

Who? What? Where? A snapshot of Nuclear Medicine Research Presentations from recent ANZSNM conferences in Australia and New Zealand

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ABSTRACT

Objective(s): The aims of this study were to: 1) discover location (by city) of contributors to poster and oral presentations at recent ANZSNM conferences; 2) determine the nuclear medicine themes most commonly explored; 3) establish institutions producing the highest number of oral and poster abstracts and 4) determine publication rates of conference abstracts to full papers from recent ANZSNM conferences.

Methods: Retrospective analysis of abstracts published in the Internal Medicine Journal Special Issues 2014–2019 identified 614 abstracts. Invited plenary speaker abstracts were excluded. Descriptive statistics were used in data analysis. Conference abstracts were analysed using the following criteria: poster or oral presentation, author/s, city location, hospital and subject matter. Themes defined by the ANZSNM conference committee for abstract submission were: cardiology, oncology, neurology, therapy, renal/urology, gastrointestinal, paediatrics, musculoskeletal, infection/inflammation, technology, physics, radiation safety, radiopharmacy/radiochemistry, education, or general. Retrospective analysis of 555 conference abstracts (excluding New Zealand and International, 59 abstracts) using Google Scholar, Pubmed and Google databases was undertaken. Abstract titles, key words, institutions and/or authors' names were used to find peer-reviewed papers. Identified papers were authenticated through either open access, publicly available author information or Monash University's library access. Published paper citations were also recorded (up to 1st July 2019).

Results: Analysis of 614 abstracts 2014 – 2019 was performed. Over five years, the average number of poster abstracts was 67.8 and oral 55.0. Sydney submitted the highest number of poster abstracts, while Melbourne the highest number of oral abstracts. Most popular abstract theme was oncology for both poster and oral abstracts. Publications found had in excess of 1250 citations.

One hundred and one publications from one hundred and seven conference presentations were identified, distributed across sixty journals. Conference presentation to full publication rate was 18.2%; excluding 2019 conference abstracts the rate was 21.5%.

Conclusion: Publishing research findings is a challenging process. A retrospective analysis of research presented at recent ANZSNM conferences by abstract content was undertaken, with conference presentation to full publication rate found to be at the lower end of reported literature findings.

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Introduction

In general, health and medical research underpins improvements in our quality of life and patient outcomes (1). Australians are generally living longer, with greater freedom and are healthier (2). The Australian government has invested in research since the early 1900's providing significant funding for world class research facilities such as the Commonwealth Serum Laboratories (CSL), Commonwealth Scientific and Industrial Research Organisation (CSIRO), and later, organisations such as Australian Nuclear Science and Technology Organisation (ANSTO). Alternate funding sources such as the National Health and Medical Research Council (NHMRC) also provide important support for medical research. Most recently, the government has endorsed value in medical imaging research with major funding dedicated to dementia, magnetic resonance imaging, breast cancer, prostate cancer and head and neck cancer (3, 4). The importance of medical research cannot be underestimated, with reports that investment in research can lead to economic health benefits. Each dollar invested in Australian medical research can result in as much as a \$3.90 return in health benefits (5). Furthermore, collaborative research, particularly with other countries is considered "a critical way to foster and maintain their global innovation competitiveness" (6). This is also supported by government initiatives, with funding models and frameworks designed to foster international research collaborations (7, 8). A Victorian government directive for developing research led by allied health professionals was published in 2018 (9). The aim of this government initiative was to embed a stronger research culture across allied health. It also seeks to develop a sustainable framework for research to become a permanent part of the professional responsibility of allied health practitioners. Defining a research culture is complex, with differing needs at an organisational, team or individual level (10, 11). Measuring changes in research culture can use traditional metrics such as publications or conference presentations, but other aspects of culture shift are not easily quantifiable (12). Research underpins evidence-based practice and can improve health care delivery (13). Through research, evidence is collated to challenge and address gaps in current practices. Translation of research findings leads to improved processes and quality of care for patients (14, 15). Reporting outcomes can have significant impact upon healthcare locally, nationally and internationally (16). These principles support our core business to provide high quality healthcare in Australia .

