2020 Clinical Radiology Workforce Census Report: Australia

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The Royal Australian and New Zealand College of Radiologists®

The Faculty of Clinical Radiology

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FOREWORD AND ACKNOWLEDGEMENTS

The Royal Australian and New Zealand College of Radiologists' (RANZCR) Clinical Radiology Workforce Committee (CRWC) are delighted to present the *2020 Clinical Radiology Workforce Census Report: Australia*.

The Clinical Radiology Workforce Census (census) is a quadrennial survey of all clinical radiologist members that aims to understand current workforce dynamics and their impact on clinical radiologist staffing levels and skill-mix. This report presents and analyses the results of the 2020 census.

The College sets, promotes and continuously improves the standards of training and practice in clinical radiology and radiation oncology for the betterment of the people of Australia and New Zealand. The College aims to influence policy and promote appropriate economic conditions and workforce supply, in order to encourage and support excellence in practice and patient care.

Data collected from previous member surveys has been used to improve the training program (including its supporting curriculum, standards, and selection criteria) and guide development of services for members. The data has also been shared with state and federal governments, so as to improve their resourcing of clinical radiology and the funding of training positions.

Thank you to Dr Catherine Mandel, under whose Chairmanship of the CRWC, this census was conducted.

Thank you to all members who supported this activity. This report would not have been possible without the contributions of those who have given their time freely to complete the census.

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EXECUTIVE SUMMARY

This report describes the Australian clinical radiologist workforce as it was in late 2020. It provides a comparison with past reports, recent workforce trends, and the overall Australian medical workforce.

The 2020 Census (the Census) was distributed to 2,609 clinical radiologists in Australia, including 2,332 practising clinical radiologists and 277 retired clinical radiologists. The Census was open to respondents for 14 weeks, from the end of July 2020 to the end of October 2020. A total of 1,098 responses were returned from practising clinical radiologists consisting of active fellows, educational affiliates, life, honorary, and associate members, thereby yielding a response rate of 47.1%. This figure excludes trainees and members who are inactive, retired, have permanently left clinical radiology or are temporarily inactive. This Census report was based on data from the 2020 Census and the RANZCR membership database.

In 2020, there were 2,332 practising clinical radiologists, a 16% increase since 2016 and a 103% increase since 2000. The 103% increase since 2000 is mainly the result of the doubling of trainee numbers between 2000 and 2016. In 2020, nearly one-third of practising members (35%, n= 815) obtained their primary medical qualification from overseas which is similar to the 2016 and 2012 membership data, indicating that Australian radiology is still very reliant on international medical graduates, including from New Zealand.

Until 2016, the average retirement age witnessed a steady increasing trend. However, in 2020, this was the first census to demonstrate a decline in the average retirement age from 71.1 years in 2016 to 66.1 years in 2020.

Based on self-reported FTE, the average FTE in 2020 was 1.02, which is similar to that reported in 2016 (1.04) and 2012 (1.03). Therefore, there were 2,350 FTE clinical radiologists in Australia in 2020 (91.5 clinical radiologists per million population). There was only a very small number (4.7%) of clinical radiologists who were unemployed or actively seeking more work.

Clinical Work Activity:

According to the results from this census, respondents reported that 76% of work activity was classified as ‘clinical activities’. The vast majority of a radiologists’ time is spent in clinical activities, including 49% of work activity in a typical working week, was spent reporting imaging studies in hours (67% in 2016), 15% of activity is spent on clinical procedures. And the rest was spent in clinical meetings and clinical after hours, clinical un-rostered or unpaid work.

Since 2000, there has been a decline in self-identification as a ‘generalist’ and corresponding increases in self-identification as either a ‘generalist with area(s) of interest’, or a ‘subspecialist’. In the 2020 Census, a majority of the respondents (51%) considered themselves a ‘generalist’, with 36.3% of respondents identifying as a ‘generalist with area(s) of interest’ and 14.7% as a pure ‘generalist’.

A high percentage of radiologists (73%) agreed or strongly agreed that the amount of time they were rostered as on-call is sustainable but the effect of offsite teleradiology support could not be ascertained.

Gender differences:

In 2020, 71.1% of practising clinical radiologists were male and 28.9% were female. Female clinical radiologists were more likely to work part-time, mainly during their early and mid-career stages, whereas male radiologists were more likely to work part time in the later stages of their career.

The proportion of female clinical radiology trainees to the total number of trainees is now 33.8%. This has decreased from 38.0% in 2012 and 35.2% in 2016 and is similar to the 2008 data (36.8% of total respondents, including New Zealand and overseas trainees). The reasons for this, when a majority of medical graduates are female, needs to be determined and addressed.

Geographical maldistribution:

The rural and regional shortage persists and is similar in extent to the situation reported in 2012 and 2016. Rural/regional radiologists are generally older than their metropolitan peers, are more likely to be male and more likely to practise as a generalist.

International Medical Graduates:

About 34.9% of practising clinical radiology members obtained their medical qualifications overseas, with the majority of international medical graduates (IMG) coming from India (7.8%), followed by South Africa (5.7%) and the United Kingdom (5.0%). Most IMG obtained their radiology training overseas and some wholly in Australia. The number of practising members who are obtaining their primary medical qualification in Australia has been decreasing since 2012 (1.2% decrease since 2012), indicating that Australi n clinical radiology is still relatively reliant on overseas-trained medical graduates (including from New Zealand).

Teaching Supervision & Research:

Many clinical radiologists report d that they are willing to be involved in teaching and supervision of trainees as well as being involved in research However, some of the reported barriers include heavy workloads due to staff shortages (especially in rural and regional private sector practices) current practice restrictions, family or personal commitments, and a lack of infrastructure to for training onsite. The College is considering approaches to promote and support training in non-traditional training sites including a review of the Training Accreditation Standards (due for release in 2024) that enable greater flexibility and adaptability for training sites, consideration of models of supervision, and the introduction of the 2022 Training Program which has shifted training to an outcomes-focused training program. The College is also exploring opportunities to expand training in regional and rural settings along with appropriate support mechanisms to ensure an ongoing supply of skilled clinical radiologists and to build a sustainable clinical radiology workforce.

Trainee Demographics:

In 2020, there were 512 clinical radiology trainees situated at RANZCR-accredited Australian training posts which is a 12.8% increase since 2016, and a 172.3% increase in trainees since 2000. The vast majority of training posts remain in major metropolitan centres (MM)[i].

It is interesting to note that the increase in trainee numbers since 2016 is approximately equal to the compound increase in Medicare utilisation (i.e., Medicare billed services) during the same time period. However, it is not possible to determine the exact change in work volume as public hospital work, privately funded work, and other payers (e.g., workers' compensation) are more difficult to determine compared with Medicare-billed work. In addition, work complexity is difficult to calculate just from MBS data as more complex work requires more clinical radiologist's time.

In 2020, 67.3% of trainee respondents were from MM1, 7.7% are from MM2, 3.2% are from MM3 and 12.2% are from MM4-MM6[i]. This should be noted as 70% of the Australian population lives in areas classified as MM1 and 87% of the active clinical radiology workforce lived in MM1 regions. Therefore, ensuring that there are enough clinical radiologists, with an interest and ability to live and work in rural areas, is critical to meeting workforce demands and honouring the College's obligations to train the specialists needed across Australia, given the College's monopoly in training.

Adequacy of the workforce and trainee numbers:

Ascertaining the intermediate and long-term needs for clinical radiologists is complex. The MBS data is the most robust available, but it does not capture all the work performed by clinical radiologists and

[i] MM 1-Metropolitan areas: Major cities accounting for 70% of Australia's population,
MM 2-Regional centres: Inner (ASGS-RA 2) and Outer Regional (ASGS-RA 3) areas that are in, or within a 20km drive of a town with over 50,000 residents. For example: Ballarat, Mackay, Toowoomba, Kiama, Albury, Bunbury,
MM 3-Large rural towns: Inner (ASGS-RA 2) and Outer Regional (ASGS-RA 3) areas that are not MM 2 and are in, or within a 15km drive of a town between 15,000 to 50,000 residents. For example: Dubbo, Lismore, Yeppoon, Busselton.
MM 4-Medium rural towns: Inner (ASGS-RA 2) and Outer Regional (ASGS-RA 3) areas that are not MM 2 or MM 3, and are in, or within a 10km drive of a town with between 5,000 to 15,000 residents. For example: Port Augusta, Charters Towers, Moree.
MM 5-Small rural towns: All remaining Inner (ASGS-RA 2) and Outer Regional
(ASGS-RA 3) areas. For example: Mount Buller, Moruya, Renmark, Condamine.
MM 6-Remote communities: Remote mainland areas (ASGS-RA 4) AND remote islands less than 5kms offshore. For example: Cape Tribulation, Lightning Ridge, Alice Springs, Mallacoota, Port Hedland. Additionally, islands that have an MM 5 classification with a population of less than 1,000 without bridges to the mainland will now be classified as MM 6 for example: Bruny Island.
MM 7-Very remote communities: Very remote areas (ASGS-RA 5). For example: Longreach, Coober Pedy, Thursday Island, and all other remote island areas more than 5kms offshore.

does not measure complexity. Anecdotally, as per comments made by the CRWC members, there is increasing pressure on clinical radiologists to perform more work per day and that this work is increasingly complex. The SARS-CoV-2 pandemic (COVID-19 pandemic), with its restrictions on movement between states and territories, as well as the closure of the international border, demonstrated the vulnerability of Australia and Australians to long-term supply chains; especially those that cross borders. This is just as true of clinical radiology where there has been a heavy reliance on overseas-trained radiologists to fill jobs, especially in regional and rural locations. The long-standing rural workforce shortage persists, and anecdotally, is progressively getting worse. The small 'isolated' jurisdictions of Tasmania and the Northern Territory are at a higher risk of sudden undersupply of clinical radiologists, as the small workforces are susceptible to significant imbalance. This is supported with the small change in clinical radiologist FTE numbers from retirement, health issues or migration (including interstate, which has been exacerbated by the COVID-19 pandemic.

Some CRWC work seeks to capture more robust data on this issue. Regardless, the COVID-19 pandemic has made it clear to the Committee that Australia needs to become self-sufficient in the supply of clinical radiologists throughout the entirety of Australia.

INTRODUCTION AND BACKGROUND

This is the Australian report of the 2020 Clinical Radiology Workforce Census (the Census), which is conducted every four years by RANZCR's CRWC. The survey encompasses all of RANZCR's clinical radiology members, including retired and active fellows, educational affiliates, life, honorary, and associate members. The CRWC confined the census analysis to those who are working, or seeking work, for more accurate data analysis. Two census reports have been written by the CRWC, with assistance from RANZCR staff: one for Australia and one for New Zealand.

This report describes the Australian clinical radiologist workforce as it was in 2020, compares it with recent past reports and the Australian medical workforce overall. It highlights issues and trends for future action and observation. This 2020 Census Report includes a summary of the demographic information from the RANZCR membership database (as of 30 June 2020).

For more information about the history of the RANZCR Workforce surveys and the responsibilities of the CRWC, please refer to *Appendix 1. The History of RANZCR Workforce Surveys and the CRWC.*

Geographical Definition

The Modified Monash Model (MMM)[66] is now used by governments to define geographical distribution and has been used throughout this Census report. The MMM 2019 was developed to better target health workforce programs to attract health professionals to more remote and smaller communities. The MMM classifies metropolitan, regional, rural, and remote areas according to geographical remoteness, as defined by the Australian Bureau of Statistics (ABS), and town size. The Modified Monash Model (MMM) 2019 was updated to align with the latest available census data (2016). It better categorises regional and rural areas according to both geographical remoteness and settlement (village, town, city) size[68]. The system was developed to address the challenges in attracting health workers to the smaller settlements/communities in the MM2+ categories[68].

1. METHODOLOGY

Aim

The objectives of the Census are to gather current workforce information about:

1. Practising clinical radiologists, that cannot be obtained from the college's membership database
2. The type of work and other professional activity of clinical radiologists in Australia
3. Clinical radiology workforce supply dynamics.

The information is used to identify workforce and training strategies to help the College and governments meet the clinical radiologist workforce needs, to ensure the provision of high quality, effective radiological clinical care (i.e., provide optimal patient care) for all Australians.

The Census collects specific thematic data that could affect the supply and quality of clinical radiologists: demographics; geographical distribution; work-life balance; training history; work patterns, settings, and types, including workload; clinical practice variations, including degree of subspecialisation; involvement in trainee supervision and teaching; and specific information from trainees. This is integrated with the College's membership database including age and geographical location of clinical radiologists to create a comprehensive picture of the current radiologist workforce

In June 2020, the CRWC agreed on the questionnaire format, distribution timeline, and data collection methodology.

Questionnaire construction

The census questions were developed by a subgroup of CRWC members, using the questions from previous manpower/workforce surveys as a comparative base. New questions were added to investigate new workforce trends and some older questions were excluded because the information was collected at the time of membership renewal or were no longer relevant to workforce planning. Some of the retained questions were adjusted to reflect changes in the workforce and/or practice dynamics. The changes that the CRWC made in regard to the 2020 Census questionnaire format can be found in *Appendix 2. The CRWC's 2020 Census Considerations for Questionnaire Format.*

A draft questionnaire was initially tested on a small group of clinical radiologists around June 2020. Revisions and modifications were then made to the final questionnaire prior to commencement of the actual Census data collection.

Data collection and analysis

All active clinical radiologists, all clinical radiology trainees and those identified as retired (prior to 30 June 2020) on the RANZCR membership database (CRM) were invited to participate in the 2020 Census. This included all Educational Affiliates and International Medical Graduates (IMGs) working as area of need consultants or as consultants under supervision.

The Census was conducted through the online survey tool Survey Monkey (http://www.surveymonkey.com). All identified participants with valid email addresses were contacted electronically with a link to the online version of the Census. The Census was open for 14 weeks from the end of July until the end of October 2020. Those who wished to opt out of the Census were able to do so via Survey Monkey or by notifying the RANZCR. Weekly email reminders were sent to all non-respondents with valid email addresses.

Once the Census collection period was completed, all responses were cleansed and de-identified to ensure anonymity by a member of the RANZCR staff. Data was stored and analysed using IBM SPSS Statistics v.19. The information derived from the Census was triangulated with the previous censuses and manpower/workforce surveys and validated. The questions which were not answered by respondents were deemed as 'missing data' and therefore excluded from totals (unless otherwise stated).

The workforce figures in this report are given as a headcount, unless otherwise stated. Full Time Equivalent (FTE) figures were calculated based on the standard hours of work per week (40) stated by Australian Institute of Health and Welfare (AIHW).

Gender, age, residential postcode (for geographical classification and branch classification) and membership type and category were obtained from the RANZCR membership database (CRM) and linked to each individual's response for analysis.

Previous report structures were used as the foundation for the 2020 report and the draft reviewed, analysed, and amended by the CRWC members, Members were asked to identify key elements in the report for highlighting. Unfortunately, the COVID-19 pandemic restrictions prevented the CRWC members from meeting in person to discuss in detail and had to resort to teleconference meetings for discussion.
**The drafts were reviewed by the Senior Analyst and supervising author, with comments and suggestions made by Committee members. This was then reviewed at a CRWC online meeting, final edits were made by the CRWC and ratified, and the final draft reviewed by the Chair before being formatted accordingly by College staff.*

Statistical reliability and generalisability

The Census was distributed to 2,609 clinical radiologists in Australia, including 2,332 practising clinical radiologists and 277 retired clinical radiologists. A total of 1,186 responses were returned, yielding a response rate of **45.4% (for comparison, this includes the retired members)**. In 2016, the census was distributed to 2,237 radiologists in Australia, including 2,013 practising radiologists and 224 retired radiologists. A total of 1,053 responses were returned, yielding a response rate of 47.1%. It was suggested by the CRWC to restrict the analysis in the 2020 census to those members in work or seeking work (the active workforce), thereby bringing the number of responses analysed to 1098 (47% response rate).

