Sonography – the emergence of a profession

Lynette Hassall

Australian Institute of Ultrasound, Mermaid Beach, Queensland 4218, Australia
Correspondence to Lynette Hassall. Email lynette@aiu.edu.au

Abstract

This paper discusses the history of ultrasound, the emergence of sonography as a profession and the title 'sonographer' as a professional role. The education of sonographers in Australia is also discussed briefly.

Introduction

I have chosen to research this topic as history provides the background for the development of the profession as it is today.

This paper will endeavour to describe the process by which sonography has emerged as a profession and the issues which still confront the profession today. In writing this paper, I have found great difficulty in obtaining references, reflecting the dearth of information on this subject within the literature. There have been a number of articles reflecting the development of sonography and the history of ultrasound as a technical subject, but little has been written about the teaching and educational developments that accompanied the research and early development of the practice of ultrasound.

What is a profession?

'A profession is a self disciplined group of individuals who hold themselves out to the public as possessing a special skill derived from training or education and who are prepared to exercise that skill primarily in the interests of others.'

This quote is taken from an article written by David Penington and is a quote from Judge Peter Wright of the High Court of Ontario in 1951, the quote is an elegant description of what a profession entails[1]. Another very famous quote (within the ultrasound community) from Dr William Garrett (obstetrician) observes that sonographers have a 'wide decisional latitude' compared to other imaging professionals[2], and describes the increased responsibilities which a sonographer bears. These added responsibilities are the reason for sonographers' increased initial training and ongoing learning throughout their careers

A brief history

The use of medical ultrasound grew out of the sound navigation ranging (SONAR) devices that originated during the First World War, and was further developed during the Second World War. Research was conducted in many countries – America, the United Kingdom, Europe, Japan and in Australia.

In Australia, in 1955 the National Health and Medical Research Council set up an Ultrasonics Committee to inquire into the control and use of ultrasound physiotherapy equipment, the director of the Commonwealth Acoustic Laboratories (CAL), Norman Murray, was appointed Chairman[3].

In 1956, in Scotland, ultrasound was used to study ovarian cysts and in Sweden ultrasound was used to study valve motion and contractility of the heart. In 1956, research on Doppler techniques to study blood flow was conducted in Washington[4].

In 1958, Murray recommended that the CAL undertake research into ultrasound in Australia. Due to this recommendation, in 1959, George Kossoff, with William Garrett, an obstetrician, began the Ultrasonics Research section to research the clinical applications of the newly developed ultrasound techniques. This institute was unique in that research projects were interdisciplinary in nature – initiated by engineers and physicists, with clinicians evaluating the advances. Murray also adopted the policy that 'all equipment was to be evaluated in hospitals to determine the clinical usefulness of the new technology'[5]. On 11th May 1962, the first Australian obstetrics examination was performed at the Royal Hospital for Women, Paddington, Sydney by engineer David E Robinson and William J Garrett, an obstetrician. In June 1962, George Kossoff presented examples of the study at a symposium held at the University of Illinois, USA.

By 1969, the team at the Ultrasonics Institute had developed grey-scale imaging and were trialling obstetric, eye and breast ultrasound machines in 1970. In 1974, due to the development of the scan converter, manually driven contact scanners became commercially available within Australia[6].

The first training was technical and in order to obtain an image with ultrasound contact scanners (1972), technique was critical. The persons operating the ultrasound contact scanner had to perform the panoramic scan with a perfectly smooth motion, which had to be scanned in 17 seconds. The first sonographer training was undertaken by scanning in rhythm with a metronome and timed by a stopwatch until the technique was mastered[7]. The researchers who developed the techniques were also the main operators of the machines in Australia at this time.

United States professional development

In the USA the people operating the ultrasound machines were known as 'ultrasound technical specialists' and in 1969, six technical specialists wrote a proposal suggesting the formation of a professional society for those people performing ultrasound examinations. This led to the creation of the first professional society for sonographers on 12th October 1970, when the American Society of Ultrasound Technical Specialists (ASUTS) was formed[8]. The founding of this society occurred very early in the development of clinical acceptance of diagnostic ultrasound, as, prior to this, most of the technical specialists were conducting research, not diagnostic procedures.

