

Will the Australian nuclear medicine technologist workforce meet anticipated health care demands?

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Abstract

Determination of national nuclear medicine technologist workforce size was made from census data in 2001 and 1996 and from the professional body in 2004. A survey conducted by the authors in 2005 provided retention patterns in north-eastern Australia and suggested causes. Utilisation of nuclear medicine diagnostic services was established through the Medicare Benefits Schedule group statistics.

More than half the nuclear medicine technologist workforce is under 35 years of age. Attrition commences from age 30, with very few workers over 55 years. In 2005 there was a 12% attrition of the survey workforce. In the past decade, service provision increased while workforce size decreased and the nuclear medicine technologist workforce is at risk of failing to meet the anticipated rise in health service needs.

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THE DELIVERY OF high-calibre health care services requires an adequate health workforce. The Australian National Health Workforce Strategic Framework 2004 reports the current challenges are health workforce shortages and an uneven

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What is known about the topic?

Limited data are reported about nuclear medicine technologist workforce retention issues worldwide.

What does this paper add?

This paper provides a synthesis of information from known and new data sources. Turnover, gender and age distributions, and rates of attrition of the nuclear medicine workforce are reviewed and compared with nuclear medicine service provision.

What are the implications for practitioners?

It would appear that the nuclear medicine technologist workforce has retention problems which may adversely impact future service provision.

distribution of health care workers throughout the nation.¹ Shortages often occur in outer metropolitan, rural and remote areas.¹ In addition, the ageing workforce is of concern because of the potential for rapid attrition from the workforce and reduction in future workers.¹

The Australian Productivity Commission's Australia's Health Workforce research report anticipates that the demand for future health services will escalate as the ability to provide these services constricts.² The factors listed as contributing to this rise in demand are the community's increasing incomes and expectations for timely and effective health care, technological advances, and population ageing.²

Medical imaging workers are categorised in government reports separately to allied health workers and include radiographers, radiation therapists, nuclear medicine technologists, and sonographers.^{2,3} Medical imaging workers were reported as increasing by 25% from the 1996 to 2001 census years, with a total of 8141 workers.³

Nuclear medicine technologists (NMTs) are the focus of this paper. Nuclear medicine uses unsealed sources of radioactive tracers to non-

invasively diagnose and treat disease.⁴ Nuclear medicine technologists prepare radiopharmaceuticals, use nuclear medicine instrumentation for diagnostic procedures, care for the patient during the procedure, and perform quality control on the instruments and procedures.⁵

Despite the reported increase in imaging workers, the Australian Department of Employment and Workplace Relations in 2006 listed NMTs in statewide shortage in Queensland and Western Australia.⁶ In May 2007 the Department of Immigration and Citizenship listed NMTs on the Skilled Occupation List, Sydney and Selected Areas Skill Shortage List and part of the Employer Nomination Scheme.⁷

The aim of this study is to review the NMT workforce size, retention over the past decade and utilisation of nuclear medicine diagnostic services, and to gain insight into the ability of this workforce to meet the projected rise in services in the future.

Methods

As no single data source could provide the detail required to explore the aims of this study, it was necessary to use four sources. These were a survey conducted in 2005 within New South Wales, the Australian Capital Territory and Queensland; the Australian Bureau of Statistics (ABS) Census of Population and Housing for the years 1996 and 2001; and the professional body, the Australian and New Zealand Society of Nuclear Medicine (ANZSNM). Details of the utilisation of diagnostic services for private patients in Australia were sourced from the Medicare Benefits Schedule (MBS) Group Statistics Reports.

Nuclear medicine technologist survey

The NMT survey was conducted in 2005 in NSW, the ACT and Qld. A written questionnaire was posted to the chief NMTs. Chief NMTs were deemed to be the most appropriate participants for the study because they manage NMT staffing and have an overview of the practice workload. Ninety sites in NSW, ACT and Qld were identified using the University of Sydney student clinical

placement database and the telephone directory to identify additional centres in each state not on the database. One questionnaire was returned stating the centre no longer existed, so a total of 89 centres were used in the study. An overall response rate of 54% ($n = 48$) was achieved.