Further commentary about general survey bias can be found in *Appendix 3. The Key Considerations around Survey Bias.*

Tables 1, 2 & 3 show that responses were reasonably proportionate and hence presumably representative by their RANZCR branch, geographical (2019 MMM classification) classification and gender, allowing for the small numbers of active members and census recipients in the NT, ACT and TAS branches and the MMM categories.

Table 1: Respondents by RANZCR branch

	Invited		Responded		Percentage of responses by branch
	n	%	n	%	%
ACT	52	2.2%	21	1.9%	40.4%
NSW	683	29.3%	305	27.8%	44.7%
NT	4	0.2%	2	0.2%	50.0%
QLD	480	20.6%	231	21.0%	48.1%
SA	178	7.6%	78	7.1%	43.8%
TAS	49	2.1%	28	2.6%	57.1%
VIC	618	26.5%	320	29.1%	51.8%
WA	268	11.5%	113	10.3%	42.2%
Total	2332	100.0%	1098	100.0%	47.1%

*Retired member responses have been removed for analysis

Table 2: Respondents by geographical classification

MMM-2019	Respondent		Invitation		Percentage of responses by MMM
	n	%	n	%	%
MM1	930	84.7%	2032	87.1%	45.8%
MM2	91	8.3%	164	7.0%	55.5%
MM3	21	1.9%	35	1.5%	60.0%
MM4	6	0.5%	10	0.4%	60.0%
MM5	43	3.9%	72	3.1%	59.7%

Missing Information	7	0.6%	19	0.8%	36.8%
Total	1098	100.0%	2332	100.0%	47.1%

*Retired member responses have been removed for analysis
**MM classification is based on the home postcodes provided by the members, DoHA Modified Monash Model classification[1].

Table 3: Respondents by gender

	Respondent		**Invitation**		**Percentage of responses by gender**
	n	**%**	**n**	**%**	**%**
Female	333	30.3%	674	28.9%	49.4%
Male	765	69.7%	1658	71.1%	46.1%
Total	1098	100.0%	2332	100.0%	47.1%

*Retired member responses have been removed for analysis

The reasonably large sample size, reasonable response rate and assumption of similarity of the characteristics between the responding sample and the radiologist population lend credibility to the results presented.

Results and Analysis

For ease of reading the results have been combined with the initial analyses for each section of the Census.

The sections are:

1. Overview of the Australian clinical radiology workforce (which includes the membership database information)
2. Census Demographic Data
3. Practice settings (including on-site, teleradiology and on-call)
4. Generalism and Subspecialisation
5. Workload/hours/FTE, work activity mix, leave
6. Teaching and supervision [of trainees] and research
7. Quality and Work-Life balance
8. Freehand Comments by respondents
9. Impact of COVID-19
10. Trainee Section

In general, the results reported are those of most workforce relevance and/or where there was a significant difference (or association) found between the various categories of the main data segmentations (age, gender, geographical distribution) with past results.

2. OVERVIEW OF THE AUSTRALIAN CLINICAL RADIOLOGY WORKFORCE

This section provides the demographic characteristics of currently active clinical radiologists in Australia, based on the RANZCR membership data as of 30 June 2020 and the Census responses.

Number of radiologists

As of 30 June 2020, there were 2,332 practising radiologists. This figure excludes trainees and members who are inactive, retired, have permanently left clinical radiology or who are temporarily inactive. International medical graduates who are working in either an area of need position or in a supervised practice consultant position were included.

The Australian Health Practitioner Regulation Agency (AHPRA) registration data reports 2,494 registered medical practitioners with specialist registration as radiologists for the same reference period[8].

Table 4 shows the percentage annual change in the number of active clinical radiologists since 2000. There has been consistent growth in the number of active clinical radiologists since 2000.

Table 4: Practising consultant radiologists (2000-2020)

Year	N	% Change	% Cumulative change since 2000
2000	1148	-	-
2002	1174	+2.3	+2.3
2004	1260	+7.3	+9.8
2006	1381	+9.6	+20.3
2008	1478	+7.0	+28.7
2010	1618	+9.5	+40.9
2012	1761	+8.8	+53.4
2016	2013	+14.3	+75.3
2020	2332	+15.8	+103.1

Source: RANZCR membership data

Figure 1 illustrates the same data from Table 4. It should be noted that this is only by headcount and not full-time equivalency (FTE).

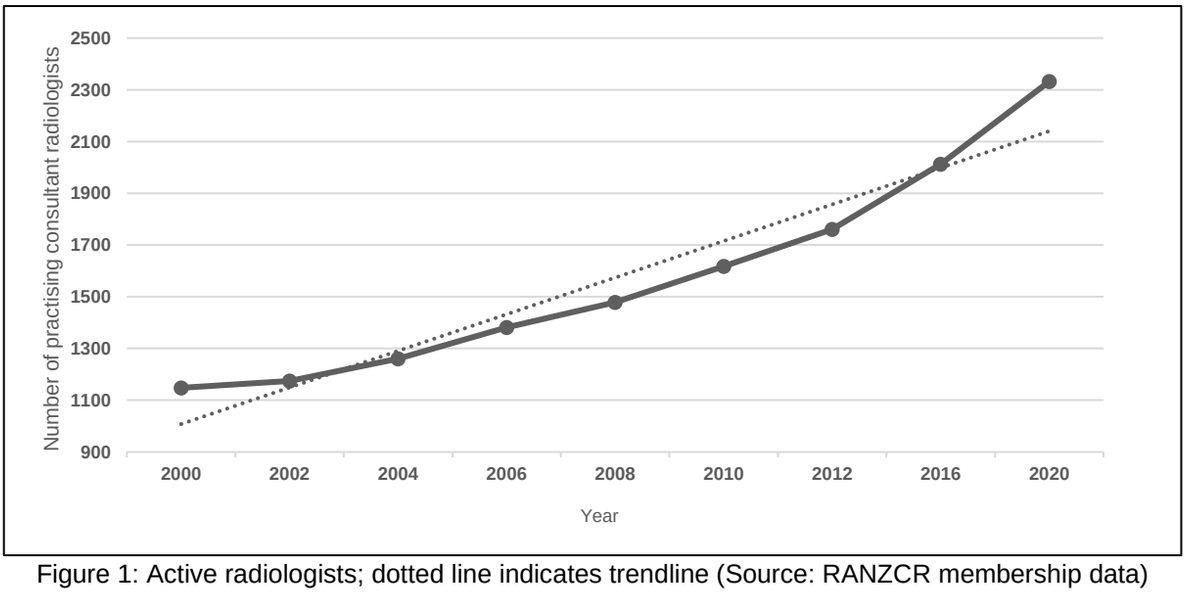


Figure 1: Active radiologists; dotted line indicates trendline (Source: RANZCR membership data)

In 1992, there were 935 practising clinical radiologists which equates to 5.3 clinical radiologists per 100,000 population, in 2016 there were 8.3 clinical radiologists per 100,000 population and in 2020, 9.1 clinical radiologists per 100,000 population.

In comparison with other countries, New Zealand had 8.9 clinical radiologists per 100,000 population[2] In 2020, the UK had 8.6 clinical radiologists per 100,000 population, European (3 and 4) averages was 12.8 radiologists per 100,000 population, and USA in 2017 had 9.0 radiologists per 100,000 population[67]. Of note, it is widely recognised that there is a workforce crisis in the UK yet the ratio of radiologists to population is not dissimilar to Australia.

Age

The average age of practising members was 49.9 years in 2020, which is similar to that reported in 2015 by AIHW for all specialists (49.9 years). Almost one-third of the practising clinical radiologists are over 55 years old, which is about 6% higher than the 27.2% of employed medical practitioners over 55 years reported by AIHW in 2015.

Female clinical radiologists are slightly younger than their male colleagues, with the comparative average ages of each gender at 47.0 years and 51.1 years respectively. Although the percentage of female clinical radiologists increases in younger age groups, the percentage of females entering the training program has been declining over the historic baseline and remains well below the proportion of female medical graduates.

Figure 2 illustrates the gender distribution across different age groups. 17.6% of the male clinical radiologist cohort were in the 30-39 age group, comparative to 24.0% of the female clinical radiologist cohort.

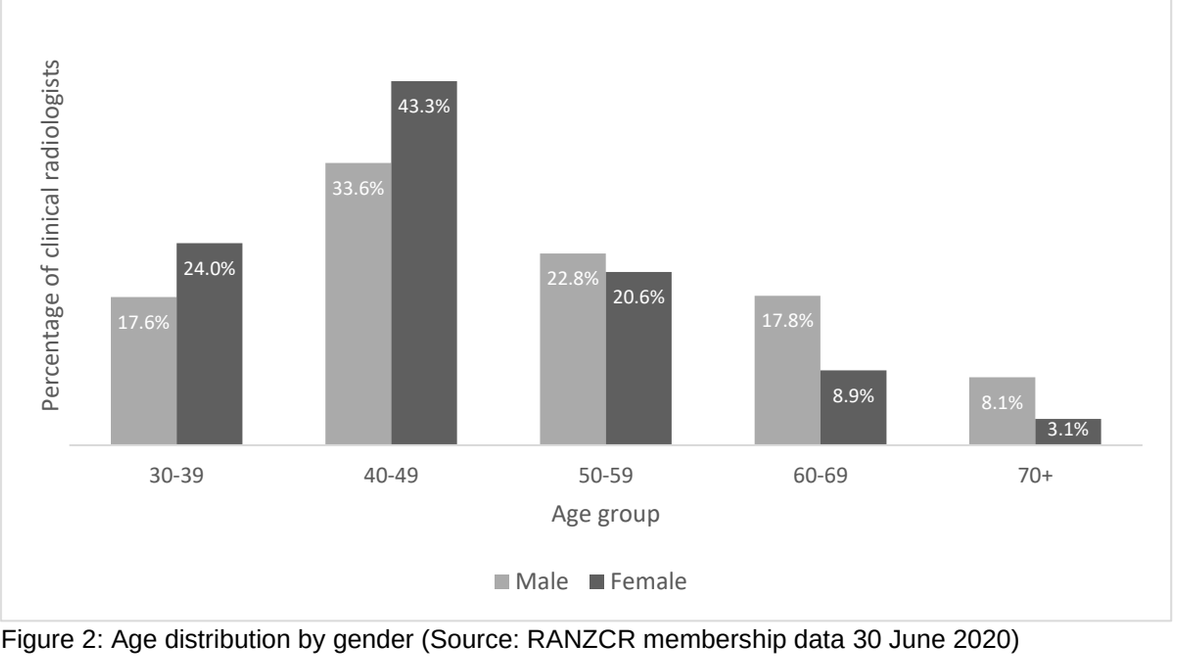


Figure 2: Age distribution by gender (Source: RANZCR membership data 30 June 2020)

Gender

Around three-quarters of practising clinical radiologists (n=1658, 71.1%) are male and around one-quarter (n=674, 28.9%) female. The percentage of female clinical radiologists has grown from 15.8% in 2000, 26.5% in 2016 to 28.9% in 2020. In 2015, the AIHW reported that women accounted for 29.5% of the total number of specialists in the top twenty most common medical specialties of practice. Hence, clinical radiology is slightly below the average for medical specialties, but there has been a gradual growth of women entering the College's clinical radiology training program (see *Trainee* section).

A significant difference is present in the proportions of females and males distributed in Monash Modified Model classification categories: MM1-5s have approximately similar proportions of male and female clinical radiologists practising in those areas (70% are male clinical radiologists and 30% are female clinical radiologists. See Table 5 for more details about the gender distributions in different MMM classifications.

Table 5: Gender distribution by MMM classification

	MM1		MM2		MM3		MM4		MM5		Missing Information		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	N	%
Male	1441	71.0	115	69.7	25	71.4	9	90.0	58	71.6	10	100.0	1658	71.1
Female	590	29.0	50	30.3	10	28.6	1	10.0	23	28.4	0	0.0	674	28.9
Total	**2031**	**100.0**	**165**	**100.0**	**35**	**100.0**	**10**	**100.0**	**81**	**100.0**	**10**	**100.0**	**2332**	**100.0**

Source: RANZCR membership data, **MM classification is based on the home postcodes provided by the members, DoH Modified Monash Model classification.

Geographical distribution

Calculating clinical radiologist distribution within MMM categories provides an understanding of workforce distribution (Table 6).

Table 6: Radiologists per million (by headcount) by MMM classification

	MM1 Major cities	MM2 Regional centres	MM3 Large rural towns	MM4 Medium rural towns	MM5 Small rural towns	MM6-7 Remote and very remote	Total
Estimated Resident Population (million) *	17.99	2.39	1.72	0.98	2.03	0.59	**25.69**
% Population	70	9.3	6.7	3.8	7.9	2.3	**100**
Clinical Radiologists with MM codes**	2032	164	35	10	72	**-**	**2313**
% Clinical Radiologists	87.9	7.1	1.5	0.4	3.1	**-**	**100**

Source: RANZCR membership data, home postcode
*Estimated Resident Population, Remoteness Areas, Australia, as of 30 June 2020
**These are clinical radiologists who are residing in certain MM postcodes.

Table 6 shows that there is a maldistribution of clinical radiologists, with a disproportionately high number of clinical radiologists in the major cities (MM1) even allowing for the presence of tertiary and quaternary care to be concentrated in MM1 locations[ii]. In 2012, the CRWC decided that home postcodes better represented the workforce distribution, as clinical radiology requires the on-site presence of clinical radiologists to provide services, as well as broader involvement in health service and community development. In addition, many clinical radiologists work at more than one location with different postcodes and therefore it would be more difficult to classify workforce distribution by work postcodes. We recognise that this does not account for fly in/fly out and drive in/drive out clinical radiologists.

The geographical distribution of radiologists in 2020 has not changed significantly from the geographical distribution in 2016 or 2012[11]. While population numbers and the number of clinical radiologists has grown, the proportional distribution has stayed similar. Anecdotally, some CRWC members have noted that this is despite the increase in more complex care being provided 'closer to home'. Of note, this census was conducted early in the COVID-19 pandemic and changes in demographics that occurred as a result of the COVID-19 pandemic have not been fully captured.

The MMM model does not capture data on age, chronic illness, or socioeconomic status: all of these are correlated with health and use of health care services including clinical radiology. The greater age,

[ii] This is based on the clinical radiologists' home/residential postcode.

lower socioeconomic status and generally poorer health of rural and remote areas are widely recognised. This further exacerbates the rural and regional clinical radiologist workforce shortages across Australia.

The geographical workforce maldistribution is compounded by a generally older cohort of clinical radiologists in MM3+. In MM3+ areas, 33% of the clinical radiologists are 60 years old or older, compared with 21% of the radiologists in MM1 and MM2. See Tables 7 & 8.