There are many forums for reporting and communicating health research. Frequently, preliminary research data presented at conferences is planned for publication in peer reviewed scientific journals (17). Conference presentations bring scientific knowledge, feedback and provide opportunities for new ideas and collaborations, however may limit depth of knowledge transfer (18, 19). Expansion of conference presentation to publication of research data can bridge the gap of knowledge transfer (16). There are factors however, limiting publication of research including lack of time, resources, publishing not a priority nor aim or research considered of low value in the hierarchy of evidence-based medicine (20,21).

A scope of the literature identified significant variation in the number of conference abstracts converted to publication with Bydder et al in 2004 reporting a range from 17-78% for different medical specialties (22). For Royal Australian and New Zealand College of Radiologists (RANCR) conferences (between 1996 and 1999) the abstract to publication rate was 29% for radiology and 41% for radiation oncology (22).

In the 2019 Autumn edition of the gamma Gazette (Issue 26), Dr Roslyn Francis referred to celebrating fifty years of the foundation of the Australian and New Zealand Society of Nuclear Medicine (ANZSNM) and called for a historical snapshot (23). It seemed fitting to undertake an analysis of the research landscape in nuclear medicine through review of published abstracts of recent ANZSNM conferences. Please note, this is not a comprehensive literature search of all research recently reported in nuclear medicine, but rather investigates nuclear medicine research in the Australian context presented at recent ANZSNM conferences. This will show which health networks are engaging in a consistent level of research output reported at this conference. It should be noted, not all Australian institutions conducting research choose to present research data at this conference. For those seeking to strengthen their own institution's research capacity and translate research into better health outcomes, identified research leaders' initiatives could be used as a model of best practice .

While a number of studies have assessed the abstract to publication rates in radiology and ultrasound, including both national (Canada, France and Turkey)(24-27), and international conference data (28-31), to the author's knowledge, no research of nuclear medicine abstract to publication rates has been published. The aims of this study were to: 1) discover location (by city) contributors to poster and oral presentations at recent ANZSNM conferences; 2)

determine the nuclear medicine themes most commonly explored; 3) establish institutions producing the highest number of poster and oral abstracts in this context and 4) determine publication rates of conference abstracts to full papers from recent ANZSNM conferences.

Methods

A retrospective analysis of abstracts published in the Internal Medicine Journal Special Issues 2014 – 2019 identified 614 abstracts available for analysis (32-36). Conference presenters were from a variety of professions embedded in nuclear medicine such as technologists, nurses, medical physicists, radiochemists, radiopharmacists and nuclear medicine physicians or trainees. Countries represented were Australia, New Zealand, United Kingdom, India, Belgium, Poland, Taiwan, Singapore, Saudi Arabia, United States of America, Austria, Russia, Thailand, China,

Bangladesh, Iran and the Netherlands. Note: In 2018, the World Federation of Nuclear Medicine Biology (WFNMB, Melbourne) was held concurrently with the annual ANZSNM so this data was excluded. A brief summary of this data appeared in the winter issue 2018 of the Gamma Gazette (Issue 24). All invited plenary speaker abstracts were excluded. Descriptive statistics were used in data analysis .

Conference abstracts were primarily analysed according to the following criteria: poster or oral presentation, author/s, city location, hospital and subject matter. Themes defined by the ANZSNM Conference Committee for abstract submission were: cardiology, oncology, neurology, therapy, renal/urology, gastrointestinal, paediatrics, musculoskeletal, infection/inflammation, technology, physics, radiation safety, radiopharmacy/radiochemistry, education, or general. Host cities are listed in Table 1 .

Table 1. Total number of oral and poster conference abstracts in listed conference city per year

Location	Year	Oral abs.	Poster abs.	Total
Adelaide	2014	50	62	112
Brisbane	2015	61	82	143
Rotorua	2016	61	64	125
Hobart	2017	60	69	129
Adelaide	2019	43	62	105
Total		275	339	614
Average		55.0	67.8	122.8

Conference abstracts were further investigated to determine the abstract to publication ratio and whether research was collaborative. Inclusion criteria to be met for peer reviewed journal publication were: presence of abstract author/s and/or research institute, date of publication, comparable data and/or methodology, conclusion analogous with conference abstract.