It was suggested at this stage that appropriate training programs for technicians should be instituted and two approaches were suggested by ASUTS. Both approaches

were related to the x-ray technician training, at this time set up more as apprenticeships with practical work and study in addition – one suggestion was to include ultrasound as part of the x-ray technicians curriculum, the other was to add a post-graduate year after completion of the x-ray course. At the time, neither suggestion was implemented. The reasons for this non-implementation are unclear in the literature. I can only surmise that it was thought to be unnecessary as the ultrasound operators were also researchers, developing the techniques and learning as they went along.

If either of these suggestions had been implemented at this early stage, the history of education and acceptance within the medical and administrative fields would have been very different. If sonography training had been added to the radiography course, there would have been a number of outcomes; all radiographers would have been sonographers, and no separate profession would have developed. Further, no other health professionals would have been accepted into sonography, as the training would have been an integral part of the radiography course, so all sonographers would have been radiographers.

The terminology was also important to the early development of the role of the sonographer. The main issue was semantic and the term 'technical specialist'[9] was used for the first sonographers in America because the American Medical Association (AMA) defined a technician as someone with six weeks to six months education beyond high school. The term technical specialist was devised to alter the perceptions of the medical specialists and alert them to the fact that sonographers were a separate profession and were dedicated to ensuring high research and educational standards for the profession.

By 1955, a consensus had been achieved and the term 'ultrasonography' was used to define the diagnostic procedure, 'ultrasonograms' were the images recorded and 'ultrasonographers' were the persons who performed the procedure. This was shortened to 'sonography', 'sonograms' and 'sonographers' and in 1974 sonography was recognised as a separate profession in the USA by the AMA[10].

In contrast, the United States Department of Labour only classified the diagnostic medical sonographer as a separate occupation in the 2002–2003 edition of the Occupational Handbook.

A point of interest to note is that 'ultrasonography' is now used as the sole MeSH keyword for the subject in Medline Indexes[11].

In 1969, a working committee was created by the 'Societas Internationalis pro Diagnostica in Ophtalmologia' (SIDO) to develop an international non-profit scientific organisation with specific focus on diagnostic ultrasound. The members of this committee included the Chairman, Dr Vleiger, Netherlands, Dr Brown, USA, Dr Wagai, Japan, Dr Oksale, Finland, Dr Kossoff Australia, and Dr White USA. This was the beginning of the World Federation for Ultrasound in Medicine and Biology (WFUMB).

The constitution was developed in 1973, and Dr Baum, an ophthalmologist and Past President of the American Institute for Ultrasound in Medicine (AIUM), became president. The first recorded World Congress took place in 1976[12]. This society still holds large world congresses dedicated to showcasing the latest research or developments within the field of ultrasound.

Vocational training in Australia

Because the first sonographers were involved in research and developing the techniques involved with the new technology, the training was technical in nature and researchers and engineers were the first to use the techniques. In 1962, CAL employed a midwife to assist Kossoff, Garrett and Robinson in their initial bistable obstetrics research[13].

The first obstetric sonographer, Claire State, was employed by the Royal Hospital for Women, Sydney in 1970. She was involved initially in obstetrics research and then branched out into paediatric clinical trials. At this time ultrasound was being performed in the hospitals only on experimental models built at the CAL.

When the ultrasound machines were introduced commercially, the machines were placed in x-ray departments. The early companies who sold the new technology also provided training for the technicians who were going to use the machines. Often only a couple of days' training was provided and the x-ray technician was then left to operate the new ultrasound machine[14]. This minimal training provided by the company was often the only way to obtain a sale, as there were no trained personnel available for hire at the time. This lack of training in the use of ultrasound was of concern to the dedicated sonographers and researchers; if the new profession was to maintain its high ideals, good education and training were essential for all persons who were to operate the machines.

In the early 1970s the Ultrasonics Institute began to offer education programs for Australian and overseas doctors (but not technicians) at its location in Sydney[15].