Table 7: Age distribution of respondents by MMM classification

	MM1		MM2		MM3		MM4		MM5		Total	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
30-39	412	20.3	19	11.5	5	14.3	0	0.0	17	21.0	**453**	**19.5**
40-49	724	35.7	82	49.7	16	45.7	1	10.0	24	29.6	**847**	**36.5**
50-59	461	22.7	32	19.4	6	17.1	3	30.0	12	14.8	**514**	**22.2**
60-69	305	15.0	23	13.9	5	14.3	3	30.0	18	22.2	**354**	**15.3**
70+	127	6.3	9	5.5	3	8.6	3	30.0	10	12.3	**152**	**6.6**
Total	2029	100	165	100	35	100	10	100	81	100	**2320**	**100**

Source: RANZCR membership data
**MM classification is based on the home postcodes provided by the members, DOH Modified Monash Model classification. Due to missing postcodes or age information, some members couldn't be added to this table.

Table 8: Average age of practising clinical radiologists by MMM classification

MM1		MM2		MM3		MM4		MM5	
n	**Average Age**	**n**	**Average Age**	**n**	**Average Age**	**n**	**Average Age**	**n**	**Average Age**
2031	49.7	165	49.5	35	50.0	10	63.0	81	52.4

Source: RANZCR membership data
**MM classification is based on the home postcodes provided by the members, DOH Modified Monash Model classification.

Member type

RANZCR has five membership categories for members:

Table 9: RANZCR membership categories

Member type	Description
Fellow	Has obtained fellowship of the College (FRANZCR).
Educational Affiliate	Is not a fellow of the College but maintains membership for Continuing Professional Development (CPD) activities.
Life Member	Where a fellow has been admitted to the College as a life member.
Associate	A non-medical practitioner who are graduates of universities approved by the Board, with at least two years' relevant work experience.
Honorary	Honorary Fellows are professionals who have made an important contribution to the scientific advancement of clinical radiology or allied sciences through original research, or who have rendered special service to these sciences or the College.

Table 10 shows the number of practising members in each membership type by branch.

Table 10: Membership type of practising clinical radiologist by branch

	ACT	NSW	QLD	SA/ NT	TAS	VIC	WA	Total	
	n	**n**	**n**	**n**	**n**	**n**	**n**	**N**	**%**
Associate	-	-	1	-	-	-	1	**2**	**0.1%**
Educational Affiliate	1	16	13	2	3	6	4	**45**	**1.9%**
Fellow	51	658	460	177	43	603	261	**2253**	**96.6%**
Honorary	-	3	2	1	-	2	-	**8**	**0.3%**

Life	1	7	4	2	1	7	2	24	**1.0%**
Total	53	684	480	182	47	618	268	**2332**	**100.0%**

Source: RANZCR membership data

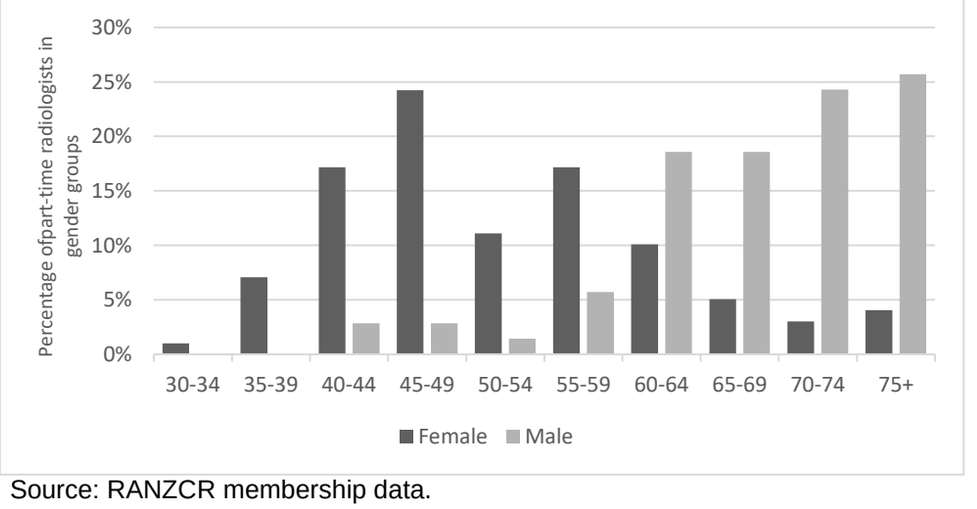
Table 10 does not give an indication of the total number of overseas-trained doctors practising clinical radiology in Australia, because once an IMG meets the requirements of their specialist recognition assessment and receives the fellowship, they are listed as fellows. Some IMGs may be educational affiliates of the RANZCR and are therefore included in that membership type.

Part-time category

Part-time (versus full time) self-identification is based on a definition of working less than five sessions per week (as per RANZCR's membership classification and database).

Figure 3 displays the distribution of those who self-identified as part-time by age and gender. The majority of clinical radiologists are working more than 0.5 FTE, regardless of age or gender. 61.5% of clinical radiologists are over the age of 55 years and a significant association can be seen with age groups and gender. Male clinical radiologists tend to work part-time during their late career life, whereas more female clinical radiologists work part-time in their early and mid-career life.

Figure 3: Distribution of part-time clinical radiologists by age and gender.



Source: RANZCR membership data.

For further information on Full Time Equivalent data see Section 6: Workload/Hours/FTE, Work Activity Mix, Leave.

Primary medical qualification

Nearly two-thirds of practising members (65.1%, n= 1,517) obtained their primary medical qualification in Australia. This has decreased by 0.6% since the 2016 census and 1.2% since the 2012 census, indicating that Australian clinical radiology is still very reliant on overseas-trained medical graduates (including from New Zealand). As shown in Table 11, in 2020, the majority of overseas-trained medical graduates were from India (7.8%), followed by 5.7% from South Africa and 5.0% from the United Kingdom.

Table 11: Country where primary medical degree obtained

	n	**%**
Australia	1517	65.1
India	181	7.8
South Africa	132	5.7
United Kingdom	116	5.0
New Zealand	114	4.9
Sri Lanka	41	1.8
Ireland	31	1.3

Iran	26	1.1
Others	174	7.5
Total	**2332**	**100**

Source: RANZCR membership data

Most IMGs obtained their radiology training overseas and some wholly in Australia. RANZCR does not have accurate historical numbers on this aspect, although it is now collecting such data prospectively. See the *Specialist qualification* in Section 3- Census Demographic Data below, for more information.

Workforce retirement

Table 12 illustrates the number of retirements per year and the average age of retirees from 1993. There has been a gradual increase in the average retirement age over the last 23 years. In 2020, there is an evident decline in the average retirement age. Of note, the COVID-19 pandemic had been affecting life and work in Australia for six months at the time of the census.

Table 12: Australian retirements (1993-2016)

Year	Number retired	Average age retired
1993	1	67
1994	9*	68
1995	12	63.7
1996	5*	67.8
1997	7	68.4
1993-1997	***34***	***66.4***
1998	14	68.1
1999	3	67.3
2000	17**	65.9
2001	17	65.3
2002	14	65.8
1998-2002	***65***	***66.3***
2003	9*	67.8
2004	6	70.7
2005	14	62.9
2006	20	69.8
2007	18	64.8
2003-2007	***67***	***66.8***
2008	8	68.5
2009	17	68.3
2010	11	68.4
2011	15	67.8
2012*	17	71
2008-2012	***68***	***68.9***
2013	11	69.9
2014	7	75.9
2015	16	69.9
2016	15	71.1
2013-2016	**49**	**71.1**
2017	8	69.1
2018	6	68.3
2019	4	70.0
2020	7	66.1
2017-2020	**25**	**68.4**

* One member does not have DOB so average retirement age excludes member
** Two members do not have DOB so average retirement age excludes members
Source: RANZCR membership data

3. CENSUS DEMOGRAPHIC DATA

The Census collected data on demographic indicators such as employment status, specialist qualification, public and/or private sector work and Indigenous status, which were not obtained at the time of membership renewal. The Census responses were similar to the RANZCR membership data in key demographic characteristics as described in the previous section: *Statistical reliability and representativeness* in Section 1- Methodology.

Specialist qualification – country awarded

This topic has been asked since the first workforce survey in 1993.

Of the 79% (n=862) of total responses received for this question, nearly three-quarters (70%, n=600) have obtained their specialist qualification in Australia; 5.9% (n=51) in India, 5.7% (n=49) in South Africa, 5.6% (n=48) in the United Kingdom, and 4.2% (n=36) in the New Zealand. In 2016, 69.8% had obtained their specialist qualification in Australia. Comparisons with the previous survey/census results shows there has been a gradual decline in the reliance on overseas trained specialists but it this may be confounded by border closures in the six months before the Census was performed.

The respondents were further queried about the year they first qualified as a clinical radiologist and the year they first practised as a clinical radiologist in Australia. Of note, some overseas trained clinical radiologists arrive in Australia at the mid-career stages of their life and hence have a generally shorter working life in Australia.

Employment status

The Census collects information on the current employment status that best describes the respondent's employment at the time of the Census, to calculate the active practising population of clinical radiologists in Australia. Of the 1,098 who responded to the Census, 86.4% identified as working as a consultant-level clinical radiologist in Australia (Table 13). This number differs from the RANZCR membership data for a variety of reasons, e.g., lag time between actual retirement and the time at which the retirement is reported to the RANZCR. In addition to the 1,098 responses, 88 respondents stated they were not working and do not intend to return to work (e.g., retired), and as suggested by the CRWC, these respondents were not included in the Census analysis.

Table 13: Employment Status

	n	%
Working as a consultant-level clinical radiologist in Australia	1025	93.4
Working as a consultant-level clinical radiologist outside Australia	12	1.1
Working in a post-FRANZCR/subspecialist fellowship position, without working as a consultant radiologist	25	2.3
Working in an accredited nuclear medicine training position, without working as a consultant radiologist	12	1.1
Not working but intending to return to work as a consultant-level clinical radiologist	17	1.5
Currently working but NOT as a consultant-level clinical radiologist	7	0.6
Total	**1098**	**100.0**

Unemployed/actively seeking work

Members were asked to report the number of weeks they identified as unemployed, under-employed or actively seeking work. The response rate for this question was very low. See Table 14.

Table 14: Weeks unemployed or actively seeking work

	n (%)*	Mean (weeks)	Median (weeks)	Range (weeks)
Unemployed	56 (4.7)	14.2	8	1-53
Seeking more work	58 (4.9)	12.1	8	1-52
Seeking alternative position	46 (3.9)	13.6	9.5	1-53

* Respondent could select more than one option

Of those who identified as being unemployed, thirteen were recently qualified (2019-20). The majority of members reporting periods of unemployment were from New South Wales (n=18) and Queensland (n=17). Respondents seeking more work were from Victoria (n=25), New South Wales (n=17), and Queensland (n=10).

Sector – public and/or private

The public and/or private segmentation is historical, originally being public or private (not both). Current working patterns are more diverse.

In the past, it was assumed that responses with respect to public and/or private activity would be based on whether the respondents were working as a salaried medical officer of a public hospital or working as a partner, associate or employee of a company or partnership.

Table 15: 2020 Census distribution of members by public and private

	n	%
Private	329	38%
Public/Private	307	35%
Public	229	26%
Total Responses	865	100

79% (n=865) of the total Census respondents answered the question regarding their work setting or the hours they worked in each of the above settings. From the table above, the majority (38%, n=329) of respondents self-identified as working in private settings, followed by 35% of respondents identified as working in public and/or private settings (n=307) and the least number of respondents identified as working only at public settings with a total of 26% of all responses collected (n=229).

Indigenous status

78% (n=852) of the total Census respondents answered the question regarding Indigenous status. Two respondents (0.2%) identified as Aboriginal, both male. This compares with less than 0.5% of medical practitioners[72] and 3.2% (2021) of the population of Australia[73].

4. PRACTICE SETTINGS: ON-SITE, TELERADIOLOGY; ON-CALL

This section of the Census quantified clinical radiologist activity in different practice settings that affect clinical radiology as a profession and industry, including teleradiology and the increasing demand for after-hours work.

The response rate for the question where respondents were asked to indicate the number of hours per week that they worked in different practice settings (i.e., Please indicate the time (in hours) per week you spend working in each of the given situations) was 84% (n=925).

From the responses provided to this question, most were for 'on-site, [rostered] in hours' (98% of total responses, n=906), with the mean number of hours worked as 34.2 hours per week. This result does not include any additional hours outside the scope of rostered on-site hours. The practice setting that received the lowest response rate was 'Dedicated teleradiology, [rostered] in-hours' (15% of the total responses, n=141), with the mean number of hours worked as 11.3 hours per week.

Table 16 : Number of hours per week worked in different practice settings

	n	%	Mean	Median	Range
On-site, [rostered] in-hours	906	98%	34.2	38	2-80
On-site, rostered after-hours	263	28%	5.0	4	1-80
Dedicated teleradiology, [rostered] in-hours	141	15%	11.3	9	1-40
Dedicated teleradiology, rostered after-hours	147	16%	7.2	5	1-36
Total Sum of 4	925		37.9	40	

The response rate for the following question, where respondents who do rostered, after-hours work were asked to indicate the number of hours worked in various after-hours practice settings (i.e., If you completed rostered after-hours work, where you were rostered to be at a site to report studies, whether on-site or teleradiology), please estimate the time (in hours) per week you spend on the following work) was 59% (n=650). The highest amount of rostered after-hours work spent was on 'Call centre and Onsite work', with a mean of 6.5 hours per week from 34% of the total responses (n=222). On the low range, the lowest number of after-hours rostered work hours completed was in 'Non-urgent outpatient after-hours', with a mean of 5.1 hours per week from 15% of the total responses (n=100).

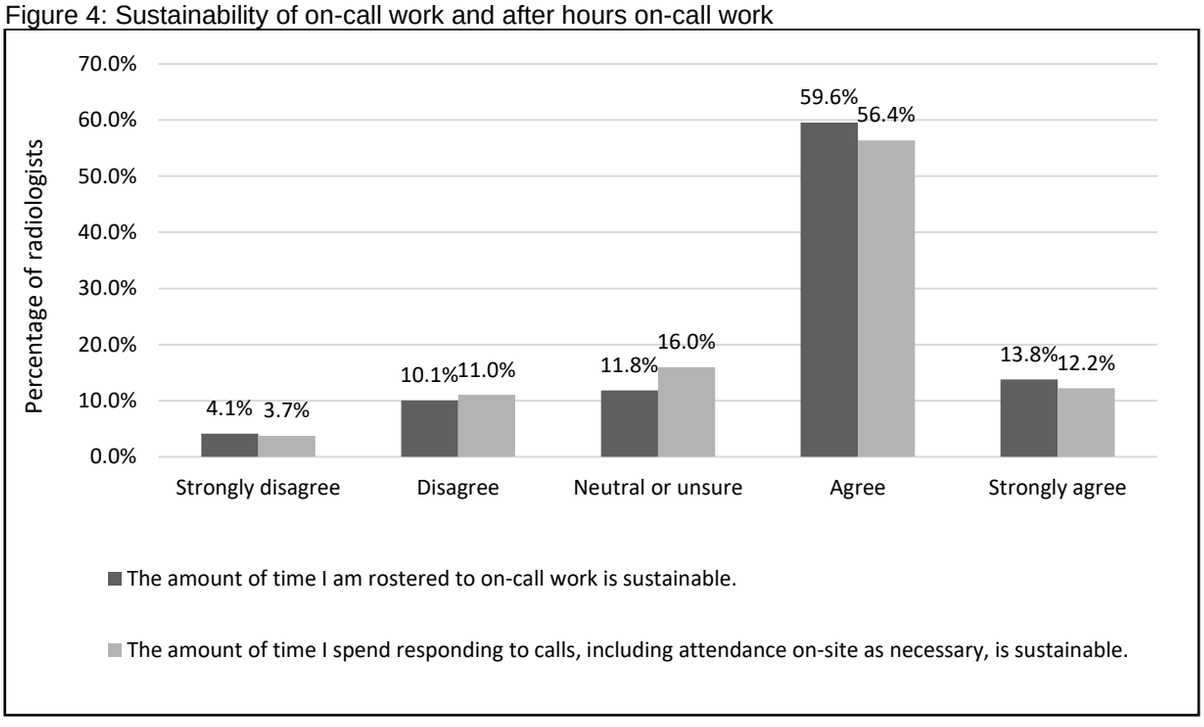
Table 17: Time (in hours) per week you spend on the following work (only for rostered after-hours work)

	n	%	Mean	Median	Range
Call centre and Onsite work	222	34%	6.5	4	1-90
Hospital inpatient/ED not on-call	193	30%	6.4	3	1-43
Overflow from workforce shortage	135	21%	4.3	3	1-15
Non-urgent outpatient after-hours	100	15%	5.1	3	1-35
Total Sum of 4	650		10	5	

After-hours on-call and qualitative assessment of sustainability

More than half of the respondents (55%, n=507) stated that they provide after-hours on-call services. The majority (73%) agreed or strongly agreed that the amount of time they are rostered to on-call is sustainable and that the amount of time spent responding to calls, including attendance on-site as necessary, is sustainable. See Figure 4.

