper extremity and shoulder, the lower limb and pelvis, and the chest. This includes all of the examination types covered by the NSW Type I.14R radiation licence.[1]

At the outset each course participant is required to supply the name and contact details of a local radiographer who will act as their mentor and assist their learning, particularly in the distance learning component. The nominated local radiographer (NLR) may be the radiographer that visits their facility on a sessional basis or a radiographer who lives or works within reasonable travelling distance. Anecdotal evidence suggests that the relationship between rural radiographers and remote x-ray operators has been marked by interprofessional tension, radiographers perceiving remote operators as a threat to their professionalism and remote operators being somewhat dismissive of the radiographers' role in the health care system.[2,3] Thus, a deliberate attempt has been made to bring them together in a collaborative learning environment. The NLR is contacted by the University staff and is sent an instructor's workbook that duplicates some of the material sent to the course participants, including practical exercises that are to be completed by the participants. The difference, however, is that the NLR is also given gold standard answers to the exercises.

As the course participant works through the distance learning (DL) material they come to a point where they have to contact their NLR in order to get both instructions on how to complete the exercises and feedback about their answers. The exercises are structured in such a way that the course participant and the NLR have to meet at least once during this period. Some may decide to meet more often to work through some of the course material, depending on their mutual availability and the participants agreed needs.

The distance learning component
Each participant is sent a DL package that includes the following material:

- The Course Information Booklet containing an outline of the course and detailed instructions on how to get the most out of the other material.
- The Radiographic Positioning Manual, which contains step-by-step instructions on how to perform each radiographic projection. It is designed in such a way that it can be used as companion and guide in their future radiographic duties.
- Module 1 – The Principles of Radiographic Imaging
- Module 2 – Radiobiology and Radiation Protection
- Module 3 – Radiography of the Upper Limb and Shoulder
- Module 4 – Radiography of the Lower Limb and Pelvis
- Module 5 – Radiography of the Chest
- A booklet of the Course Readings
- Video 1 – The Upper Limb and Shoulder
- Video 2 – The Lower Limb and Pelvis + The Chest

Although it is intended that the package contain all of the material that the participants will need to successfully complete the course, a copy of the National Health and Medical Research Council guidelines on the safe use of ionising radiation[4] is also included. This emphasises the importance of this aspect of the course.

Participants work through the modules sequentially over a six-week period (see Table 2). At various points they must refer to one of the readings or view a portion of the video, all of which are clearly marked so they are easy to access. Each module contains a set of assignment questions that they must complete and that contribute to their final assignment submission. They may of course consult with their NLR, who has by this stage signed, and copied to the University, a statutory declaration that they will not give the participant, or any future participants, access to the gold standard answers. The assignment then is a compilation of the participant's answers to all of the module exercises, including practical components that involve actually performing and analysing the results of some radiographic exposures of simple, commonly available phantom objects.

At the end of this six week period the course participants sit for the first part of their licensing test, a knowledge-test consisting of sixty multiple choice questions (MCQs) randomly selected from a question bank held by the University. Security and equity are assured by asking each participant to nominate a test supervisor who may be the local Health Service Manager, another senior member of staff, or their NLR. They also indicate a date and time at which the test will be completed. The nominated supervisor is then sent a copy of the test in the mail and is required to sign a consent form and a declaration that they will maintain security and confidentiality. The completed test, together with the declaration, is mailed back to the University, post-marked the same day that the test was completed.

The participants are then ready for the second component of the course, the workshop, where they will first receive personal

and confidential feedback about their performance in the MCQ quiz. Those who have performed poorly in the quiz can be flagged for closer attention during the workshop.

The two-day workshop

The two-day, weekend, hands-on workshops are designed to be conducted at rural hospitals by tutor radiographers (TRs) for groups of four to six course participants. The TRs will all have been identified and trained by the University's academic staff and, while some have already been selected, it is estimated that six to ten TRs will eventually be trained to run the workshops. They will be senior rural radiographers who have agreed to participate in the program and have subsequently attended a train-the-trainer program at which the course material will be explained to them. In addition, they will be instructed in the exercises that the course participants must undertake during the workshops. Being employed as casual University staff, they are paid for the time spent conducting the workshops and are thus obligated to observe relevant University policies and procedures.

The workshops are strongly oriented to the acquisition of relevant clinical skills. By being conducted on weekends the participants are able to access to the hospitals' radiology department for the purpose of completing practical exercises using real x-ray equipment. They perform exercises on the operation and maintenance of equipment, practice radiographic positioning, view radiographs and participate in question and answer discussions.