The rationale for the sample was based on educational opportunities and workforce size. For those seeking to enter the field of nuclear medicine technology, the availability of education within their home state was seen to be an advantage, and therefore states without this opportunity would be disadvantaged regarding employment of recent graduates. Gaining data from a range of workforce sizes would provide data that were representative of the nation. New South Wales has three educational institutions offering nuclear medicine courses, while Qld and the ACT have none. The ANZSNM Accreditation Board reports that NSW is the largest employer of NMT services, Qld is the third largest and the ACT is one of the smallest (Australian New Zealand Society of Nuclear Medicine Inc, Secretariat, 8 September 2004, personal communication).

A pilot of the survey was conducted to ensure the aims of the study were being met and that no ambiguities existed within the questionnaire. The survey was approved by the University of Sydney Human Ethics Committee and was mailed out on 26 July 2005, including a reply paid envelope. Items relating to retention were both closed and open ended. In addition, the number of staff, including those NMTs working in other areas within the practice, such as sonography, were included to provide detail on the current workforce.

The items used in the questionnaire relating to movement of staff are listed below and questioned the number of staff moving to another practice, to ultrasound, to any other aspect of nuclear medicine such as an applications specialist, radiopharmaceutical suppliers or out of nuclear medicine.

Open-ended responses related to retention were subjected to thematic analysis, with frequency of responses in the themes identified.

Analysis was conducted independently by two of the researchers to ensure consistency of coding and, hence, validity. The results of the independent analyses were reviewed with major themes agreed upon and reported. A reallocation of responses was made to match the agreed themes, with the frequency reported. Where responses could not fit into a major theme they were combined together into a general category.

Australian Bureau of Statistics Census

A special extract from the ABS Census microdata file was obtained and aggregated to preserve confidentiality by variables such as age, sex and hours of work and then analysed to determine attrition rates and gender trends. The Census years 1996 and 2001 were used. Although earlier Census data were available, NMTs were not categorised separately. A limited analysis of age distribution of diagnostic radiographers and radiation therapists was undertaken to compare trends.

The data were extracted and analysed using Microsoft Office Excel 2003 (Microsoft Corporation, Redmond, Wash, USA) using the approach reported by Schofield and Beard to estimate medical attrition.⁸ The rate of attrition by age group for the NMT workforce was calculated by the percentage decline in the size of the NMT workforce between 1996 and 2001 for each age group. The percentage population for age groups less than 35 years and 55 years and over was calculated for NMTs, diagnostic radiographers and radiation therapists. Census data provides 5-year age groupings.

Australian New Zealand Society of Nuclear Medicine

The Secretariat of the nuclear medicine professional body that includes physicians, technologists, radiochemists, physicists and nurses, was approached in late 2004 seeking details of the current membership of NMTs.

Medicare Benefits Schedule group statistics

The use of nuclear medicine diagnostic services for private patients from July 1996 until June 2006 was determined by accessing the MBS

Group Statistics Report on line.⁹ A limitation of these data is that services provided for public or veteran affairs patients in public hospitals are not included.

Bone and myocardial perfusion imaging are by far the most common nuclear medicine procedures, making up almost 80% of the services provided.¹⁰ It is expected that the proportion of these services is similar in private and public practice and therefore the omission of the public data will not skew service provision findings. Diagnostic services only were accessed and therefore the proportion of therapeutic services was omitted. Therapy is a very small proportion of the total service provided in nuclear medicine and is performed predominantly in public hospitals.¹⁰

Data were again analysed using Excel. The percentage change in service provision over discrete time frames was calculated.

Results

The results are presented in three distinct areas — workforce size, retention, and service provision. Each section presents results from a variety of data sources and then compares and contrasts findings.

Workforce size

Workforce data from the ANZSNM were compared with those from the 2001 ABS Census on a state-by-state basis and are displayed in Box 1 as the total number of NMTs per state. A total of 440 NMTs were reported in the 1996 Census, increasing to 527 in the 2001 Census year.

The majority of states demonstrate a shrinking workforce in 2004 as compared with 2001 with only two states recording growth. The Northern Territory is unique, with no NMTs reported in 2001. In 2004 anecdotal reports indicated that staff from South Australia travelled to the NT to cover the nuclear medicine service.