Figure 4: Sustainability of on-call work and after hours on-call work



Periodic in-person services

Census respondents were asked to provide details on any periodic in-person services, e.g., a fly-in or drive-in visiting services to a rural location. Of the 135 who answered this question, the frequency of this type of service varied from one day a week to once every six months. Eleven respondents reported that the purpose of their periodic in-person service was to fill in for locum positions; ten reported they were attending breast screen assessment clinics, one reported that it was for PET and one reported it was for medico-legal issues.

5. GENERALISM AND SUBSPECIALISATION

Clinical radiologists in Australia are mostly generalists (noting the term multispecialty radiologist is used in the USA[59]), i.e., and they mostly provide services for a wide range of pathologies, body systems and patient ages using a wide spectrum of imaging modalities.

Current subspecialty training

Only 2.3.% (n=25) of census respondents are currently working in post-FRANZCR fellowship positions. This is a much smaller number than expected and almost certainly an unreliable respondent sample, given the 48% 'fellowship rate' of active clinical radiologists (see below) and the results from the 2020 New Fellow Survey where 40% (n=14) had undertaken and 57% (n=46) were still undertaking a subspecialist fellowship).

Fellowship training history of active clinical radiologists

48% (n=525) of the total 1,098 respondents indicated that they have undertaken some form of post-FRANZCR fellowship training. This contrasts with the results above, noting that this now forms a historical baseline following the change in curriculum and timing of subspecialty fellowship training (as mentioned above). Table 18 illustrates the type and duration of the training that has been undertaken.

Table 18: Post FRANZCR fellowship training*

	<6 months		**6-12 months**		**12-18 months**		**18-24 months**		**>24 months**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Abdominal imaging	43	11	55	13	4	11	6	6	4	9	**112**	**11**
Breast imaging	72	19	18	4	4	11	3	3	1	2	**98**	**10**
Chest/thoracic imaging	30	8	16	4	2	6	3	3	0	0	**51**	**5**
Obstetric and gynaecological imaging	18	5	10	2	0	0	0	0	0	0	**28**	**3**
Neuroradiology imaging	34	9	40	10	4	11	8	7	3	7	**89**	**9**
Head & Neck/neurological imaging	7	2	16	4	2	6	2	2	2	4	**29**	**3**
Neurointervention	6	2	11	3	1	3	5	5	3	7	**26**	**3**
Interventional non-neurological angio & embolisations	15	4	37	9	4	11	11	10	7	15	**74**	**8**
Interventional basic	14	4	14	3	1	3	3	3	3	7	**35**	**4**
Musculoskeletal imaging	44	12	58	14	4	11	2	2	4	9	**112**	**11**
Nuclear medicine	2	1	3	1	0	0	44	41	11	24	**60**	**6**
Paediatric imaging	26	7	30	7	4	11	7	6	4	9	**71**	**7**
Emergency department imaging	4	1	4	1	0	0	0	0	0	0	**8**	**1**
Oncology imaging	5	1	9	2	0	0	4	4	0	0	**18**	**2**
MRI	48	13	83	20	4	11	8	7	4	9	**147**	**15**
Other	13	3	10	2	1	3	2	2	0	0	**26**	**3**
Total responses	**381**	**100**	**414**	**100**	**35**	**100**	**108**	**100**	**46**	**100**	**984**	**100**

* Respondents could select more than one option

Of the 26 respondents who reported other areas of subspecialist training, 11 were in cardiac imaging (cardiac CT, cardiac CTA, cardiac MR, CTCA), 6 in ultrasound (including Diploma in Diagnostic Ultrasound), 3 in PET/CT, 5 in Body/cross-sectional, 4 in paediatric IR and INR and other respondents completed general clinical radiology fellowships.

Self-identification of subspecialty status

Of the total Census respondents, 79% (n=864) replied to this question. 36.3% of the respondents (n=314) considered themselves a generalist with an area of interest. As shown in Table 19, there has been a decline in self-identification of a generalist since 2000 and an increase in self-identification as a 'generalist in area(s) of interest' or 'subspecialist'.

Table 19: Self-identified category (2000–2020)

	2000 (%)	2002 (%)	2004 (%)	2006 (%)	2008 (%)	2010 (%)	2012 (%)	2016 (%)	2020 (%)
Generalist	37.1	36.2	38.6	37.0	-	26.4	23.5	12.4	14.7
Generalist with area(s) of interest	42.2	42.6	40.1	42.0	-	45.8	55.4	59.0	36.3
Sub-specialist	19.5	20.4	20.6	20.6	-	26.9	21.0	28.6	-
-Sub-specialist working as a generalist	NA	NA	NA	NA	NA	NA	NA	NA	5.8
-Sub-specialist working as both a generalist and in my sub-specialty	NA	NA	NA	NA	NA	NA	NA	NA	31.6
-Sub-specialist working in my sub-specialty	NA	NA	NA	NA	NA	NA	NA	NA	11.6

Table 20 shows the distribution of the self-identification by gender. Similar to the 2016 Census there were no significant differences between male and female clinical radiologists.

Table 20: Self-identified category by gender

	Male		Female		Total	
	n	%	n	%	N	%
Generalist	101	16.6	26	10.2	**127**	**14.7**
Generalist with an area(s) of interest	217	35.6	97	38.0	**314**	**36.3**
Sub-specialist working as a generalist	34	5.6	16	6.3	**50**	**5.8**
Sub-specialist working as both a generalist and in my sub-specialty	191	31.4	82	32.2	**273**	**31.6**
Sub-specialist working in my sub-specialty	66	10.8	34	13.3	**100**	**11.6**
Total	609	100.0	255	100.0	**864**	**100.0**

Table 21 shows the distribution by MMM category. MM2-MM5 regions have a larger proportion of generalists with an area(s) of interests and fewer subspecialists compared with MM1, which demonstrates the difficulty of perusing sub-specialist activities in rural and regional centres. Furthermore, MM2 and MM5 have similar proportion of generalists (2%).

Table 21: Self-identified category by Monash Modified Model category

	MM 1		MM 2		MM 3		MM 4		MM 5		Total	
	n	%	n	%	n	%	n	%	n	%	N	%
Generalist	97	13.2	14	20.6	3	18.8	-	-	13	36.1	127	14.8
Generalist with an area(s) of interest	257	34.9	32	47.1	8	50	-	-	16	44.4	313	36.4
Sub-specialist working as a generalist	43	5.8	4	5.9	3	18.8	-	-	-	-	50	5.8

Sub-specialist working as both a generalist and in my sub-specialty	246	33.4	15	22.1	2	12.5	2	66.7	6	16.7	271	31.5
Sub-specialist working in my sub-specialty	94	12.8	3	4.4	-	-	1	33.3	1	2.8	99	11.5
Total	737	100	68	100	16	100	3	100	36	100	860	100

*Four respondents had missing postcode and therefore couldn't be classified in MMM.

Respondents who identified as a generalist (n=127) were asked to indicate which services they provide during a typical working week (respondents could select more than one). Table 22 illustrates the services respondents reported, compared with previous census/surveys.

Table 22: Percentage of self-identified generalists who report/perform the various clinical radiology services (2000–2020)

	2000	**2002**	**2004**	**2006**	**2008**	**2010**	**2012**	**2016**	**2020**
General radiology	96.2	97	97	97	-	87.1	96.9	96	95.3
Ultrasound	93.6	96	97	95	-	89.1	94.6	92.1	97.9
CT	92.3	93	94	94	-	91.1	92.8	92.1	NA
CT coronary angiography	-	-	-	-	-	-	-	-	17.3
CT colonography	-	-	-	-	-	-	-	-	11.8
CT (not listed above)	-	-	-	-	-	-	-	-	85
Basic interventional	-	82	80	83	-	66.9	78.8	68.3	75.6
Diagnostic mammography	80.4	78	75	74	-	44.3	65.5	57.4	44.9
Bone densitometry	-	61	61	60	-	16.6	58.7	50.5	54.3
MRI	45.3	47	51	53	-	32.1	34.1	29.7	NA
Breast MRI	-	-	-	-	-	-	-	-	5.5
Cardiac MRI	-	-	-	-	-	-	-	-	0.8
Prostate MRI	-	-	-	-	-	-	-	-	13.4
MRI (not listed above)	-	-	-	-	-	-	-	-	49.6
Screening mammography	45.5	33	29	28	-	15.7	15.2	2	4.7
Nuclear medicine	16.5	12	11	10	-	9.2	7.2	1	4.7
Advanced interventional (IR)	-	23	21	21	-	14.7	8.1	0	0
Neurointerventional	-	-	-	-	-	-	-	0	0.8

Census respondents who identified as generalists with an area(s) of interest (n=314) were asked to provide the area(s) of interest, see Table 23.

Table 23: Subspecialty interests of Generalist with area(s) of interest*

	n	%
Abdominal imaging	132	**42**
Breast imaging	124	**39**
Chest/thoracic imaging	79	25
Cardiac imaging	53	17
Obstetric and gynaecological imaging	57	18
Neuroradiology (diagnostic)	69	22
Head & neck Imaging	48	15
Neurointervention	0	0
Interventional - basic	122	**39**
Interventional - advanced e.g. non-neurological angio, embolisations (not neurointervention)	11	4
Musculoskeletal imaging	138	**44**
Nuclear medicine	19	6
Paediatric imaging	41	13
Emergency department imaging	68	22
Oncology imaging	70	22
Others	10	3
Total respondents	**314**	

* Respondents could select more than one option

Similar to the 2016 Census results, the most popular interests were MSK, abdominal, basic interventional and breast imaging.

Respondents who identified as subspecialists (n=423) were asked to indicate their subspecialty(ies) and the percentage of time spent providing subspecialty services in a typical working week, see Table 24.

Table 24: Subspecialists - time (in hours) spent on subspecialty area(s)*

	n*	%	Mean (hours)	Median (hours)	Range (hours)
Abdominal imaging	262	62%	7.02	5	1-55
Breast imaging	156	37%	10.18	6	1-44
Chest/thoracic imaging	242	57%	4.82	4	1-25
Cardiac imaging	66	16%	5.32	4	1-25
Obstetric and gynaecological imaging	186	44%	4.07	3	1-30
Neuroradiology (diagnostic)	227	54%	7.05	4	1-95
Head & neck imaging	175	41%	3.52	2	1-44
Neurointervention	17	4%	20.24	20	1-60
Interventional - basic	219	52%	7.38	5	1-100
Interventional - advanced e.g. non-neurological angio, embolisations (not neurointervention)	63	15%	15.51	10	1-70
Musculoskeletal imaging	240	57%	9.40	5	1-52
Nuclear medicine	41	10%	13.93	10	2-40
Paediatric imaging	111	26%	9.05	2	1-100
Emergency department imaging	176	42%	5.09	4	1-40
Oncology imaging	191	45%	5.59	4	1-40
Other (please specify)	19	4%	12.63	6	1-42
Total respondents	**423**				

* Respondents could select more than one option

There are only a very small number who work exclusively in their subspecialty (paediatric imaging and Interventional - basic) and only one subspecialty had a responding workforce that spend 20 hours of

their time in their subspecialty (Neurointervention). Thus, the Australian clinical radiology workforce is characterised by very strong generalism, or multispecialty radiologists.

Table 25: Responses by time spent on subspecialty areas by gender*

	Male		Female	
	n[1]	%	n[1]	%
Abdominal imaging	190	65%	72	55%
Breast imaging	85	**29%**	71	**54%**
Chest/thoracic imaging	173	59%	69	52%
Obstetric and gynaecological imaging	123	**42%**	63	**48%**
Head & Neck/neurological imaging	535	184%	81	61%
Neurointervention (INR)	15	5%	2	2%
Interventional – non-neurological angio & embolisations (IR)	59	20%	4	3%
Interventional – basic	174	60%	45	34%
Musculoskeletal imaging	179	62%	61	46%
Nuclear Medicine	33	11%	8	6%
Paediatric imaging	71	24%	40	30%
Emergency department imaging	120	41%	56	42%
Oncologic imaging	136	47%	55	42%
Cardiac imaging	50	17%	16	12%
Neuroradiology (diagnostic)	164	56%	63	48%
Total respondents	291		132	

*Respondents could select more than one option

There are significantly more females who identify as subspecialists (proportionately, compared with males) in breast imaging and head & neck/neuroradiology compared with their male colleagues. Table 25 also shows the very large disparity of gender representation in the intervention (IR and INR) subspecialties – there were two females, while 15 males identified as INR subspecialists, and 44 males and four females identified as IR subspecialists.

INR, IR, breast screening

These are new specific subspecialty/area of interest questions, asked because:

- there is a recognised shortage of interventional neuroradiologists (INR), a particular problem now, given the need for time-critical 24-hour acute stroke clot retrieval and targeted thrombolysis therapy.
- there is a recognised shortage of interventional radiologists (IR)
- there are now significantly smaller numbers of clinical radiologists involved in the national breast screening program and the committee wants to try and quantify this and seek reasons why there is dwindling participation.

In the response, 16.6% (n=159) of the total respondents work as interventional radiologists (IRSA Tier B or equivalent) and only 2.5% (n=24) work as an INR.

More than half of the INRs (62.5%, n=15) work in the public sector, 20.8% (n=5) work in both the public and private sectors and 12.5% (n=3) work in the private sector. The majority of INRs working in the public sector spend more than 50% of their time on INR procedures, whereas those working in the private sector spend less than 10%-20% of their time on INR procedures.75% (n=18) of INRs provide on-call services for INR and 75%(n=14) state their workload, including on-call, has an increasing trend.

Breast screening involvement responses are shown in Table 26.

Table 26: Breast Screening Activities*

	n	**%**
Reader	149	15.8
Assessor	101	11.1
None of the above (Please specify why not?)	705	73.1

*Respondents could select more than one option

There was a wide range of reasons given by the 73.1% who do “none of the above”, and these were not always clear. The most common clear reasons are not trained in breast screen work and/or subspecialised in other areas; not interested in breast screen; poor remuneration, not many vacancies available in breast screening, not locally or conveniently available breast screen site (a particularly common rural clinical radiologist response).