In 1971, Michelle Gallant worked with Ian McDonald, researching echocardiography applications of ultrasound. An echocardiography teaching program for cardiologists was established in 1974 at St Vincent's Hospital Melbourne. Ian McDonald published a definitive echocardiography textbook in the mid 1970s[16].

The Australasian Society for Ultrasound in Medicine (ASUM) began as the Australian Society for Ultrasound in Medicine and Biology (ASUMB), publishing its first newsletter in December 1970[17] and holding its inaugural meeting in 1971. In 1976, a group of 22 Australians from ASUMB visited ultrasound units on the west coast of the USA to study the performance of ultrasound studies there and to formulate an opinion on the implications for practice in Australia. It was realised that there was a need for identification and qualification of medical practitioners performing ultrasound studies. The group also recommended that sonographers would be certified in either general or cardiac sonography. Because of the diversity of medical practitioners involved in ultrasound studies at that time (obstetricians, cardiologists, ophthalmologists and radiologists) ASUMB established its own Diploma of Diagnostic Ultrasound (DDU) for medical practitioners to 'identify those practitioners whose training, experience and level of competence was appropriate to referral ultrasound practice'[18].

In 1977, a group of sonographers attended the ASUTS meeting in Texas, holding discussions with the directors, and decided that a formal ultrasonographers group should be set up within ASUMB, and in March of 1978 the Ultrasonographers Group was formed. Its initial task was to implement education directions and programs for the sonographers. Their document *Education and Accreditation of Sonographers* was the

basis for future education programs[19].

In August 1979, the Diploma of Medical Ultrasonography (DMU) Board of Examiners was established. The establishment of this board was the start of formalised recognition of ultrasound technicians in Australia[20]. The DMU was set up to rigorously examine candidates in both academic and practical applications. However, this was a qualification that depended entirely on self-directed learning. The DMU Board would send to the candidates a subject list, and a book list, and the timetable for the examination. At this time no tuition or extra guidance was given to the candidates and it was assumed that the candidates were self-motivated and able to self-direct their study appropriately. While this style of learning suited some people, many others experienced great difficulty, due to the essentially unstructured approach.

There were two parts to the granting of the DMU. Part 1 consisted of written examination papers in (1) Physical Principles of Ultrasound and Instrumentation; and (2) Anatomy, Physiology and Pathology. The Part 2 examination required two years of clinical experience, which equates to 3000 hours of work. There were three sections to the Part 2 examination; (1) a written paper on ultrasound techniques; (2) an oral examination in two parts – technical and diagnostic; and (3) practical examination of two random patients in an ultrasound department, conducted by two examiners.

There was a 'Foundation Phase' for the DMU, which ended on 1st January 1981, where exemption from examination was granted for sonographers who could prove clinical practical experience of greater than three years prior to January 1979. A total of 22 applicants were granted this exemption, and were the teachers and advisors for the setting up of the professional standards and education[21] for the rest of the profession, as these sonographers were the researchers and developers of the new techniques which were being examined.

In February 1980, the first oral examinations were carried out in Adelaide and Sydney, and the first Part 1 written examinations were held in May 1980, in Adelaide, Canberra, Rockhampton, Palmerston North (NZ) and Sydney

In 1985, Graduates from the Royal Melbourne Institute of Technology (RMIT) ultrasound program were granted an automatic exemption from the Part 1 Examination, and offered a modified Part 2 Examination, in order to attain professional recognition by ASUM. This meant that even though the students had obtained the Graduate Diploma in Ultrasonography, their qualifications were not recognised by the professional body without further examinations. This was a disincentive for students to attend these tertiary learning institutions as the graduate would have to pass a second set of examinations to be recognised by the professional body.

In 1986, ASUM amalgamated with the New Zealand society and the name changed to The Australasian Society for Ultrasound in Medicine.

In 1987 the Vascular DMU was inaugurated, as sonographers were beginning to specialise in vascular applications of ultrasound. The regulations for this new diploma were published in 1988 and the foundation phase, similar to the foundation phase for the general and cardiac sonographers, expired on 1st January 1991. This foundation phase recognised six sonographers.