Both data sources were used because each has some limitation in providing an accurate figure. The ANZSNM data in 2004 provided only a rough measure of the active workforce size

I National workforce size

State	ABS census 2001	ANZSNM 2004	Change 2001–2004
New South Wales	165	209	+ 44
Victoria	166	153	-13
Queensland	73	54	-19
Western Australia	60	41	-19
South Australia	42	39	-3
Tasmania	6	14	+ 8
Australian Capital Territory	15	10	-5
Northern Territory	0	SA staff cover	unknown
Total	527	520	-7

Sources: 2001 Census and Australian and New Zealand Society of Nuclear Medicine (ANZSNM), authors' calculations.

because a small number of NMTs may not be up-to-date with their membership and therefore not be counted, and current members such as sonographers and educators may keep their professional membership but not be working in the field. The ABS Census data should provide the most accurate figure of workforce size, but unfortunately until access to the 2006 Census data is available it is not current. Neither data source provides full-time-equivalent staff numbers per state. Licensing/regulatory requirements were not required by all states until 2006. They were therefore not useful for obtaining an accurate measure of workforce size.

Nuclear medicine technologist workforce survey 2005

The NMT survey provided data about the active workforce within the responding centres. A total of 202 individuals were reported by the chief technologists ($n = 48$) as working as NMTs, with 25 of these in their first year of practice; full right to practice is not gained until successful completion of the first year. An additional 32 staff were reported in the survey who have an NMT qualification but work in other areas of practice within the centre, such as sonography. The figures reported were the total number of NMTs in the

centre where the respondent works and not full-time-equivalent staff numbers.

Membership of 274 for the same states was reported by the ANZSNM in 2004, and in 2001 the ABS Census data reports 244. An accurate comparison of the states surveyed to the 2004 workforce size is not possible because the NMT survey did not have a 100% response rate, but it would seem the workforce in these states in 2005 is in the range of 240–280. It appears then, that in 2005 there has been little or no growth in the NSW, ACT and Qld workforce.

Retention

Staff movement was reported by 52% ($n = 25$ centres) of the chief NMTs over the 12 months before receipt of the survey. A total of 47 individuals or 23% of the respondent workforce ($n = 202$) changed jobs (either to another nuclear medicine centre or leaving the profession) within this period. Of these, there is almost 12% attrition, with 24 individuals leaving the profession entirely.

Box 2 outlines the movement of staff to specific areas reported by the Chief Technologists. Examples of the type “nuclear medicine-related position” could mean the individual is working as an applications specialist or radiopharmaceutical supplier but is no longer working as an NMT.

2 Staff movement in New South Wales, Queensland and the Australian Capital Territory in 2005

Direction of movement	No. of centres	No. of staff	Proportion of survey workforce
Another NMT position	16	23	11.4%
Sonography	7	9	4.5%
Nuclear medicine-related position	4	4	1.9%
Out of nuclear medicine completely	9	11	5.4%
Total	36	47	23.2%

NMT = nuclear medicine technologist.
Source: NMT survey, authors' calculations.

Sonography is also a move away, although it is often located within the nuclear medicine centre.

The analysis of census data examined national age distributions of NMTs, diagnostic radiographers and radiation therapists. A comparison of the age distribution of respondents for the Census periods 1996 and 2001 who stated they were NMTs is displayed in Box 3. There are very few NMTs beyond the age of 45 years, which reflects the relative newness of the profession.

In 2001, diagnostic radiographers had 40.5% of their workforce aged < 35 years and 8.6% \geq 55 years. In 1996 the proportions were similar with 42.5% < 35 years and 5.3% \geq 55 years. Radiation therapists displayed a slightly younger workforce with 54.2% < 35 years and 2.6% \geq 55 years in 2001. In 1996 a similar pattern emerged with 54% < 35 years and 3.6% \geq 55 years. Diagnostic radiographers and radiation therapists have fewer staff aged less than 35 years compared with NMTs, with 64.7% in 2001 in this age group.

Net rates of attrition for NMTs and attrition by gender were calculated and compared.

Box 4 displays the net attrition of the NMT workforce from 1996 to 2001 for all age groups. The first NSW course for nuclear medicine tech-