6. WORKLOAD/HOURS/FTE, WORK ACTIVITY MIX, LEAVE

To better understand the workload and the range and mix of activities that clinical radiologists spend work time on, the Census collects data on time spent on a range of activities (clinical, non-clinical and work-related travel) that respondents were engaged in a typical working week. In this section, total hours worked in a typical week is calculated based on the clinical and non-clinical activities, excluding the time spent on work-related travel.

Workload

Full-time equivalent (FTE) is an accepted measure of hours worked by health practitioners. The FTE can be averaged across a workforce by considering the number of practitioners who are working and the hours they each work. AIHW glossary defines a standard working week (1 FTE) for medical practitioners as 40 hours**Error! Reference source not found.** per standard working week.

The FTEs calculated in this section was based on question on hours worked in public practice hours worked in private practice.

The Census calculated FTE hours worked as the total time spent on clinical and non-clinical activities by a clinical radiologist in a typical working week. 28% (n=329) of the total respondents did not provide an answer to this question, with the remaining three-quarters (72%, n=857) reporting FTEs ranging from 0.1 to 5.0 (self-reported; no scaling applied). See Table 27.

Table 27: Reported FTE

	n	%
0.1 FTE	3	0.3
0.2 FTE	13	1.5
0.3 FTE	15	1.7
0.4 FTE	21	2.4
0.5 FTE	29	3.4
0.6 FTE	46	5.3
0.7 FTE	30	3.5
0.8 FTE	49	5.7
0.9 FTE	65	7.5
1.0 FTE	**206**	**23.8**
1.1 FTE	108	12.5
1.2 FTE	69	8.0
1.3 FTE	61	7.1
1.4 FTE	38	4.4
1.5 FTE	32	3.7
1.6 FTE	17	2.0
1.7 FTE	13	1.5
1.8 FTE	10	1.2
1.9 FTE	8	0.9
2.0 - 2.9 FTE	31	3.6
3.0+ FTE	1	0.1
Total	**865**	**100.0**

24% of respondents report working 1.0FTE, 31.3% reported working less than 1.0FTE and 45% report working more than 1.0FTE. In 2016 and 2012, 56.7% and 57.2% reported working more than 1.0FTE.

Based on the reported FTE, excluding those reporting 2.0–3.0 FTE, the average is 1.02 FTE, which is almost similar to the average of 1.04 FTE in the 2016 Census. Applying this to the total active workforce by headcount (n=2,304), an assumption can be made that there are 2,350 FTE radiologists in Australia (a ratio of 91.4 radiologists per million population). If the 2.0-2.9FTE respondents are included for both censuses (excluding 3.0+FTE), the 2012 average is 1.04, 2016 is 1.15 and 2020 is 1.1.

In addition, there is now a significantly smaller number of respondents in the ≥2.0FTE bracket – in 2020 3.7% radiologists (n=32) reported working ≥2.0FTE compared with 8.6%(n=69) in 2016 and 1.3% (n=13) in 2012.

Age differences
Of the 32 who answered that they work ≥2.0FTE, more than half (n=18) are aged 50 or older and they are nearly all males. In addition, the 55+ year old radiologists reported working an average FTE of 1.05, compared with 1.1 in 2016. Many more radiologists are now working full time up to "retirement age" rather than transitioning to retirement as they were in previous census/surveys.

Gender differences
A statistically significant difference in reported FTE exists between the genders, with females working less than males (p = 0.001) - the female average is 0.97 FTE, the male average is 1.1 FTE. Older survey data was reported as average hours per week. See Table 28.

Table 28: Average hours worked per week by respondents (2000–2020)

	2000	2002	2004	2006	2008	2010	2012	2016	2020
Male	46.6	46.1	44.2	43.4	42.5	43.4	42.1	48.7	43.9
Female	38.4	38.7	37.9	35.6	35.4	36.3	40.9	42.1	38.1
Total	**45**	**44.7**	**43.2**	**41.9**	**41**	**41.5**	**41.8**	**46.1**	**42.2**

The gender difference has been relatively stable. The difference between the gender averages: 5.8hrs in 2020; 6.6hrs in 2016; 1.2hrs in 2012; 7.1hrs in 2010; 7.1hrs in 2008; 6.3hrs in 2004; 7.4hrs 2002; 8.2hrs 2000.

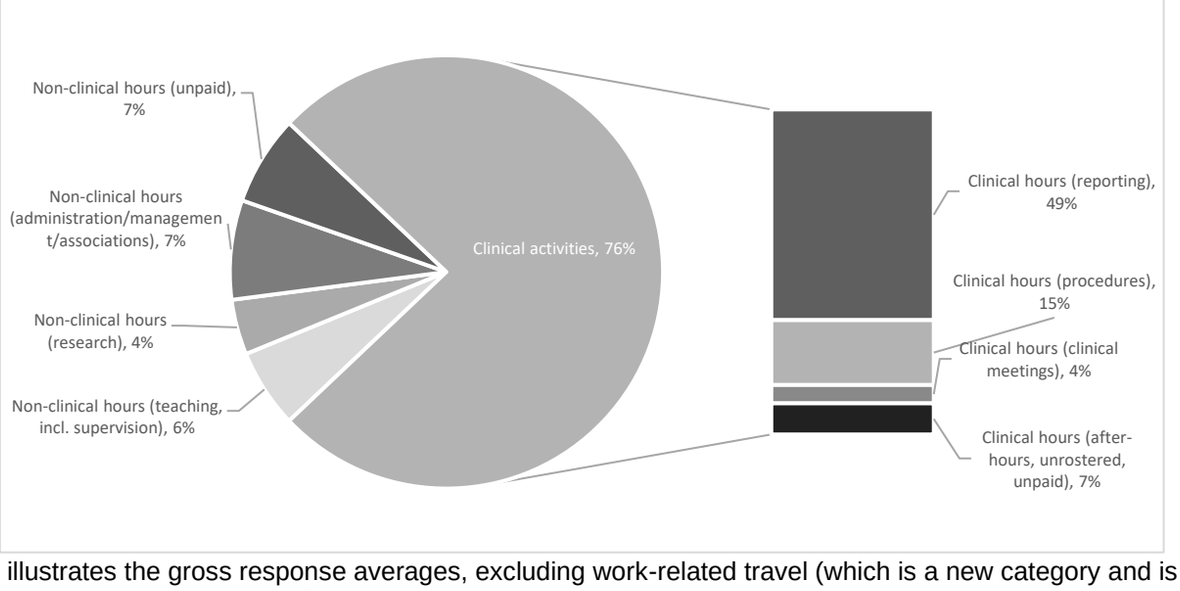
Mix of work activity

The data in this section identifies the mix of activities that make up 'work':

1. **Clinical "hours**" were divided into 4 activities: reporting; procedures; clinical meetings; after-hours/un-rostered/unpaid.
2. **Non-clinical "hours"** were also divided into 4 activities: teaching (including supervision); research; administration/management/associations; unpaid.
3. **Work-related travel** (between sites, not home-work commute).

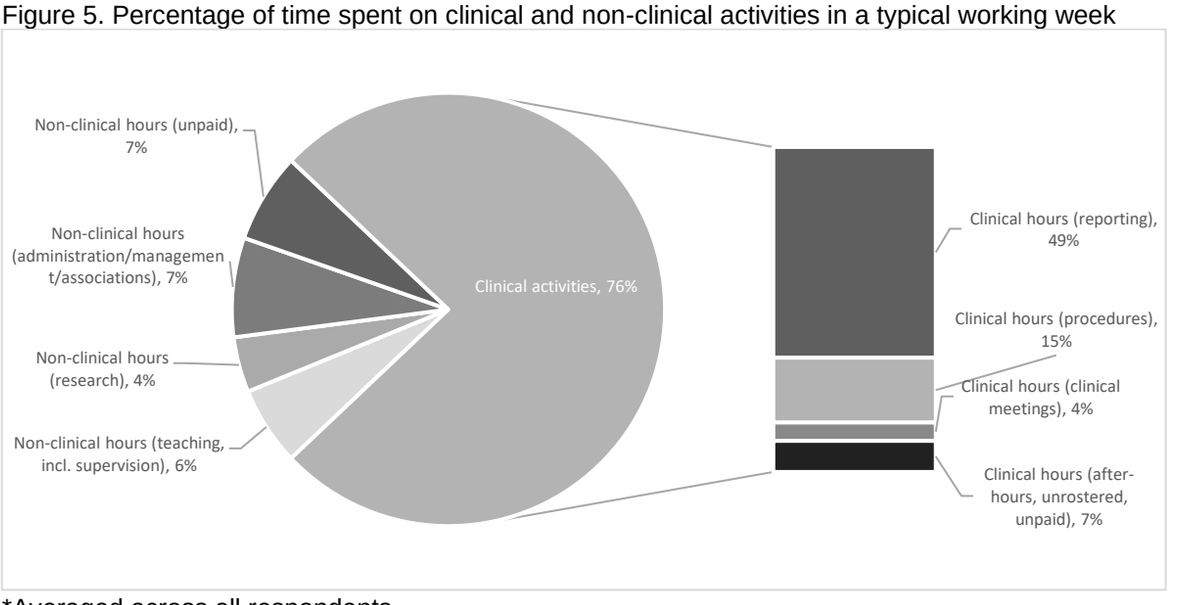
Respondents were required to label which hours were "public" and which "private". The distinction between public and private is of dubious reliability, for the reasons mentioned above.

Figure 5. Percentage of time spent on clinical and non-clinical activities in a typical working week



illustrates the gross response averages, excluding work-related travel (which is a new category and is discussed further below). Clinical activities make up 76% of work activity.

Figure 5. Percentage of time spent on clinical and non-clinical activities in a typical working week



*Averaged across all respondents

Clinical activity

The Census showed 49% of a typical working week is spent reporting imaging studies. In the 2016 census, 66.7% of time was spent reporting imaging studies. This is an important consideration for workforce planning and performance measurement. Presumably this decrease is due to an increasing amount of time spent on procedures, multidisciplinary and clinical meetings, etc.

Gender differences

- Males, on average, work more clinical hours – 40,6hrs/week for males and 34.1hrs/week for females.
- Males, on average, spend more time on procedures – 10.2hrs/week for males and 6.5hrs/week for females.
- Males, on average, spend more time reporting – 31.1hrs/week for males and 27.3hrs/week for females.

The difference in procedural work is not surprising given the previously noted gender differences in IR and INR.

Non-clinical activity

See Table 29 for the summary of responses.

Table 29: Average time spent on non-clinical activities in typical working week

	Mean	**Median**	**Range**
Non-clinical hours (teaching, incl. supervision)	3.6	2	1-48
Non-clinical hours (research)	2.5	2	1-16
Non-clinical hours (administration/management/associations)	4.5	2	1-32
Non-clinical hours (unpaid)	4.1	2	1-20
Total responses	**865**		

Regarding gender differences:

- Male clinical radiologists spend 3.8hrs/week on teaching and supervision, whereas female clinical radiologists spend on average 3.2hrs/week on teaching and supervision.

See also the following, Section 7 - Teaching & Supervision, Research, for more data and analysis on teaching and supervision.

Work related travel

Almost a fifth of the census respondents (19.7%, n=171) reported spending time each week travelling between practice/work sites. An average of 4.8hrs/week was spent on travelling (median=4.0; range=1.0–40). There were no statistically significant differences between the genders and no significant change overall since 2012, although in 2012, there were significant differences between genders, with males reporting more travel time.

Leave

The Census asked for an estimation of the paid, unpaid and leave FTE weeks that clinical radiologists had in the past 12 months.

Leave FTE weeks – see Table 30.

Table 30: Average FTE weeks leave (past 12 months)

	n (%)*	Mean (weeks)	Median (weeks)	Range (weeks)
Maternity/parental leave	62 (4.1)	10.7	6	1-51
Extended/unplanned leave(sickness/bereavement)	114 (7.6)	4.9	2	1-50
Annual/recreational leave	792 (52.5)	5.5	5	1-40
Educational leave	370 (24.5)	2.3	2	1-53
Long service leave	77 (5.1)	3.9	2	1-26
Other	94 (6.2)	10.0	6	1-51

*Respondents could select more than one option

This question is different from past census questions because it includes educational leave as a separate category to other types of leave. The total average reported FTE weeks leave taken by respondents for 2020 was 5.06 weeks/year. It was 4.95 weeks in 2016 and 6.4 in 2012. It is unclear whether the difference is because less leave overall is being taken or whether the inclusion of educational leave (2020 average 2.3 weeks/year) is responsible for the difference.

Geographical difference

Clinical radiologists working in MM1-2 reported taking less leave than clinical radiologists working in MM3-5: the MM1 average was 8.5 weeks/year, in MM2 it was 8.4 weeks/year, MM3 the average was 9.3 weeks/year, in MM4 it was 11.8 weeks/year, and MM5 it was 9.1 weeks/year.

7. TEACHING & SUPERVISION, RESEARCH

Teaching, supervision of trainees and research are important roles that are necessary for clinical radiologists to be stewards of their craft and enables the next generation of clinical radiologists to provide high standards of clinical care.

It was reported that respondents in the public sector in a typical week spend, on average, 3.5 hours in teaching and supervising, and 2.5 hours on research. In the private sector in a typical week, respondents spend, on average, 3.1 hours in teaching and supervising trainees, and 2.1 hours researching.

78% (n=860) of total respondents answered this section.

Teaching & Supervision

56.6% (n=487) of respondents were involved in teaching and supervision.

80.5% (n=392) of respondents provided teaching and supervision in metropolitan public hospitals, compared to 12.7% (n=62) in non-metropolitan public hospitals, 12.5% (n=61) in metropolitan private practices and 4.9% (n=24) in non-metropolitan practices, 9.7% (n=47) provide teaching and supervision in university department settings. MM1 respondents are more likely to be involved in teaching and supervision: MM1 88.0%; MM2 8.7%; MM3 0.6%; MM4 0.2%; MM5 2.5%.

Of the 43.4% (n=373) respondents who are currently not involved in teaching and supervision, nearly one-half (44.2%, n=161) stated that they are willing to provide teaching and supervision, but do not have the capacity to do so. See Table 31.

Table 31: Responses to the question asked; 'If you are not currently involved in the teaching or supervision of clinical radiology trainees, do you have the capacity or willingness to take on a teaching role?'

	n	%
Willing, but no capacity at present	161	44.2
Neither willing nor have capacity	89	24.5
Willing and have capacity	89	24.5
Not willing, but have capacity	25	6.9
Total	**364**	100.0

216 respondents commented that the barrier(s) to taking on teaching and supervision roles were: 29.0% (n= 61) stated that heavy workload due to a lack of clinical radiologists working onsite, especially in rural and regional private sector practices, is a barrier. Other barriers stated include; restricted by current practice site regulations, different family/personal commitments, and lack of trainees on site.

Research

A total of 34.0% (n=291) of respondents are currently involved in research, most of whom (n=246) perform it in their own time, unpaid. 249 respondents are involved in multidisciplinary clinical research. Other 'research' activities include clinical and non-clinical audits and artificial intelligence projects.

From those who responded as currently not involved in research, 47.6% (n=263) stated that they are neither unwilling nor do not have the capacity to undertake research, with 31.7% (n=175) of respondents who stated that they are willing but do not have the capacity. See Table 322.