In the final session of the workshop participants are required to perform an Organised Structured Clinical Assessment (OSCA) that constitutes the second part of the licensing test. Each participant is given a clinical scenario and asked to describe and demonstrate (using a mock patient) how they would go about performing the necessary radiographic examination. They are also asked to view radiographs of the same anatomical region and comment on them. Participants are assessed by the tutor radiographers according to the following criteria:

- Understanding of the examination requirements
- Preparation of the equipment and the patient
- Technical considerations (film/screen combination, exposure factors, etc)
- Positioning technique (views chosen, collimation, use of markers, etc)
- Patient care and consideration of the patient's condition
- Radiation protection considerations
- Ability to solve problems and overcome difficulties
- Knowledge and appreciation of the radiographic criteria

Final assignment submission

Throughout the six-week distance learning component the participants will have been completing answers to a series of short answer questions related to the material covered in the modules. During the two-day workshop they will have had the opportunity to refine their answers and obtain advice from the TRs on how best to answer the questions. The final component of the course, therefore, is the submission of the short answer question assignment, which constitutes the third and final part of the licensing test. While it is considered a discrete component it integrates their learning over the entire course. The final assignment must be post-marked within one week of the completion of the workshop.

Timeline, duration and frequency of the course

The course is completed over a seven-week period, as shown in Table 2. It is estimated that participants will have to spend between four and six hours a week on the distance education component, prior to attending the workshop. The workshop consists of two seven-hour days (excluding lunch). A further four to six hours is required in the seventh week to complete the assignment. Thus, it is estimated that participants' time commitment will range from about 42 hours, for those who find the work easy and complete it quickly, to a maximum of some 56 hours, for those who find it a bit more challenging.

It is expected that the course could be offered up to four times per year for about four to six participants each time. The numbers are limited by the need to provide the opportunity for participants to get as much hands-on experience as possible during the workshop. These numbers of 16 to 24 participants per year compare well with the number of participants who previously completed the course each year.

Assessment

The assessment is weighted so that Part 1 (the MCQ test) is worth 20 per cent of the aggregate score and both Part 2 (the OSCA) and Part 3 (the final assignment) 40 per cent each. In order to pass the course the candidates are required to meet the following criteria:

- Achieve an aggregate mark of 50% or greater overall.
- In the combined OSCA and final assignment achieve a mark of 60% or greater.
- Gain a score greater than 50% in the radiation safety aspects of the assessment.

PILOT COURSE OUTCOMES AND EVALUATION

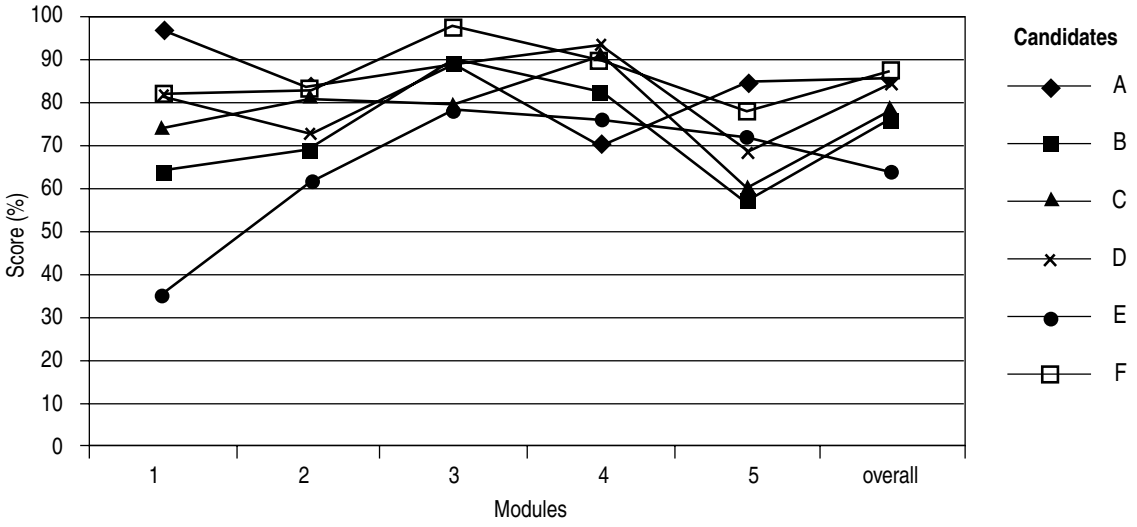
The pilot included six participants, five RNs and one GP. They were from Warialda, Ivanhoe, Lord Howe Island, Condobolin, Bonalbo and Lightning Ridge, typical locations where there is a need for remote x-ray operators. Interim approval of the NSW Radiological Advisory Council was received prior to beginning the pilot so that it was possible for successful course participants to be eligible for licensing. The results for each of the candidates in each of the assessment components are shown in Table 3.