Results

Results of the study were as follows: in each year examined, number of posters exceeded number of oral abstracts (Table 1). Sydney consistently presented the highest number of posters submitted at each conference over five years examined (Table 2). Melbourne has cumulatively submitted more abstracts than any other city .

Case study abstracts identified during the years 2015 to 2017 comprised 25-30% of all submitted abstracts.

Table 2. Number of oral and poster conference abstracts in listed city per year

Year	Adelaide		Brisbane		Melbourne		Perth		Sydney		New Zealand	
	Oral	Poster	Oral	Poster	Oral	Poster	Oral	Poster	Oral	Poster	Oral	poster
2014	10	12	0	1	15	13	2	8	18	19	0	0
2015	4	3	2	11	16	17	3	8	20	28	2	0
2016	5	7	2	2	16	13	10	9	15	20	7	2
2017	6	13	6	4	22	9	3	5	11	28	3	0
2019	12	8	5	9	11	15	0	4	10	23	0	1
Total	37	43	15	27	80	67	18	34	74	118	12	3

A further review of institutional contributors at recent ANZSNM conferences identified Austin Health to have submitted approximately twice as many conference abstracts compared with other institutes (data not shown). Other significant contributors to these programs included: Royal

North Shore, Royal Adelaide, Sir Charles Gairdner and Royal Brisbane Hospitals (Table 3). Over the 5 years examined, an overwhelming average of 93% abstracts came from major metropolitan areas.

Table 3. Top 10 highest abstract contributors to ANZSNM conferences by institution and their publication output between 2014 & 2019

Institution	Oral abst.	Poster abst.	Total	Pubs
Austin Health	40	38	78	23
Royal North Shore	10	27	37	7
Royal Adelaide	11	23	34	4
Sir Charles Gairdner	9	23	32	6
Royal Brisbane	12	17	29	1
Westmead	9	15	24	3
Liverpool Hospital	10	14	24	4
Bankstown Hospital	2	17	19	1
VCCC (Peter MacCallum Cancer Instit.)	15	4	19	9
ANSTO	13	2	15	8

A basic analysis of abstract themes found oncology was the most common theme for both poster and oral abstracts shown in Figures 1 and 2. This theme comprised between 21 and 24% of

all conference abstract content. Other themes commonly represented were radiopharmaceutical sciences and technology.

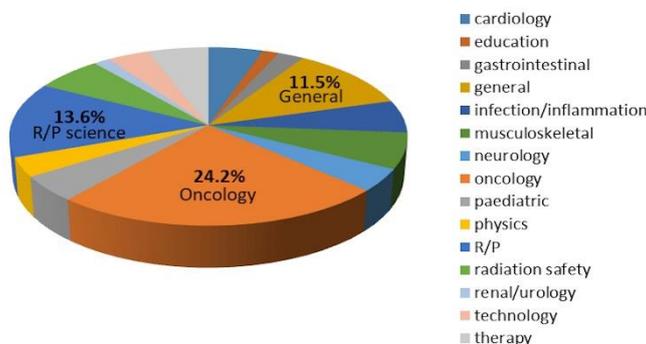


Figure 1. Distribution of themes for poster abstracts ANZSNM 2014 - 2019

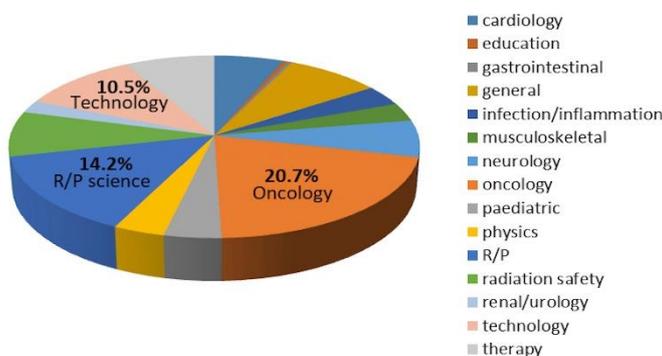


Figure 2. Distribution of themes for oral abstracts ANZSNM 2014 - 2019

A retrospective analysis of 555 conference abstracts (excluding New Zealand and International, 59 abstracts) using Google Scholar, Pubmed and Google databases was undertaken. Abstract titles, key words, institutions and/or authors' names were used to find peer-reviewed papers. Identified papers were authenticated through either open access, publicly available author information or Monash University's library access. Published paper citations were recorded (up to 1st July 2019).