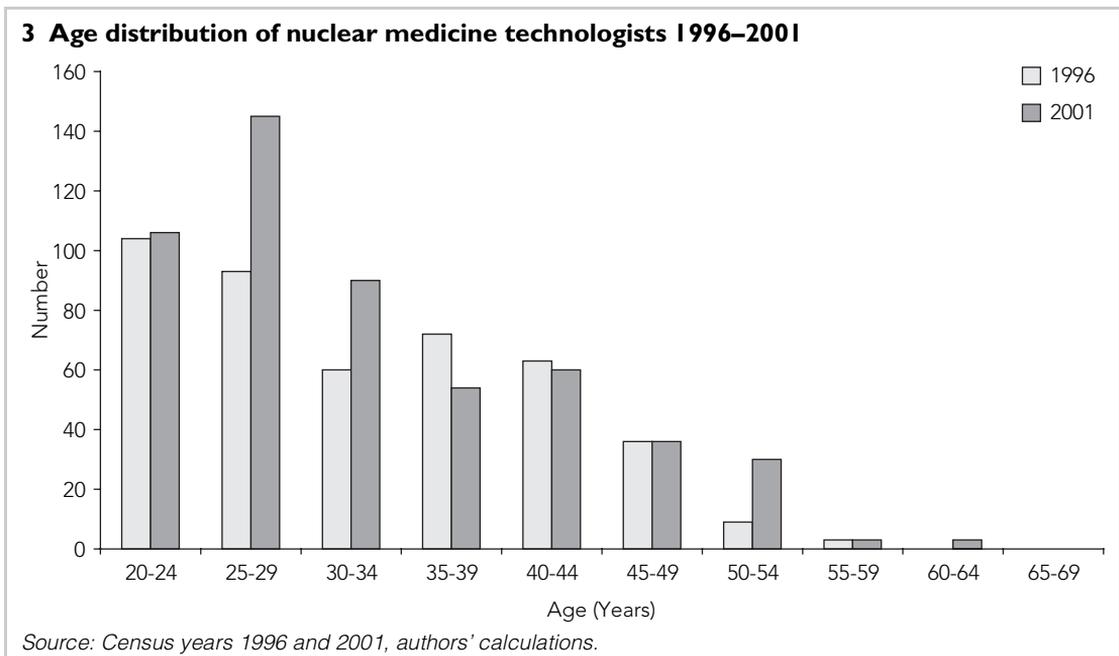
nology commenced in the Technical and Further Education sector in 1971. The large influx of NMTs in the mid 1990s (ie, NMTs in the 25–29-year age group) could be a result of the move to university education in NSW in 1991. Movement out of the workforce commences from age 30 years and continues until retirement.

A comparison of attrition by gender is displayed in Box 5. Male NMTs leave the profession earlier than females, but females often leave in their mid thirties and return to the workforce in their forties.

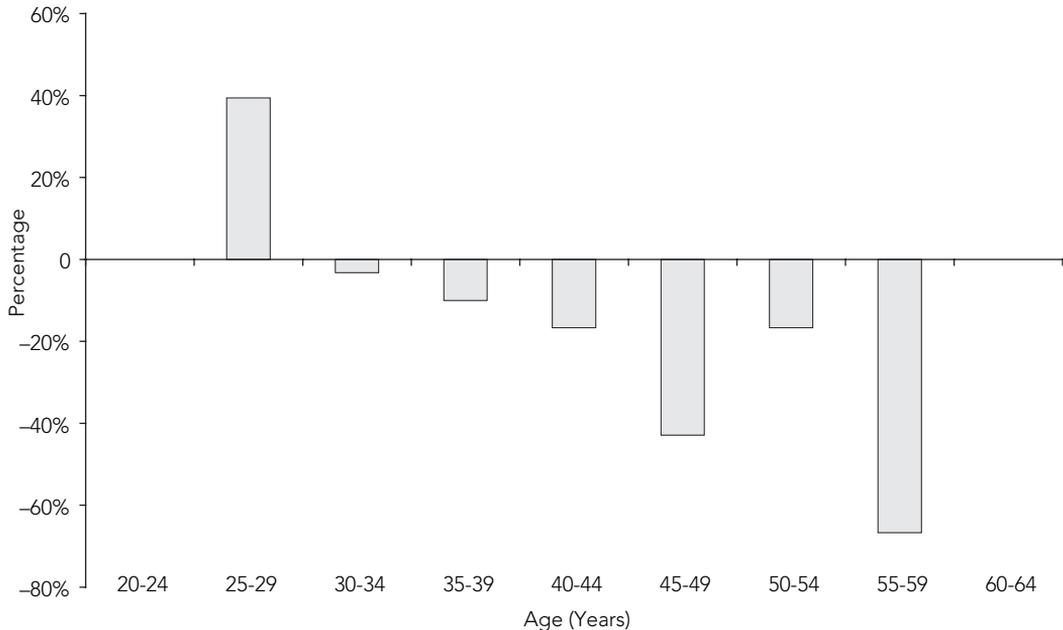
The NMT survey provided respondents with an opportunity to express their opinions about retention in nuclear medicine technology. Twenty respondents (47.1%) provided comments regarding retention. Box 6 lists the themes, provides an example response and the frequency of this type of response within the theme. There is only one theme reporting no difficulty with retention, which is listed first.