Although the testing of these course participants was

Table 3: Results in the pilot course for each of the six candidates.

Cand'te	Assessment components						Total (%)	OSCA + SAQ (%)	Radiat'n Safety (%)
	MCQ		OSCA		Final Assign't				
	/100%	/20%	/100%	/40%	/100%	/40%			
A	72	14.4	88	35.2	86	34.4	84	87	85
B	58	11.6	89	35.6	76	30.4	78	83	68
C	75	15.0	82	32.8	79	31.6	79	81	81
D	73	14.6	86	34.4	85	34.0	83	86	73
E	48	9.6	70	28.0	64	25.6	63	67	61
F	75	15.0	78	31.2	88	35.2	81	83	83
Mean	66.8	13.4	82.2	32.9	79.7	31.9	78.1	80.9	75.2
C of V	0.17		0.09		0.11		0.10	0.09	0.13

Figure 1: Performance of the course participants in the final assignment by module.



more rigorous and thorough than it had previously been all participants passed the pilot of the new course, most achieving an aggregate mark higher than the mean for the participants in the old course. This seems to indicate that their understanding of the course material was at least satisfactory, although the pilot sample is small. Only one candidate failed the MCQ test and was thus flagged during the workshop for special attention. Overall that candidate was weaker than the others suggesting some inherent lack of ability, although it was also noted that there were special circumstances that may have contributed to the candidate's poorer performance.

In the final assignment most candidates performed reasonably well and no strong pattern of preferred learning for any particular module was apparent (see Figure 1). Perhaps the only exception was that half of the candidates did noticeably worse in Module 5 (Radiography of the Chest) than in the upper limb and lower limb modules. This may be because it was the last of the five modules and so received less attention, or it may have been that they regarded the material as simpler, thus under-answering the assignment questions. Either way, it is a valuable indicator for future course revision.

At the end of the pilot participants were asked to complete a course evaluation questionnaire. The participants could rank each statement on a five-point Likert scale with the choices ranging from strongly agree (SA) through unsure (U) to strongly disagree (SD). A sample of 13 of the questions is shown in Table 4, together with a breakdown of the responses of the six course participants. In addition the participants were asked to rate the course on a seven-point scale, where "7" was very good and "1" was very poor. One participant did not answer this question, perhaps overlooking it, but four of the five participants that did answer rated the course as a "7" and one as a "6".

Table 4: Frequency of the responses to some of the statements on the course evaluation questionnaire.

Statements	Frequency				
	(SA)	(A)	(U)	(D)	(SD)
The material delivered in this course was easy to understand	2	4			
The course covered topics in appropriate depth	3	3			
The assessment requirements in this course were appropriate	3	2	1		
The course was challenging	5	1			
The modules explained the concepts clearly	3	3			
I found the modules interesting	3	3			
The contact with the university staff was helpful	3	2	1		
The course material was made available in a timely way	3	1	1	1	
The contact I had with the nominated local radiographer was helpful	2	2	1		1
I'm confident that I'll stay in contact with the local radiographer	4	1		1	
I found the positioning manual easy to use	5	1			
The workshop was well organised	3	3			
The workshop was an essential part of the course	5	1			

It is apparent that overall the course participants found the course a satisfying, though challenging, learning experience, with most answering either strongly agree or agree to the closed-ended questions. It is difficult, with only six participants, to make a clear comparison with the outcomes for the previous course, for which results and feedback from 145 participants was available, but early indications are that it was certainly not a backward step.

CONCLUSION

This project aimed to improve access to training in radiography for GPs and RNs from parts of Australia where no radiographer is available by developing flexible teaching/learning material and helping to develop rural radiographic support networks. The teaching material is now available and has been trialled in a pilot of the redeveloped NSW Remote X-ray Operators Licensing Course. The course now has full accreditation from the NSW Radiological Advisory Council for the purposes of obtaining a limited x-ray licence (Type I.14R). The material is all original work and drafts of the modules and manual have been subjected to both internal and external evaluation processes as well as the pilot. The six course participants who took part in the pilot passed with results comparable to previous course participants and their evaluation of the course was very positive.

Without the funding provided by RHSET, and the complementary funding from NSW Health, the production of such a high quality teaching and learning resource would not have been possible. While the funding has now ceased the NSW remote x-ray operator program will be ongoing. Over the next several months and years the course will continue to be offered. It will be further reviewed and improved; and communication with government authorities, professional bodies and individual rural radiographers will continue with the aim of enhancing the remote operators program in NSW and elsewhere in Australia.

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