One hundred and one publications from one hundred and seven conference presentations were discovered via this methodology and distributed across sixty journals (data not shown). Twelve oral or poster presentations reporting similar research data contributed to six publications. Conference presentation to full publication rate (2014 – 2019) was 18.2%. Repeat analysis excluding 2019 conference abstracts resulted in a rate of 21.5%.

Discussion

Notably, Sydney and Melbourne led abstract submissions in the poster and oral categories. Given Sydney has a greater number of health services and research institutes submitting abstracts compared with all other cities examined, this was not unexpected. Melbourne, however, submitted more oral abstracts than any other city. It could be concluded, Melbourne representatives when preparing for conferences, present their work as an oral presentation. Whether this can be attributed to departmental directors' initiatives, educational influences or staff preferences is difficult to determine. In 2017, Melbourne submitted 22 oral abstracts, more than doubling any other city (Table 2). This is more unusual given the conference was not held in Melbourne that year.

When cities host the conference, abstract submission rates were generally higher than for other years. For example, when Adelaide hosted the 2014 and 2019 conferences, the total conference abstract rate (posters and oral presentations) was 19.6% and 19.0% respectively (Table 2). For all other years the average abstract rate was 9.7%. Similarly, when the 2016 conference was held in Rotorua, the New Zealand conference abstract rate was 7.2%. For other years, the average rate over the remaining 4 years was 1.2%. Conversely, when Hobart hosted the 2017 conference, no change was observed. Brisbane's conference abstract rate for the 2015 Brisbane conference was 9.1%. However, when the conference was held in Adelaide (2019), Brisbane's conference abstract submission rate was highest (13.9%). In general, cost reduction for conference attendance when in the host city may

provide greater incentive for staff to present research findings. Approximately one third of all conference abstracts submitted between the years examined were found to be collaborative in nature. The majority (68%) of collaborations were developed within their own or between local institutions (state-wide). It was found 7% were national collaborations and 25% were international partnerships, suggesting a supportive environment for building research capacity. In 2018, it was reported Australia is recognised for high quality research. With only 0.3% of the world's population, Australian researchers contributed to 4% of world research publications (37). This demonstrates Australia is well placed for collaborative research. It has been described collaborations with international research institutions can bring economic, educational and greater impact and visibility (38). An extensive review of institutional contributors at recent ANZSNM conferences identified Austin Health as a major contributor. In comparison with other attending institutions Austin Health had more than double the number of abstracts accepted during the examined time period with an overall rate of 12.7%. Their strong record may be attributable to a number of causes. This could be the subject of further research as identified key factors could then be adopted by other institutions.

Of note, since 2014, approximately 75 institutions around Australia had presented some work at least once. With institutional support, these seeds of research have potential to grow as the value of medical imaging research is acknowledged and implemented, leading to a stronger research output.

In the themed analysis of abstracts examined over five years, it was not surprising oncology and radiopharmacy/radiochemistry was most prominent, given the importance Positron Emission Tomography (PET) now plays in oncology. With progression towards personalised medicine, there is need for development of novel radiopharmaceuticals targeting specific pathways. PET also plays a significant role in clinical trial assessment of metabolic tumour response to new treatments. This is evidenced in the "Image of the Year" awarded in 2018 by the Society of Nuclear Medicine and Molecular Imaging to Professor Michael Hofmann and the Victorian Comprehensive Cancer Centre (VCCC) team for their work in "PSMA PET Imaging of Theranostic for Advanced Prostate Cancer (39).

Of note, education, urology and gastrointestinal tract themes were less prominent at recent conferences. An emerging theme for potential future growth is the technology sector, as new developments in artificial intelligence, imaging

processing, software and imaging systems continues.

While many health services and research institutes across Australia have participated in sharing research activities, has this resulted in scientific papers?

Using databases described in the methods section, 101 publications were found. A recent systematic review by Foster et al reported research presentations were less than 50% likely to be submitted for publication following a conference (40). Conference data presented from government agencies was likely included in reports or documents, however this was difficult to confirm, thus not included in the total number of publications.