Table 32: Willingness to be involved in research activities

	n	%
Neither willing nor have capacity	263	47.6%
Willing, but no capacity at present	175	31.7%
Not willing, but have capacity	61	11.1%
Willing and have capacity	53	9.6%
Total	**552**	100.0

41.3% of respondents are willing to do research. See Table 33 for the barriers to undertaking research.

Table 33: Barriers to research

	n*	%
Not interested in research	213	38.6
Financial – lack of funding	68	12.3
Financial – impact on earnings	87	15.8
Does not align with long-term career objectives	94	17.0
Restricted by current employment situation	211	38.2
Lack of specialist statistical support	100	18.1
Other (please specify)	88	15.9
Total respondents	**552**	

*Respondents could select more than one option

"Other" specified barriers are workload, COVID-19, lack of training and guidance in research, administration effort, and other personal and family commitments.

8. QUALITY & WORK-LIFE BALANCE

Three Likert scale questions were posed to assess clinical radiologists' perceptions of workload, work quality and work-life balance. Overall, the data shows little change in the perception of work-life balance or workload affecting quality since the 2012 census, which is when these questions were first asked.

Respondents were given the following three statements to score their level of agreement or disagreement.

"I consider my overall workload to be too heavy"

79% (n=864) of Census respondents answered this question.

A total of 38.3% agreed or strongly agreed that their current workload is too heavy, while another 32% who disagreed or strongly disagreed, which was similar to the results in 2016.

MM3-MM5 respondents are more likely to agree/strongly agree that their workload is too heavy than those who were working in MM1 (MM1 37.6%, MM2 39.1%, MM3 50%, MM5 47.2%). This is not surprising, given the known MM2+ shortage of clinical radiologists.

A significant difference is observed between genders: male clinical radiologists were more likely to agree/strongly agree on having a heavy workload, whereas female clinical radiologists were more likely to disagree/strongly disagree. See Table 34.

Table 34: "I consider my overall workload to be too heavy" by gender

	Female		Male		Total	
	n	%	n	%	n	%
Agree	87	34.39%	188	30.77%	275	31.8%
Disagree	70	27.67%	164	26.84%	234	27.1%
Neutral or unsure	70	27.67%	188	30.77%	258	29.9%
Strongly agree	16	6.32%	40	6.55%	56	6.5%
Strongly disagree	10	3.95%	31	5.07%	41	4.7%
Total	**253**	**100.0**	**611**	**100.0**	**864**	**100.0**

A potential explanation for gender differences in workload perception are the differences in hours worked (as per *workload* above).

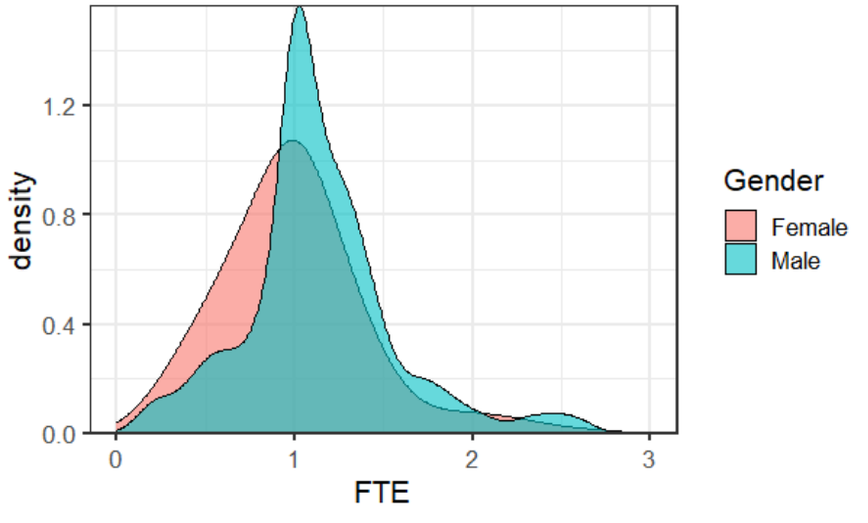


Figure 6: Density of FTE by Gender (Excluding any reported FTEs > 3.0)

Figure 6 shows that male clinical radiologists work longer FTEs than female clinical radiologists. Figure 6 also shows that the FTE density of female clinical radiologists is larger than those of male clinical radiologists around the lower FTEs (i.e., <1 FTE), indicating that females are more likely to work part-time than their male counterparts.

Figure 7: Density of FTE by age for males (Excluding any reported FTEs > 3.0)

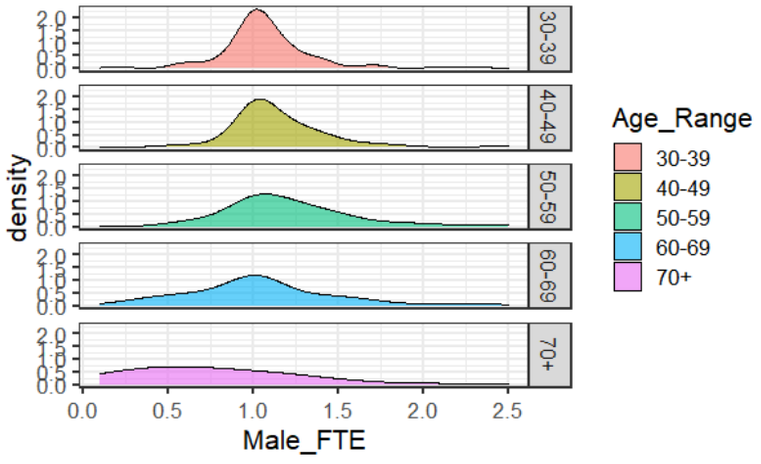
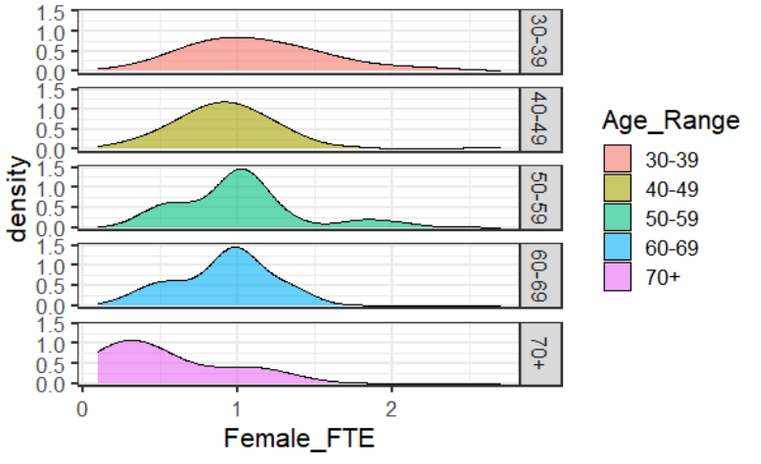


Figure 8: Density of FTE by age for females (Excluding any reported FTEs > 3.0)



As shown in Figure 7, the distribution of workload across male respondents were more densely recorded to be around 1.0 FTE with significant declines in the distribution of recorded FTEs (i.e., less than 1 FTE) in older male respondents (i.e., males within the age range of 70+ years old).

In Figure 8, there is a broader distribution of recorded FTEs from 0 to 2 FTE for female clinical radiologists across the various age ranges compared with their male counterparts.

"My overall professional workload has affected my work-life balance over the past 12 months"

864 (78%) responses were received to this question.

36.2% agreed/strongly agreed with the statement, while 41.8% disagreed/strongly disagreed.

"My overall professional workload has compromised my work quality over the past 12 months"

73% (n=862) of the total census respondents answered this question.

44.6% disagreed/strongly disagreed, while only 24.4% agreed that their workload affected their work quality. There was no significant difference observed between genders, MMM classifications or practice types

9. FREEHAND COMMENTS (Q66)

121 (10.3%) respondents gave feedback to this question. See Table 35 for the summary of feedback subjects.

Table 35: Summary feedback subjects

Subject of comments	n	%
Accreditation	1	0.9
CoVID-19	25	22.1
CPD	2	1.8
IMGs	2	1.8
Impact of technology	1	0.9
IR	3	2.7
Job market	6	5.3
Medicare reimbursements	3	2.7
Nuclear Medicine	1	0.9
Other	15	13.3
Patient safety	3	2.7
Public-private	1	0.9
Quality and workload	16	14.2
Remuneration	2	1.8
Retirement	4	3.5
Rural and regional	2	1.8
Subspecialty interest	1	0.9
Survey related	18	15.9
Teaching and supervision	4	3.5
Teleradiology	1	0.9
Training/trainees	2	1.8
Total comments	**113**	**100**

The most common feedback was about the impact of COVID-19 on clinical radiologist's workload. Most respondents believed that COVID-19 restrictions lead to reductions in workload, but with the recent decreases in COVID-19 cases, the workload has increased considerably, and lower staffing levels were an add on to the situation.

There was common mention of the negative impact of increasing and/or heavy workload on work-life balance, including specific mention of increased unpaid over-time work by respondents.

There were also some frequent comments linked to teaching and non-clinical time, e.g.

- "Lack of non-clinical time in the public sector."
- "Working long hours with very little to no time for teaching."
- "Difficult to find staff specialists with commitments to teaching trainees."

Some other comments included:

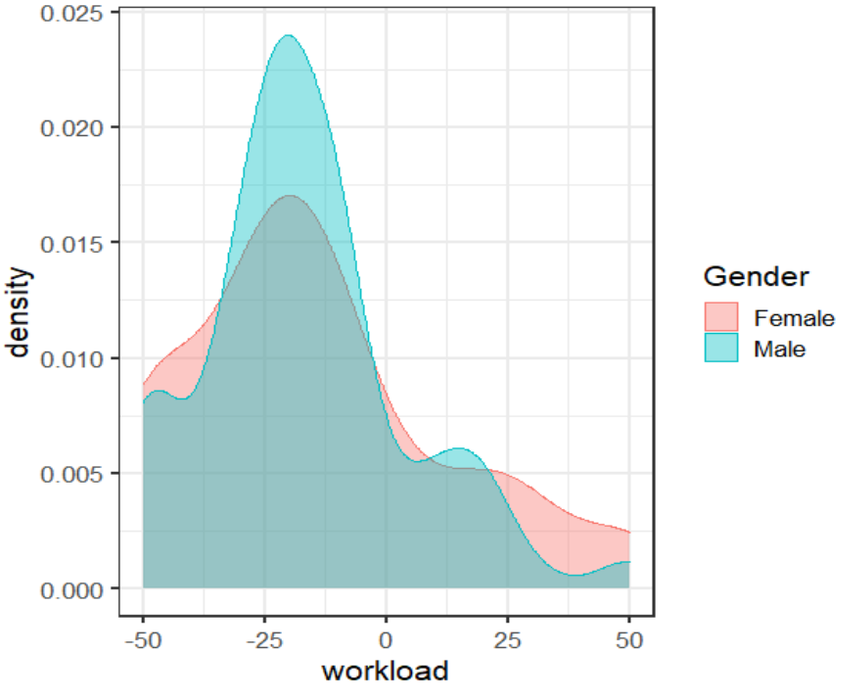
- "Public sector is over-burdened by unjustified utilisation."
- "Medicare reimbursements need to be increased to restore a better quality and work-life balance."
- "Difficulty in recruitment in rural and regional areas"

10. IMPACT OF COVID-19

A total of 78.1% (n=857) respondents provided clear information regarding how they were affected by the COVID-19 crisis. The Census was open for 14 weeks from end-July 2020 to end of October 2020.

On average, respondents saw a 16.3% decline in their workload, with male respondents (-17.0%) experiencing a greater decline in workload compared with female respondents (-14.5%). Figure 9 illustrates the density of change in workload among male and female respondents. Victorian respondents witnessed the maximum decline in workload i.e., -20.5%, followed by New South Wales and Queensland.

Figure 9: 2020 Density of change in workload by Gender



37.5% (n=321) of the total respondents agreed that their working hours have been cut by their employers. On average, respondents experienced 14.4 hours per week reduction in working hours, with a median reduction of 8 hours per week. Male clinical radiologists witnessed a greater reduction in working hours compared to female respondents.

32.1% (n=274) of the total respondents also witnessed a variation in salary by their employers with an average percentage change in salary of +12.9%. Female clinical radiologists (average increase of 16.4%) experienced a greater percentage change in their salaries compared to males (average increase of 11.6%).

The majority (n=577) of respondents agreed that their working hours and terms of employment have returned to normal since the start of the COVID-19 pandemic.

Due to the restrictions and changes in practice brought by COVID-19 related government requirements, 65.2% (n=559) of total respondents reported that their organisation has a waiting list for radiology tests and 68.5% (n=587) reported that their organisation has a waiting list for radiology procedures.

Respondents were asked to comment on the change in waiting lines at their practice with 218 (25.4%) respondents providing comments. The majority of respondents (n = 104; 47.7%) said that waiting list times have increased in their practices, 38 (17.4%) respondents indicated that the waiting list times were same as pre-COVID-19 pandemic, and 33 (15.1%) respondents indicated that waiting list times have decreased at their practices.

Some of the key comments were:

> *"Cut down waiting lists significantly but now starting to return to normal with easing of restriction/recommencement of elective surgery."*
>
> *"Initially reduced workload but now vastly increased due to bulk billing in private practice, with new long waiting lists."*
>
> *"Reduced for most outpatient studies due to patient cancellation. Urgent inpatient studies have increased."*
>
> *"Breast Screen- reduced throughput to adhere to COVID safe protocol."*

248 respondents (28.9%) provided comments on the strategies adopted within their practices to manage the change in waiting lines. Some of the key comments were:

> *"plans to cut down on non-urgent investigations if covid flares up locally"*
>
> *"Employ more staff, introduce bonus incentive to increase radiologist productivity"*
>
> *"Longer hours of scanning; longer appointment time to allow more cleaning and more social distancing"*
>
> *"Employing locums to do tele-reporting and using the onsite radiologist to do more procedures"*
>
> *"Staff encouraged to use up annual leave during the quiet periods. Increased non-clinical time for research in our department"*

11. TRAINEE SECTION

This section provides a 2020 snapshot of what the total number and characteristics of the trainee cohort in the RANZCR Clinical Radiology Training Program.

Demographics (from RANZCR Clinical Radiology Training Program data)

At the time of the Census there were 512 trainees in the Australian arm of the RANZCR Clinical Radiology training program. This equates to a 12.8% increase in the total number of trainees since the 2016 census (n= 454), 26.7% increase since 2012 (n= 404), and a 172.3% increase in trainees since 2000 (n=188).

In spite of the increasing output of the training program, the RANZCR 2014 Workplace Survey showed there is still a high net demand for clinical radiologists in Australia.

Primary medical degree

As per the RANZCR's membership data, out of the total available data on primary medical qualification, 91.8% of respondents obtained their primary medical qualification from an Australian university and 3.3% from a New Zealand university, and 4.9% are international medical graduates (IMGs). Around 99 respondent's primary medical qualification data wasn't available in the database.

Age

There was no significant change in the average age of trainees since 2012, with the 2020 mean being 31.9 years and the median as 31.0 years. This suggests that many trainees are not still entering clinical radiology specialty training, even after only the minimum postgraduate experience (i.e., they are working for more than two years in other roles). Alternatively, this may reflect the increasing number of universities only offering medicine as a postgraduate qualification meaning that the age of the graduating students is older compared to previous cohorts.