Service provision

An overview of diagnostic service provision for private patients demonstrated a national growth of 34.7% over 10 years from July 1996 to June



4 Age-related attrition from 1996–2001



Source: Census years 1996 and 2001, authors' calculations.

2006. The timeframes provided by the MBS statistics match the financial year and are therefore from 30 June to 1 July.

Growth in nuclear medicine services was demonstrated in all states between mid 1995 and mid 2004, with the exception of the ACT. In the period 2005–2006, five states (NSW, Vic, Qld, SA and NT) displayed a growth in service provision, while the remaining three states showed a small decline in usage. The rise in services in the NT in 2005–2006 may be attributed to employment of permanent staff, rather than the previous workforce coverage by SA.

A summary of the change in service provision for specific time intervals per region is given below. The time intervals have been chosen to match workforce data and 10 years for completeness.

Change over 3 years (June 2001–July 2004)

Queensland and WA had a similar percentage growth (12.7% and 11.2%) during this period and yet their NMT workforce decreased by 31% and 26% respectively during the same period (see

Box 1). The ACT was the only region to show a reduction in service provision (–1.5%) and a corresponding loss of one third of its workforce during the same period.

Change over 5 years (July 1996–June 2001)

All regions experienced growth during this period, with WA demonstrating the greatest increase (42.9%) in service provision.

Change over 8 years (July 1996–June 2004)

All regions experienced growth in service provision with WA and Tas experiencing the greatest increase (58.9% and 52.7%).

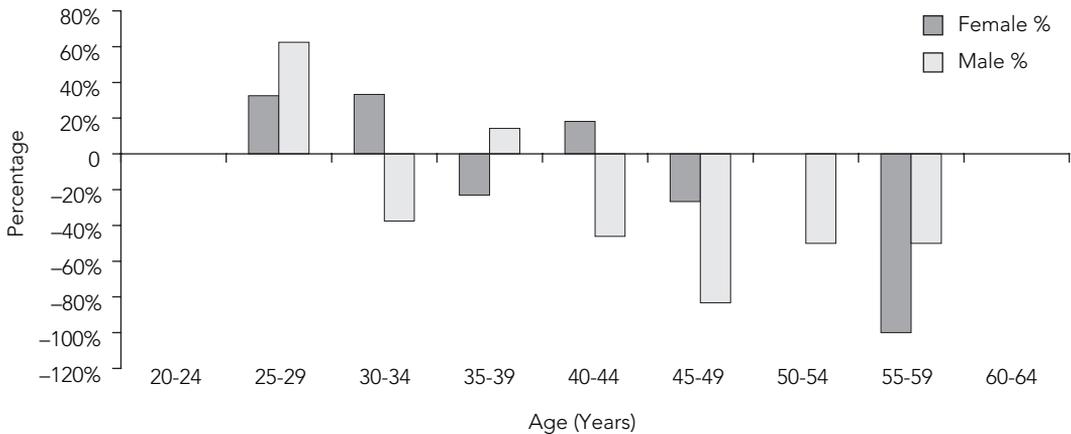
Change over 10 years (July 1996–June 2006)

The NT, WA, and Qld, had the greatest change in service provision over the decade. The ACT was the only state to incur a decrease (–11.4%) in service provision during this period.

Service provision versus workforce size

A comparison of national change in service provision versus the workforce change is displayed in

5 Comparison of attrition by gender 1996–2001



Source: Census years 1996 and 2001, authors' calculations.

Box 7. The time intervals reported match the Census data and the professional body. The 1996 to 2001 period was the only time where growth in service provision usage was similar to the increase in workforce size. All other periods exhibited a greater increase in service provision as compared with the change in workforce size.