A syllabus was published for the General, Cardiac and Vascular Diplomas in 1992. This changed the format of the examinations, because the examinable topics were separated into Part 1 topics and Part 2 topics, with emphasis on certain areas in order to direct candidates' learning to subjects which should be known in detail[22].

In 1993, an Obstetric DMU was introduced, with an appropriate syllabus, which allowed the sonographers to specialise in the obstetrics field and qualify within that speciality.

1997 saw a change in the DMU regulations to incorporate exemption protocols and 1998 saw the introduction of Recognition Certificates to the practical examiners. Instead of the oral examinations an Objective Structured Clinical Examination (OSCE) was trialled, and received a favourable reception. This format allowed the assessment of the student's clinical skill to be performed in a more objective and reproducible format which was more easily documented, with systematic marking and guidance for the student also available. This change in format allows the Australian Sonographer Accreditation Registry (ASAR) to objectively assess the DMU qualification, and to reaccredit it as appropriate.

University based education in Australia

In April 1979, NSW TAFE started the first education course for general sonographers. This course was 15 hours in duration, but later expanded to 45 hours. This was the first step towards the introduction of sonography as a tertiary academic qualification, not a vocational qualification[23].

In 1980, RMIT established a Graduate Diploma in Ultrasonography[24]. This was the first distance tertiary academic qualification available in Australia for sonographers, but graduates from this course had to sit an abbreviated DMU to be considered 'qualified'. This was in part due to the practical nature of ultrasound, and it was considered essential for sonographers to prove themselves competent in a clinical setting, not only academically.

In 1984, due to pressure from within the profession in Queensland, the first attempt to accredit an ultrasound course at Queensland University of Technology (QUT) was made by J Whiting, and BW Thomas. This, however, was not accomplished until 1989. QUT was thought to be a logical place for the ultrasound course to be located as it was viewed internally as an extension of the existing medical radiation technologist undergraduate program. The first intake was in July 1989 and consisted of approximately 15 students[25].

In 1995, the first private practical ultrasound training institute, the Australian Institute of Ultrasound (AIU) was set up on the Gold Coast, this institution was started to provide practical training in the skills required for new sonographers, and for experienced sonographers wishing to improve or update their skills. The AIU was set up in response to the perceived need for practical training for students, as there is little time for dedicated and focused training of students by senior sonographers in the clinical environment[26].

Many universities within Australia, such as the University of South Australia and Charles Sturt University are now offering Graduate Diploma or Masters Course work in ultrasound. The University of Sydney, in addition, also offers certificates of specialisation in vascular and cardiac ultrasound. In 2000, QUT offered a Graduate Certificate in Breast Ultrasound, in response to a need within the breast imaging community (mainly Breast Screen Queensland) and in 2002, a dedicated

cardiac ultrasound course was offered.

Monash University is the latest university to offer an ultrasound course, and this was offered in 2002[27].

Many issues arise with these courses in the Universities[28]. These were discussed at the September 2005 ASUM Conference. Practical assessment of student sonographers is critical and, although guidelines are issued, there is the question of reproducibility of results and comparison of competency or criterion referenced assessment between one examiner and another, and between one university and another. The standards of courses between universities are monitored by the ASAR, but the issues of quality control and equity remain[29].

Another issue is the increase in the number and complexity of ultrasound examinations, and the requirement of the Commonwealth Department of Health and Aged Care (DHAC) for formal accreditation of sonographers. This requirement necessitates that sonographers obtain accreditation at the beginning of their career, while they are still inexperienced students. While this increase in regulation and responsibility has occurred, there has been a significant reduction of funding to the higher education sector, with a decrease in funding for courses and university staffing levels. This leads to an increased workload on academic sonographers concurrent with an increased expectation and need for training of students who are less experienced practically, and often only fulfill the very minimum requirements for admission to the university courses[30]. Due to the expectation that sonographers in academic positions will increase their own skills and education by studying for Masters and PhDs as well as maintaining their own clinical skills, the universities are experiencing great difficulties in both attracting and retaining suitably experienced sonographers. If this is taken to its natural conclusion, with experienced university-based sonographers leaving, there is the potential for existing courses to become non-viable, or to have less experienced and less skilled, but more academically able, sonographers teaching the students.