Gender

The number of female trainees has decreased from 38.0% in 2012 and 35.2% in 2016 to 33.8% in 2020. This is about the same as the 2008 data (36.8% of total respondents, including New Zealand and overseas trainees). Women still remain underrepresented in clinical radiology – a situation which is not exclusive to Australia (or New Zealand).

Rural origin

A total of 156 respondents provided clear information regarding where they spent most of their time growing up. The census showed 67.3% of those respondents are from MM1, 7.7% are from MM2, 3.2% are from MM3 and 12.2% from MM4-6. The results showed 27.1% of total respondents did not provide sufficient information. This compares to 70% of the population living in MM1 and 87% of the active clinical radiology workforce living in MM1.

In 2020, there were 32 (14.8%) respondents who had a 'return of service' obligation, such as the Medical Rural Bonded Scholarship Scheme or the Bonded Medical Places Scheme. Whereas in 2016, there were versus 31 (14.3%) and 17 (5.7% of total respondents, including New Zealand and overseas trainees) in 2012.

Typical working week / Work hours

There has been a decrease in time (hours per week) respondents report spending on clinical activities – 10.1% report spending up to 35 hours per week and 23.5% report spending 46 or more hours per week - by comparison with 2016 (12.5% and 24.5% respectively) and 2012 (11.0% and 37.7% respectively).

There has been a significant increase in the amount of 'protected time'[iii]: 12.9% reporting no such time and 64.5% reporting four or more such hours per week (22.6% and 45.7% respectively in 2016, and 25.2% and 15.4% respectively in 2012). This may account for the decrease in clinical time.

There has also been a slight decrease in the amount of time spent on after-hours on-call activities since 2016: 46.1% report spending >10 hours per week, 51.9% in 2016, and 36.6% in 2012.

There has not been a significant change in the amount of time spent on non-clinical activities, whether in-hours or after-hours.

Career Choice

Career interest (81.0%) was the most commonly reported reason for trainees to pursue clinical radiology, with lifestyle (58.4%), flexibility (50.2%) and high-tech technology (44.3%) rating as the most important factors determining career choice. It should be noted that respondents could choose more than one reason. These results are comparable with the findings of the 2016 and 2012 census data.

Interestingly, out of 217 respondents who answered the question on when they decided to become a clinical radiologist, 27.2% of Australian trainees decided to do clinical radiology before PGY1 (25.3% in medical school). This seems high and is significantly more than the New Zealand cohort (11.8% and 9.8% respectively). It would be interesting to compare with other specialties, where there is a much larger exposure of potential trainees to the other specialties during the prevocational medical officer years because there are very few clinical radiology RMO positions and little direct exposure to medical students. There was not a significant change to the 2016 and 2012 results.

Awareness of the RANZCR 2014 Radiology Workplace Survey

Only 17.4% (22% in 2016) of respondents indicated an awareness of the results from the RANZCR 2014 Radiology Workplace Survey. The survey found a very high demand for general radiologists with broad skill sets, especially those with subspecialist interest and skill in Tier B interventional radiology, MSK and breast imaging.

Stress

Training and exam demands were reported to be the most common cause of trainee stress. A total of 66.4% of respondents reported that the training and exam demands resulted "a lot" or "very much" of their stress (comparable to 72.0% in New Zealand). This has increased when compared with the 2016 data in which 58.5% (38.0% in 2012) of trainees indicated that the greatest source of stress was training demands.

The same results for the other options are: balancing work & family commitments 27.9%; job/service demands 25.3%; work/HR environment in network 17.6%; adequate exposure to all modalities & subspecialties 19.2%; spending time in remote centres 6.4%; Gender issues 2.3%; Discrimination 1.9%; Bullying 2.7%; Harassment 1.9%; other 6.6%.

RANZCR has had a Trainee Liaison Officer (TLO) since 2016. This role continues to act as a conduit between the College and trainees, providing support for workplace issues, mental health, and College policies and processes. The TLO is a confidential advisor for trainees within the College.

Impact of COVID-19

Since the COVID-19 pandemic has disrupted medical specialty training, the CRWC decided to incorporate a few COVID-19 specific questions in the 2020 Workforce Census. Of the total Census trainee respondents, 76.6% (n=165) of trainees responded to the impact of COVID-19 crisis questions. On average, trainees saw a 13% decline in their workload, with female trainees (-14.2%) experiencing a greater decline in workload compared with male trainees (-12.4%). Victoria, Western Australia, and New South Wales witnessed higher decline in trainee workload compared with other states.

Most clinical radiology trainees did not experience major changes in their working hours and salary by their employers during this period.

[iii] The term 'Protected' Time is the time that Trainees are not available for normal clinical duties and is therefore part of non-clinical time. This requires that their clinical responsibilities are covered for the period of the 'Protected' Time by their peers and/or senior colleagues. This time is intended to be used for formal teaching activities, research activities and for gaining practical experience in planning and treatment as stipulated by the curriculum.

12. DISCUSSION

RANZCR is entrusted with the task of training future clinical radiologists to meet the healthcare needs of all Australians. Therefore, the College needs to address the training gap that exists in the supply of clinical radiologists, able and willing, to provide clinical radiologist skills and expertise to meet Australia's regional healthcare demands. If not, there is a risk that others will be asked to fill the gap.

For more information regarding the Australian Commonwealth government's historic changes to medical workforce planning and the role of specialist medical colleges roles in workforce preparation, can be found in *Appendix 4. Australian Specialist Medical Colleges Historic Responsibilities to Medical Workforce Development.*

The previous format and development process of RANZCR workforce census reports is important for comparison to the results of the 2020 Workforce Census and the particulars can be found in *Appendix 5. Past RANZCR workforce reports and Examinations of Reasons for Undersupply and Demand.*

Workforce projections

The following factors need to be considered in clinical radiologist workforce projections[65] (adapted from Figure 2, Joyce CM et al, Medical Journal of Australia 2004)

Supply of clinical radiologists

Entries to the workforce

Trainee and new fellow profile and career preference
Trainee position funding and accreditation
Immigration (permanent and temporary)
Re-entry after temporary exit

Practice type

Demographic profile
Geographical distribution
Within profession distribution (generalist versus subspecialist)
Working hours, after hours, on-call and other lifestyle factors
Availability and productivity of 'clinical' (reporting and procedure) time
Support staff workforce qualities

Exits from the workforce

Retirement
Temporary exit (illness, child raising, etc)
Attrition (career change, etc)
Emigration

Demand for clinical radiologists

Population characteristics
Service use patterns
Developments in knowledge and technology
Community expectations
Healthcare system infrastructure and funding models
Supply of other doctors and health professionals

Under normal circumstances, the following factors may contribute to a general undersupply of clinical radiologists in Australia: an ageing population, increasing chronic illness, technological development, and evolution, expanding roles of medical imaging, expanding utilisation, increasing after-hours demand, increasing subspecialisation of the referral workforce and the recent doubling of medical graduate output.

Factors that potentially mitigate against this are: artificial intelligence replacing clinical radiologists in the longer term; strategies to reduce inappropriate utilisation and over-diagnosis, which needs to be managed as part of professional stewardship.

Impact of COVID-19

The clinical radiology workforce and workplace changes caused by the COVID-19 pandemic are unprecedented. The initial shut down of most, but emergency healthcare services resulted in a marked decrease in demand for clinical radiology and all elective care were also restricted or cancelled. As the COVID-19 pandemic progressed, clinical radiology workload was influenced by a combination of catchup referrals, patient's reluctance of some to seek healthcare due to a fear of being infected, a trend for rural patients to seek radiology closer to home adding to the complexity of local care and the delayed diagnosis of many patients resulting in the more intense use of certain resources. As the COVID-19 pandemic continues, these factors cannot be definitively resolved and will continue to affect demand in ways that are currently not clear. The effect of burnout on clinical radiologists and the closure of borders affecting IMGs is also relevant and should be noted for future evaluation.

Burnout

Burnout related to the unprecedented impacts of the COVID-19 pandemic has not been considered but given the recent reports from health care professionals, this needs serious considerations. There is an increasing concern around burnout in the broader medical field[71]. This is particularly true in clinical radiology, in the wake of the ongoing COVID-19 pandemic and ever-increasing workloads. This can have serious implications on the wellbeing of staff as well as patient safety.
More research could be undertaken to investigate the prevalence and factors affecting burnout amongst clinical radiologists and trainees, so that it could be properly addressed and potentially mitigated. The CRWC is planning to conduct a RANZCR Burnout survey, like the Medscape Radiologist Lifestyle, Happiness, and Burnout Report 2022[70], to further study the various contributing factors of burnout being experienced by clinical radiologists in Australia and New Zealand.

Geographical and in-specialty issues

The known geographical imbalance or maldistribution (also known as rural shortage) is being addressed in many ways by other medical specialties, e.g., dedicated training programs and mandatory longer-term rotations. Within clinical radiology, there is a good expectation that the expansion of rural radiology sites in the training networks, as well as the Commonwealth's Integrated Rural Training Pathway (IRTP) positions, should start to address this imbalance. While this is a good initiative of the Commonwealth, the IRTP is capped and RANZCR has utilised its full allocation. The College has a waiting list for additional trainees to enter the IRTP. The College must advocate for more places under the IRTP as well as advocating for increased funding. The current funding arrangements do not meet the actual costs of training and need to be revised. This needs to be actively followed by the CRWC and other training and accreditation committees at the College to encourage and address the needs of rural communities to ensure that training programs are fit for purpose
.
There are also 'small' workforces that should be considered 'fragile' or imperilled. Some of these are classed as geographical, e.g., the Northern Territory, Tasmania, and the ACT. Disruptions to the single 'home hospital'-based training network in Tasmania and the ACT are at risk. Some are in-specialty, e.g., nuclear medicine radiologists, interventional radiologists (particularly those that are neurointervention capable), and radiologists working in Breast Screen. In these small workforces, disruption of the training pathway(s) and/or the loss of only a small number of [trained] radiologists can lead to a critical supply problem. This is especially so for the small in-specialty workforces (e.g., nuclear medicine, interventional radiology) in non-metropolitan regions where the 'fragility' of the workforce is magnified by the existing imbalance and the small absolute size of the workforce. These need recognition and ongoing monitoring.

Differences between metropolitan and non-metropolitan areas

Data was not collected in the early (1990s) RANZCR reports, which measured 'geographical' differences between the states and territories only. Subsequent reports attempted measurement, although there were inaccuracies based on self-reporting of work done *for* rural and regional centres, rather than work *performed at* such centres.

At the time of the 2000 College survey, only 25% of those radiologists who identified as providing rural services were providing a resident rural service[49].

Since 2012, the RANZCR has reported the geographical distribution of the residential sites of clinical radiologists, i.e., as best as possible determining where clinical radiologists 'live and work'. Between 4 and 5% of clinical radiologists use a home post code that cannot be mapped with the MMM classification.

The reason for using the residential site rather than work site(s) is because the CRWC decided that to best perform as a clinical radiologist and to best contribute to the relevant local/regional medical community (and the broader community), a clinical radiologist best does so when locally resident in the region where they work, with very rare exceptions. This decision was taken with the knowledge that it is somewhat biased towards the consideration of non-metropolitan and outer-metropolitan regions. This was for good reason, given the workforce maldistribution and its effects on access to clinical radiologists and services, sustainability and risk management of services, and the recruitment and retention of clinical radiologists and other health professionals in regions of workforce need.

Anecdotally and as noted by the CRWC members, like all aspects in life, relationships play a key role in how clinical radiologists live and work. Trust between clinical radiologists' and their colleagues, together with referring doctors, can make significant differences to patient care and support[69].

As reported in the Census demographic section above, the geographic maldistribution of medical specialists in Australia is not getting better. While it might be expected that market forces would drive the generally increased clinical radiologist numbers out to regions of workforce need, there is a large body of Australian and international evidence[26-50] that shows that for doctors, the most predictive factors that relate to where a doctor chooses to reside and work are:

1. Site of origin (metropolitan versus rural) and that of their life partner
2. Training time spent in metropolitan versus rural locations.

Given that there are very few non-metropolitan clinical radiology training posts, it is no surprise that the geographic maldistribution is entrenched and needs to be addressed by increasing the numbers of rural training sites.

RANZCR is currently reviewing its selection into training criteria and processes, with a view to creating a fairer and more transparent selection into training process.

Current situation and predictions

The 103% increase in clinical radiologists from 2000 to 2020 is mainly the result of the doubling of trainee numbers in the 16 years from 2000 to 2016.

RANZCR and the CRWC acknowledge that there are significant clinical radiology workforce shortages in rural and regional Australia, and that urgent action is needed to address this. Such actions can include establishing new training networks to help:

1. Improve trainees experiential learning; and
2. Improve regional and rural exposure.

CRWC Recommendations

From the 2020 Workforce Census, clinical radiology workforce issues continue to be a major problem, with the main issues being identified as: geographical maldistribution of clinical radiologists, reliance on IMGs, an overflow of teleradiology services and demand, and the rolling impacts of the COVID-19 pandemic and burnout.

There is still a lack of existing pathways to produce medical graduates who want to live and work in regional and rural locations around Australia. In addition, the need for Australia to be able to self-sufficiently support and produce clinical radiologists without over-relying on overseas trained or IMG clinical radiologists is important. The COVID-19 pandemic has exposed the supply chains that can be easily broken, and that self-sufficiency is essential for maintaining sustainable medical care. The emergence of teleradiology services have the potential to aid in the overflow of clinical radiology services, out of hours cover in buy practices and with workload issues related to burnout.

Clinical radiologists remain a vulnerable workforce in Australia and priority should be given to address the issues around the workforce, such as developing sustainable training pathways and focusing on the needs of the rural and regional communities of Australia.

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DEFINITIONS

After-hours: Between ~5.30pm and ~8.30am on business days and all hours on weekends and public holidays, i.e., everything that is not your locally accepted business hours.

[**After-hours] Call centre:** A dedicated tele-radiology site where clinical radiologist(s) work rostered hours to report medically urgent (time critical) after-hours cases and are available for telephone advice (but not onsite after-hours attendance).

Dedicated teleradiology: You report work performed elsewhere (i.e. other than the site you are working at and usually the site you are working at does not perform imaging studies), including no expectation of you being available for onsite attendance if required, even though you may be available by telephone for advice etc. The work could be in-hours or after-hours work and it may also be medically urgent work.

In-hours: Between ~8.30am and ~5.30pm on business days (not weekends or public holidays), using your locally accepted 'business hours' (usually sometime between 8am-9am and 5pm-6pm).

Network radiology: While working as an onsite clinical radiologist, the radiologist reports studies performed at other sites, as part of load balancing between manned sites (sites where there is an onsite clinical radiologist{s}), for a second opinion or subspecialist opinion and/or because the other site(s) is unmanned (e.g., small rural or outer suburban site). Note that the off-site reporting of studies (whether from manned or unmanned sites) must not be the dominant work performed and, in this regard, as a guide, it should be no more than 20%. Anything more than 20% should be regarded as 'dedicated teleradiology'.

On-call: Rostered after-hours to be available to provide, as required, the following services for medically urgent (time critical) clinical cases: professional advice (including over the telephone); onsite attendance for the supervision and/or performance of a medically urgent imaging study or procedure; +/- reporting off-site (by tele-radiology) of a medically urgent imaging study. This does not include routine, elective evening and weekend lists.