Discussion

The findings indicate a serious problem with the retention of NMTs and the relationship between workforce size and service usage. The national NMT workforce growth determined from the 1996 and 2001 census data was 19.8% ($n=87$) as compared with 25% reported by the Australia's Health Workforce report³ for medical imaging workers as a whole. Of importance is the fact that 3 years later, in 2004, the national NMT population reported by the ANZSNM had decreased by 1.3% ($n=520$) as compared with the 2001 Census data ($n=527$). The provision of nuclear medicine diagnostic services however did not diminish between 2001–2004 but grew by an overall 8.3%. When analysing the entire period 1996–2004, diagnostic service provision at 29.1%, has grown faster than the NMT workforce which had only an 18.2% growth.

Workforce and service provision growth is quite variable by region. The workforce decreased

in all regions from 2001 to 2004 except NSW and Tas. Tasmania displayed a substantial 15.2% growth in service provision over this period; the second highest rate in the nation. The NT exhibited the highest growth of 29.2% but the staffing details are unknown. Queensland and WA experienced growth in services of 12.7% and 11.2% respectively and yet had the greatest decreases in workforce, with a loss of 19 staff each. Both Qld and WA are listed by Australian Department of Employment and Workplace Relations as being in statewide shortage. The ACT was the only region to experience a decrease in service provision over this timeframe, which corresponded to a loss of one third of the workforce. Anecdotally, this corresponds with a shortage in nuclear medicine physicians in this low population region.

An accurate projection of future workforce and healthcare requirements is difficult because of the complexity of the environment.² Workforce planners broadly use a demand versus supply model. The demand component includes a baseline and a growth factor. The factors considered to influence growth by Australia's workforce planners, the Australian Medical Workforce Advisory Committee and the Australian Health Workforce Advisory Committee, are demographic changes, technological advancements and disease trends.² In the case of nuclear medi-

6 Chief nuclear medicine technologists (NMTs) comments regarding attrition

Theme	Example response	Frequency
Retention satisfactory	I have been the sole tech for over 8 years and have no plans to go elsewhere	2
Lack of career path	Lack of career pathways in nuclear medicine. No succession planning. No chief jobs. Reach senior then a dead end so technologist looks for another career	5
Location deters staff	Difficult to attract technologist to country area impossible to attract experienced techs or retain after experience	4
Onerous legislation	MRTBQ legislation prohibits this department from training of a professional development year NMT despite meeting the criteria set by the ANZSNM	3
Monetary rewards	Reward scheme so instead of payment for advertising for jobs a special retention fee for accredited techs	2
General staffing problems	Difficult to get staff or retain — average work period in practice is about 15 months	6

MRTBQ = Medical Radiation Technologist Registration Board Queensland. ANZSNM = Australian and New Zealand Society of Nuclear Medicine.

Source: NMT survey, authors' analysis.

7 Comparison of service provision and workforce size

Timeframe	National service provision growth*	Workforce size change†
1996 July–2004 June (8 years)	29.1%	+18.2%
1996 July–2001 June (5 years)	19.2%	+19.7%
2001 July–2004 June (3 years)	8.3%	-1.3%

Sources: * Medicare Benefits Schedule Group Statistics Reports.⁹ † Census years 1996 and 2001 and Australian and New Zealand Society of Nuclear Medicine, authors' calculations.

ciné, the growth factors indicate rising rather than a diminishing need.

The disparity between workforce and service provision is of concern when nuclear medicine plays an important role in health care delivery to the older population. The two most commonly performed diagnostic procedures are bone and myocardial perfusion studies. Bone scintigraphy is a highly sensitive test that plays a major role in the evaluation of patients in whom skeletal metastases are suspected, particularly in those who are asymptomatic.¹¹ Myocardial perfusion imaging provides an accurate measure of the extent and severity of coronary artery disease¹² and is particularly useful in patients who cannot exercise.¹³ Cancer and cardiovascular disease accounted for 37% of the disease burden to

Australians in 2003.¹⁴ As cancer and coronary disease tend to be concentrated in older age groups, the demand for bone scintigraphy and myocardial imaging will increase in the future.

Cancer is predicted to be the largest contributor to the health burden over the next two decades.¹⁴ Positron emission tomography (PET) is growing rapidly.⁵ This technology plays an important role in oncology and clinical management of patients.¹⁵ One of the main advantages of PET is its ability to accurately stage disease, thereby altering patient management after diagnosis. With increasing access to this modality and Medicare rebates on procedures, service demand will grow and an increase in NMTs will be required. In general, the use of PET does not replace conventional nuclear medicine services. The higher radi-

ation dose received by staff working in PET necessitates a greater staffing ratio to reduce individual radiation burden.¹⁶ The increasing use of this new technology will therefore lead to greater demand for NMTs.