Recognition within Australia

In 1983, the New Zealand Government established the DMU as the standard for registration as a sonographer in that country. This meant that ASUM had an internationally recognised qualification which was not recognised nationally[31].

At present, the Ministers of Health in New South Wales, Tasmania and Western Australia recognise the DMU but, as yet, the other states do not. The Queensland Department of Health has not acknowledged the profession of sonography as a separate profession to radiography. This impacts negatively on the wages and conditions of sonographers working in the public health system, as the wages are equivalent to a radiographer's wage. Sonographers who are employed in the private sector have been recognised as a profession and paid accordingly for many years, due mainly to the shortage of sonographers and the increasing demand for the use of ultrasound for diagnosis.

The Federal Government has recognised sonography as a profession due to the DHAC regulations which require 'suitably qualified and accredited' sonographers to perform medical ultrasound studies in order for the patient to be eligible for Medicare rebates[32] It is a bizarre dichotomy – the Federal Government recognises sonographers Australia wide, but some individual state governments do not.

Regulation

A major impact on the development of sonography as a profession occurred in the early 1990s when sonographers were accepted as full members of ASUM. Prior to this, sonographers were associate members and, as such, not entitled to a vote. This was a contentious issue for ASUM as the full members were all physicians or researchers and tended to disparage the accomplishments of the sonographers. Intense lobbying by many of the sonographers was needed to convince the members of ASUM that sonographers were worthy of inclusion as full members, and the 1994 Annual General Meeting, at which this vote was taken, was the largest ASUM had seen[33]. This vote meant that sonographers were accepted and acknowledged as full members of their own professional body, and was a potent argument in the recognition of ultrasound as a profession.

In 1990, the DMU Board of Examiners met to discuss accreditation of ultrasound qualifications offered by Australian universities. Representatives from the Australian Sonographers Association (ASA), the Australian Institute of Radiography (AIR) and the Ultrasonographers Group of ASUM had discussions that led to the formation of ASUM's working committee, the Ultrasonographers Qualification Accreditation Working Party. This in turn led to the formation of the Ultrasonographers Qualification Accreditation Committee (UQAC) which recommended an Accreditation Registry be set up, and the Australian Sonographer Accreditation Registry (ASAR) was established in October 1994. The ASAR has established criteria to assess and judge academic programs in both Australia and New Zealand. The registry also has an important function in that it accredits ultrasound training programs, and reassesses and reaccredits these programs on a regular basis (usually a five year period)[34]. The ASAR also maintains a registry of accredited and student sonographers and monitors and records the continuing professional development (CPD) activities of members. Due to the accreditation of academic programs, graduates from the universities who had not sat for the DMU could now be accredited and recognised within the profession, without having to sit an abbreviated DMU exam.

Further to this accreditation, DHAC introduced the requirement that sonographers performing diagnostic ultrasound on behalf of a medical practitioner and if a Medicare rebate was to be claimed, had to be 'suitably qualified', maintain their continuing professional development and be registered with the ASAR. DHAC has sonographers enrolled on a Register of Sonographers and it is only these enrolled sonographers whose patients are able to claim a Medicare rebate for the ultrasound service[35]. This requirement for qualification did not specify where the sonographers obtained their qualification for accreditation purposes.

Formation of the accreditation body also means that the DMU will be scrutinised by a third party on a regular basis, and must also be accredited with the ASAR.

The ASAR led to significant changes in the way the DMU was regulated, major changes were implemented from 1994–1996, with input from the ultrasound faculties from QUT, University of Queensland and Sydney University. Changes in the format of the exam itself and specific requirements for numbers of examinations performed were introduced[36].