Furthermore, publications found in this analysis exceeded 1250 citations, with the most highly cited article from Nature Communications surpassing 130 citations. This was a paper from 2014 entitled "Positron emission tomography and functional characterization of a complete PBR/TSPO knockout" describing the role of peripheral benzodiazepine receptor (PBR) or translocator protein (TPSO) and its cellular functions (41). This journal had the highest impact factor (IF) of sixty journals reviewed (IF 19.819). Authors most frequently published full papers in the European Journal of Nuclear Medicine and Molecular Imaging, Clinical Nuclear Medicine and the Journal of Nuclear Medicine. From this analysis, approximately 55% were published in non-nuclear medicine themed journals. Conference presentation to full publication rate was 18.2% for years 2014 to 2019 inclusive (excluding 2018). The identified rate was low in comparison with literature findings of 29 – 51.8% and one paper reporting a lower range of 11 – 47% (18,28,30,42).

It might not be unexpected given reported literature findings were often completed approximately three to four years post conference. It has been noted the majority of publications derived from conference presentations occur within five years (18). This study was completed only two months following the 2019 conference, so it is likely more publications are in progress. This may account for the lower rate observed. Notably, three 2019 publications were found from research presented at this year's conference.

It has been reported it takes, on average sixteen months for conference abstracts to be published as full papers (22). Given this, a repeat analysis excluding 2019 conference abstracts resulted in a rate of 21.5%. This is a more representative figure of ANZSNM abstract to conference rate. Given ANZSNM conference abstracts were submitted by

nurses, technologists, chemists, biologists, physicists and medical practitioners, this result falls within literature findings, though at the lower end.

Variation of abstract to publication rates observed might be attributable to factors such as timing of research relative to conference completion as addressed by the exclusion of 2019 conference abstracts, however this is beyond the scope of this paper. Understanding the contributing factors could be the subject of further research. Rison et al has stated case reports are cited less often (43). Sun has reported case studies are considered at the lowest end of the hierarchy of evidence-based medicine with some journals no longer publishing case reports (21). Given between 25 – 30% of presentations at ANZSNM conferences studied, this may contribute to a lower publication rate. Another contributing factor may be journals have low acceptance rates for publication. For example, it was reported in 2015 the acceptance rate of manuscripts for Radiology was 15% (44). It has also been described positive study titles and conclusions are more frequently cited and likely to be published in diagnostic imaging literature (45, 46). This can impact decision making in submitting research for publication.

A comparative study in three to five years would be valuable in charting changes observed in number of institutions presenting, abstract number, format (poster or oral presentation) and research themes registered for ANZSNM conferences and an updated insight to the conference abstract to full paper conversion rate. Limitations of this research include subjective analysis of themes by one researcher. In most instances, abstracts could have been allocated to more than one theme. Interpretation of subject matter may vary depending upon opinion of the individual.

It was found during the period of analysis several cities did not host the ANZSNM annual meetings, while Adelaide convened two conferences. This may have skewed results in Adelaide's favour. The findings described here only represent a snapshot of Nuclear Medicine research conducted in Australia and New Zealand. All Australian abstracts were included for analysis. This may account for the lower publication rate. Authors may consider quality of research insufficient for publication in peer reviewed journals (46). Contributing authors also have a range of publication expertise so may lack confidence, support or skills to translate their research to publication (11). This reduces the likelihood of abstract conversion to full paper, although this is speculative. Databases selected

may have had limited ability to detect some full papers, papers in preparation or those recently submitted and in the review process.

Conclusion

Publishing research findings is a challenging process. A retrospective analysis of research presented at recent ANZSNM conferences by abstract content was undertaken, with conference presentation to full publication rate found to be at the lower end of reported literature findings. These results provide a baseline for the expectation of publishing research presented at Australian nuclear medicine conferences. Further studies evaluating contributing factors for publishing research presented at conferences could identify limitations and lead to an improvement of publishing outputs. This also provides the opportunity to investigate a comparative rate for other medical imaging specialties. Repeat examination in three to five years for assessment of conference presentation to publication rates would be valuable. This could gauge impact of government initiatives such as changes in funding opportunities in medical research or observations in institutions' research culture.

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