Onsite: Working at a site where imaging studies and procedures are performed on patients and where at least part of the role is to attend patients and give face-to-face advice and assistance to radiology and other staff and referrers, i.e., work as a true clinical radiologist.

APPENDIX

Appendix 1. The History of RANZCR Workforce Surveys and the CRWC

The first RANZCR workforce survey of Australian clinical radiologists was undertaken in 1992. It became biannual and was then expanded to include New Zealand in 2000. The survey questions have evolved and expanded. It was renamed the Clinical Radiology Workforce Census in 2012, when its frequency was changed to once every four years.

The Census provides information on the supply of clinical radiologists. This supplements the information collected from members at their annual renewal of membership.

The CRWC was formed in the 1990s and was previously called the Manpower Subcommittee to provide the RANZCR with advice and information on workforce issues. The main objectives of the CRWC are to:

1. **Provide analysis to assist the Faculty of Clinical Radiology Council** on national and state developments, to ensure sufficient workforce in radiology and respond to related queries from external parties.
2. **Collect workforce data** across the full range of factors that influence supply and demand to support workforce planning and scenario modelling in radiology. This includes (but is not limited to) conducting workforce censuses every four years for Australia and New Zealand, and publishing results.
3. **Engage** with key stakeholders in the development of **RANZCR workforce policy positions**.
4. **Identify and develop positions** on **emerging radiology workforce issues** and provide advice to the Faculty of Clinical Radiology Council on appropriate responses.
5. Ensure RANZCR **input into the policy development processes of governments and industry in relation to workforce issues in radiology**, and reform in the broader health sector.

Appendix 2. The CRWC's 2020 Census Considerations for Questionnaire Format

Changes were made according to the following principles:

- Only ask questions that truly have relevance to workforce planning (and cull or do not ask questions that are merely 'interesting').
- Only ask for information that cannot be obtained from a more reliable source, e.g., membership database.
- Only ask about what has been done and cull (or else change) all 'intention' questions. Past surveys included many questions asking about future intentions, the responses to which were notoriously unreliable, as evidenced by longitudinal analysis of past responses. The data collected can be trended for accurate longitudinal analysis.
- Keep the questions as simple as possible to increase the reliability of responses.
- Only change old questions (that are to be kept) when absolutely necessary, so that longitudinal analysis is more accurate.
- Limit the number of questions, so as to reduce 'survey fatigue'.
- Where possible, use MCQ formats and/or ranking scales, to get more reliable responses.
- Review the Workplace Survey and the New Fellow Survey, so as to use similar terminology and to avoid duplication and repetition.
- Plan for the next Census, by keeping a record of 'lessons learned' and 'corporate memory', for future CRWC members, so that mistakes are not repeated.

Appendix 3. The Key Considerations around Survey Bias.

There are two issues to consider with regard to the responses to any survey: error and bias. Error refers to the level of uncertainty in any estimate based upon a sample of responses from a population. Error is typically determined solely by the sample size and its relationship to the population. With a sample of 1,098 completed responses, the margin of error for using a 95% confidence level would be as follows:

For percentages around:	50%	± 3.0%
	40% or 60%	± 2.9%
	30% or 70%	± 2.71%
	20% or 80%	± 2.37%
	10% or 90%	± 1.77%

These margins of errors are small. Of note, not all respondents answered all questions and specific response rates are included where relevant.

Bias is more difficult to quantify. Bias refers to a systematic 'lean' toward one type of result or another. It is related to whether non-respondents are likely to give different responses to the respondents. For example, if a survey was designed to measure how conscientious people were, non-conscientious individuals would be more likely to be non-respondents and the estimated levels of conscientious people in the population would be biased upwards.

Generally, the higher the return rate, the less the likelihood of response bias. The definition of a 'good' return rate is difficult to ascertain, but there is some research literature on this question, including a 1997 meta-analysis[1] of response rates in the medical literature - response rates for physicians across 321 mail surveys published in medical journals in 1991 had a mean response rate of 54%. The response rate found here, 47.1%, is a little lower than this. Over the past years, it has also been seen that the response rate to the census have been slightly decreasing. In general response rates to member surveys in health and elsewhere are declining.

The other factor for consideration is whether the nature of the survey would engender systematic non-response of some sort. This survey, which looks at the nature of the practice, does not seem to be particularly controversial. It is hard to identify a particular segment of the surveyed population choosing not to respond because of the nature of the material.

Appendix 4. Australian Specialist Medical Colleges Historic Responsibilities to Medical Workforce Development.

In 2005, the Australian Competition and Consumer Commission co-wrote a report**Error! Reference source not found.** in 2005 with the Australian Health Workforce Officials' Committee, for the Australian Health Ministers (as part of COAG), where they reviewed the Australian specialist medical colleges. This report specifically addressed who is responsible for medical specialist workforce planning and optimum workforce numbers, amongst other things.

"It is jurisdictions' responsibility to make decisions about national and state workforce planning to determine optimum workforce numbers and colleges' responsibility to advise about capacity to train" as part of Recommendation 1 of the review of Australian specialist medical colleges by the Australian Competition and Consumer Commission (ACCC)**Error! Reference source not found.**. See further discussion of t his ACCC report in the 2013 RANZCR discussion paper[44] *Medical Colleges and competition law.*

Thus, the Commonwealth, states and territories are responsible for workforce planning and optimum workforce numbers. It is, however, naïve to believe that the states and territories can do it alone.

The specialist medical colleges, along with the medical profession generally, while not specifically responsible in the eyes of COAG, are responsible for their professions. To be recognised and respected as a profession, there needs to be self-regulation. It is a social contract with the community, where the community expects the profession to put altruism in front of self-interest. Professional organisations, such as the RANZCR, are obliged to do the right thing or else lose their 'licence to license'.

The RANZCR has sole responsibility for assessment of clinical radiologists for 'licensing' (in Australia granted by the Australian Medical Council), whether Australian (or New Zealand or Singapore) trained or not. It is a lot to lose. The ACCC are aware of potentially anticompetitive behaviours.

In addition, it has to be recognised that the radiology workforce is the profession. The RANZCR is a member-owned and driven organisation. It is fundamental to its core professional business and success that it has the best and most appropriate workforce, membership, and professional class it can. Hence it needs to fully understand what factors influence the quality and appropriateness of its workforce and to influence the jurisdictions and Commonwealth to achieve the same. It is therefore no surprise that one of the 4 strategic pillars of the RANZCR is Workforce.

Appendix 5. Past RANZCR workforce reports and Examinations of Reasons for Undersupply and Demand.

Past RANZCR workforce reports

Review of the following informed this report: 11 workforce reports[11,45-**Error! Reference source not found.**] of the C RWC and its predecessors, as well as the workforce sections of recent RANZCR annual activity reports[57,**Error! Reference source not found.**], the discussion paper on workforce distribution that came from the 2 012 census analysis[59]and the seminal 2001 Australian Medical Workforce Advisory Council publication *The Specialist Radiology Workforce in Australia*[60]. The following summarises that review.

The original Manpower Subcommittee's brief was primarily to report and advise on the adequacy of the workforce and its sustainability by the number of trainees. This has been a prime objective ever since, albeit somewhat illusory and subsequently complicated by the realisation that there is a significant geographical maldistribution, and that in-specialty skill distribution is also highly relevant.

The early surveys collected information about private vs. public work and asked intention questions (e.g. when do you expect to retire). There has been evolution of the questions asked and a lot of demographic information is now collected at the time of annual membership renewal and no longer asked in the census. Intention questions have been abandoned because the responses were proven to be unreliable when compared with later census results. Instead, actual data is obtained and longitudinally trended, e.g. retirement ages. This has resulted in more useful observations.

The issue of corporatisation and its potential impact(s) on the workforce were explored in some surveys, without conclusive observations being made. Similarly, the value of the private vs. public segmentation has not resulted in any major useful conclusions. Several old reports contained considerable comparisons between Australia and New Zealand, which are generally not valuable for workforce planning in either jurisdiction. More recently, an attempt has been made to quantify the impact of teleradiology and off-site reporting, as well as the increase in after-hours work, without success at this time.

In the early and mid-1990s, RANZCR radiologist workforce reports concluded that the Australian radiology workforce was adequate and in balance between supply and demand (although there were significant differences between states and territories), based mainly on:

- Comparison with historical USA and Canadian data that indicated an 'optimum' number of full-time equivalent (FTE) radiologists was 1 FTE radiologist per 18,000-20,000 population
- Comparison with USA and Canada radiology trainee numbers per FTE radiologist, with Australia's rate (1 per 5.7) between the two (Canada 1 per 5.5, USA 1 per 5.8)
- Later comparisons with OECD countries showing Australia to be 'mid-range' for radiologists/population and radiology procedures/population
- An assumed 'attrition' rate of 2% initially (based on a self-reported retirement rate of 1.7%/year and a death/illness rate of 0.3%/year), upgraded to 2.5%/year (based on changing responses and to match USA data)
- Population growth of 1.2%/year
- An assumed 'migrant' influx (of overseas-trained radiologists) of 8/year, which was low given the historical numbers of 15/year.

The USA doubled its number of radiologists per population between 1990 and 1996 and the Canadian data was from 1982. Population growth was mildly underestimated and what little data there was re diagnostic study or imaging-guided procedure demand was based on very general international data and self-reported volumes by Australian clinical radiologists. There were other significant factors not considered, the most important being underestimation of growth in demand for radiology services exceeding population growth.

In general, previous RANZCR clinical radiologist workforce projections were reasonably accurate in predicting future supply based on then-known trainee numbers and estimations of overseas-trained radiologist inflows, however, supply was mildly underestimated because of increases in trainee numbers and a slightly greater inflow of overseas-trained radiologists than anticipated, in addition to the trend of an increasing age of retirement. These outweighed the mild over-estimation of supply based on lifestyle choice factors, except for on-call and after-hours demand. Government (various) supply

projections are no more accurate than the RANZCR's and often less so because they often use data that is out of date.

Based on the review, the following are the significant relevant factors leading to inaccuracies in radiology workforce projections, assuming there is no significant change in the funding of radiology services:

Supply under-estimation
- older retirement ages
- more overseas-trained radiologists than anticipated
- less annual leave
- technology advancements making radiologists more 'efficient'/'productive'

Supply over-estimation
- gender and generational lifestyle choices
- newly trained radiologist knowledge, experience and career plan

Demand under-estimation
- increasing complexity of imaging and imaging-guided procedures
- increasing demand for imaging-guided procedures
- advancing diagnostic and treatment knowledge and technology
- ageing population and increasing chronic illness
- increasing use and expectation of treatment and imaging despite age, in addition to generally increased community expectations
- increased access to imaging (geographically and after-hours access) and a regulatory environment that favours access over quality
- increasing supply of other health professionals, especially subspecialists
- overuse of testing, in part due to patient expectations and in part the result of health professional overuse (e.g., declining confidence and skill in clinically-based diagnosis and patient treatment, fear of litigation with the incorrect belief that referral for imaging will mitigate this risk)

Demand over-estimation
- work practice changes, with now a significant number of radiology providers that focus on high volume, high productivity reporting without an emphasis on quality and consultation
- artificial intelligence replacing radiologists
- professional self-regulation to limit overuse

Accurate measurement of actual service demand in Australia is not possible, because there are numerous payers, only one of whom has accurate data reporting, namely Medicare (formerly the Health Insurance Commission). It is estimated that Medicare expenditure on radiology services represents ~65% of the total market. The other ~35% of the market is: public patient services in public hospitals, Veteran Affairs cases, insurance compensation cases, breast [cancer] screening, entirely privately funded work (e.g., international travellers and MRI scans not eligible for MBS rebates). There have been and there are still no reliable sources of nation-wide or state or territory-wide demand data for the non-Medicare demand.

In 1998 the RANZCR realised that it had significantly underestimated demand factors and that demand growth would outstrip supply growth. This was mainly because of the failure to consider the rising demand for radiology studies and imaging-guided procedures, as well as their increasing complexity, for all patient types. For over two decades there has been a steady compound 4% annual growth in Medicare diagnostic imaging outlays (from the 1980s). The demand growth in the public hospitals has been similar, if not greater, and a considerable amount of that is after-hours work. During the period 1990 and 2000 there was only a ~2% average compound annual increase in radiologists.

As a result, the RANZCR and the Australian Medical Workforce Advisory Committee (AMWAC) adopted formal policies and recommendations in 2000 and 2001 respectively that total trainee numbers be significantly increased, from 200 (in 2000) to 260 over 3 years. The AMWAC recommendations were accepted by the state and territory governments, who fund and are responsible for the hospitals where the training occurred, although there were a small number of privately funded trainee positions (now more). In the early 2000s the Commonwealth started funding a small number of trainee positions through its Specialist Training Program (STP). In the mid-2000s the various state medical workforce

agencies realised that increased demand (mainly related to the ageing population and the very large increase in university medical student numbers) and decreased supply (mainly concerned with the expected baby boomer retirements) required them to increase the number of radiology training positions in their public hospitals.

Note that there is considerable lead time in political decision-making, then the funding, development and accrediting of new trainee positions. Add to that the five-year period of training and it is obvious that workforce planning decisions take at least a decade to materialise as changes in the number of clinical radiologists entering the workforce. Of note the RANZCR does not determine trainee numbers: the funders of training do.

There was also a realisation that some training sites were not supplying clinical radiologists that could work as competent multi-tasking generalists. In response to that, the RANZCR from the early 2000s started changing its curriculum and training structure to address the competency problems and to allow for an expansion of training capacity.

Prediction of future workforce demand is globally recognised as fraught with error and uncertainty. This is because of: the problem of demand forecasting; the aforementioned supply lead time problems; multiple individuals, population, health system and organisation variables; and the politics of funding training.

ABBREVIATIONS

-	Not applicable
%	Percentage responding
95% CI	95 per cent confidence interval
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ADIA	Australian Diagnostic Imaging Association
AHPRA	Australian Health Practitioner Regulation Agency
AIHW	Australian Institute of Health and Welfare
AMA	Australian Medical Association
ANZSNR	Australian and New Zealand Society of Neuroradiology
AoN	Area of Need
ASGC	Australian Standard Geographical Classification
BMD	Bone Mineral Density (Bone Densitometry)
CPD	Continuing Professional Development
CT	Computed Tomography
CTA	Computed Tomography Angiography
CTCA	Computed Tomography Coronary Angiography
DI(ST)	Diagnostic Imaging (Services Table)
DoHA	Department of Health and Ageing
DWS	District of Workforce Shortage
FRANZCR	Fellow of the Royal Australian and New Zealand College of Radiologists
FTE	Full-Time Equivalent
GFC	Global Financial Crisis
HIC	Health Insurance Commission
HWA	Health Workforce Australia
IMG	International Medical Graduate
IRSA	Interventional Radiology Society of Australia
IV	Intravenous
MCNZ	Medical Council of New Zealand
MR(I)	Magnetic Resonance (Imaging)
MSK	Musculoskeletal
NSW	New South Wales
NT	Northern Territory
OTS	Overseas Trained Specialist
PACS	Picture Archiving and Communication System
PET	Position Emission Tomography
QLD	Queensland
RA	Remoteness Area
RANZCR	The Royal Australian and New Zealand College of Radiologists
RWC	Radiology Workforce Committee
SA	South Australia
SPSS	Statistical Package for the Social Sciences
STP	Specialist Training Program
Tas	Tasmania
US	Ultrasound
VIC	Victoria
VMO	Visiting Medical Officer
WA	Western Australia