The examiners for the DMU were also issued with

handbooks and were required to attend seminars and to document comments and critiques for release to the candidate. The whole DMU process became much more accountable and open to inspection and review. The introduction of the requirement for the DMU examiners to be accredited in 2004 was particularly relevant as the examiners now need to be trained and so consistency can be maintained, not only between examiners but also from year to year. Prior to this training and accreditation process, the only qualification required of the examiners was to hold a DMU, and to be willing to volunteer their time.

A significant portion of the ASAR mandate is to maintain a record of the CPD activities of the members, virtually ensuring a commitment to life-long learning within the profession.

The Australian Sonographers Association (ASA) was formed in Melbourne in 1992, in response to a perceived need for an organisation that solely represented sonographers, and the issues confronting sonographers. Its mission statement is to 'represent sonographers and raise the profile of the ultrasound profession'[37]. ASUM was, and still is, a multidisciplinary body and represents clinicians as well as sonographers.

Conclusion

Ultrasound education in Australia developed from its early beginnings in the research and development of a new technology. Increased demands on sonographers in respect of their clinical skills, knowledge and independence has shown itself in the stringent accreditation requirements now in place and in the prevalence of the more structured ultrasound courses available in universities. These university courses were originally started due to pressure from within the profession in recognition that alternative courses to the DMU were required. The increasing popularity of the university courses proves that many students preferred a formal structure to their learning, with rigorous instruction and examination guidelines. The universities rely on support from the profession, as the student sonographers must be employed by a clinical practice in order to access the course. Clinical supervisors are expected to provide the practical training and guidance these students require to become competent sonographers. A complication of this workplace training is the increasing corporatisation of the medical profession, with greater expectations and higher patient workloads being required for the experienced sonographers, and for the student sonographers who are also expected to be contributing members of the team as quickly as possible.

The DMU is a highly regarded qualification, both in Australia and throughout the world, and offers an alternative path to accreditation for persons wishing to become sonographers. This is useful for students who are unable to attend on-campus blocks of lectures due to distance, work or family commitments, and have the ability to dedicate themselves to learning at their own pace. Due to the ASAR requirements, however, the DMU also offers preparatory classes for their candidates, which offers a more structured approach to learning.

Another benefit that the ASAR has achieved is that sonographers must be committed to lifelong learning, with maintenance of their accreditation contingent upon their achieving a specific number of CPD points each triennium. This, however, raises more questions on where these 'points' are earned.

I believe that the universities should be mindful of the lifelong learning requirements for the profession and should be offering vocational courses to qualified sonographers, not just to persons who wish to qualify in the profession.

This needs to be a focus for the future at universities across Australia and indeed could become a source of additional funding as continuing professional education (CPE) courses could be run for profit and this could subsidise the training of the students. The AIR, ASA and ASUM all offer conferences and day seminars, but this role could be enhanced by the universities, which have expertise and facilities available.

Most of the ultrasound research is now being performed in-house at various equipment manufacturers, in order to improve their equipment and therefore, sales. Very few developments have recently been achieved at universities, which appear to be content to teach entry-level courses and leave the research and development to the manufacturers. This may well reflect the funding available for research where any funding must be obtained from outside sources and it appears to me that the main requirement is that the research be financially successful.

The development of specialised DMU qualifications and the offering of breast, vascular and cardiac courses by universities, reflect the increasing specialisation within the profession, and an acknowledgement that one person cannot be competent in all aspects of sonography. These specialised qualifications also fulfill the requirement by DHAC for 'suitably qualified and accredited sonographers' to perform examinations.

In the future, sonographers aspire to take on even higher-order responsibilities with the introduction of sonographer practitioners. In the United Kingdom, sonographer practitioners work within the National Health System and issue reports on their work to the referring doctors. In Australia, we are legally constrained only to communicate our findings to the radiologist we work for and are unable to communicate our findings directly to either the patient or the referring physician.

In order for the sonographers to move forward in the profession, we need to be recognised by all state and federal governments. The lack of recognition does not impact on our professionalism and the way in which we conduct ourselves, but on the wages and respect we receive from our employers and the community. We need to insist on maintaining and strengthening the quality of sonographer education, and the quality of graduates from the universities must be maintained and improved, despite the funding and staffing difficulties involved.

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