The Census data revealed that for NMTs ageing of the workforce is not evident. It appears a younger workforce is emerging, when in 2001 almost two thirds (64.7%) were aged under 35 years whereas in 1996 just over half (58.4%) the workforce was in that age group. Compared with other medical imaging workers in 2001, NMTs are a younger workforce. Diagnostic radiographers have 40.5% aged under 35 years of age and radiation therapists have 54.2%. In nuclear medicine, very few workers remain after 55 years of age (2001: 1.1%, $n = 6$; and 1996: 0.7%, $n = 3$), whereas diagnostic radiography have 8.6% and radiation therapy have 2.6%. The reason for the young NMT workforce is not known.

The supply of nuclear medicine services is in question when net loss from the NMT workforce is consistent from the age of 30 years onwards, with male workers leaving earlier than their female counterparts. In fact, in 2001, just over 70% of the NMT workforce had moved out by the age of 49 years. The factors leading to this high level of attrition are unknown, but given the staff shortages in some states, stress may be a key factor.

The NMT survey provides some insight into where staff move and opinions from the Chief Technologists as to why the movement exists. Two of the more frequently cited reasons regarding poor retention are lack of career pathways and geographical location. Sonography may offer a more attractive career pathway and that is why 4.5% of the NMTs survey moved to this field in 2005. Sonography is a rapidly growing field with the Australian Health Workforce Advisory Committee reporting 102% growth between 1996 and 2001.¹⁷ Geographical location is an issue, particularly in rural areas, but Qld also suffers because they do not have an educational provider and although graduates may take a position in Qld initially, they often return to their home state.

Another issue affecting an adequate supply of NMTs is the major dilemma of graduates in their

first year obtaining employment. There are three universities in NSW producing graduates, with about 50 graduating per year, but only 13% (22) of the workforce reported in the NMT survey are in their first year of practice. It is unlikely that the other 44 centres in north-eastern Australia (ie, those who did not respond to the NMT survey) have employed all of the remaining graduates from NSW. Victoria and SA have their own educational providers and probably maintain their own state workforce, while the other states are small employers with the exception of Qld, and have no educational provider. Where do the additional graduates work after completing their course? Do they travel overseas after graduation and return at some point in time, or do they never enter the field of nuclear medicine? Further, participants in the NMT survey indicated there were legislative requirements in Qld, such as the requirement to have two accredited NMTs on site, that are a hindrance to employing first-year graduates.

How have practices maintained or increased services with fewer staff? With technological advances and increasing automation of equipment, a small decrease in staffing may be safely associated with an increase in patient throughput. However this is unlikely to be significant because patient care is a major role of the NMT and is required at all times. If staffing levels become too low, adequate patient care may become difficult.

The identified shortage of NMTs and substantial growth in services in Qld and WA needs specific attention. A longitudinal study of graduates would be valuable to see where they gain employment and whether there is a trend for graduates to only want to work in their home state. If this is the case, it would indicate the need to have an educational provider in Qld and WA, because neither state has one.

An extensive investigation into why the current attrition pattern occurs is required. Analysis of the 2006 Census data will assist in evaluating if the trends continue. A survey of the Chief NMTs working in the states omitted in this study would provide additional information into possible reasons for the attrition of staff.

Conclusion

Given the anticipated rise in nuclear medicine service demands over the next decade and the shrinking workforce with no resolution in place, it would appear that the future NMT requirements will not be met. The key factors leading to this conclusion are the ageing population and their associated need for increased service use, in particular for cardiovascular disease, the increase in the availability of PET and its associated value in managing patients with cancer, the apparent shortfall in graduates obtaining jobs with the possibility of never working as a NMT, and the current shrinking workforce.

The Australian Productivity Commission's report and its concern for workforce shortages over the next decade, along with the findings in this study, indicate that it is important to determine the factors contributing to the low levels of NMT retention and possible lack of employment opportunities for those graduating.

Further in-depth research is required to address retention of NMTs and the possible decline in ability to meet health care needs. An evaluation of the workplace characteristics, the projected health care demands and the effect of technological changes on these demands is warranted. Findings would assist in workforce planning and ensuring that there are adequate resources to meet the future health care demands.

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Competing interests

The authors declare that they have no competing interests.

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