

## International collaboration in medical radiation science

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### Abstract

**Introduction:** International collaboration is recognised for enhancing the ability to approach complex problems from a variety of perspectives, increasing development of a wider range of research skills and techniques and improving publication and acceptance rates. The aim of this paper is to describe the current status of international collaboration in medical radiation science and compare this to other allied health occupations. **Methods:** This study utilised a content analysis approach where co-authorship of a journal article was used as a proxy for research collaboration and the papers were assigned to countries based on the corporate address given in the by-line of the publication. A convenience sample method was employed and articles published in the professional medical radiation science journals in the countries represented within our research team – Australia, the United Kingdom (UK) and the United States of America (USA) were sampled. Physiotherapy, speech pathology, occupational therapy and nursing were chosen for comparison. **Results:** Rates of international collaboration in medical radiation science journals from Australia, the UK and the USA have steadily increased over the 3-year period sampled. Medical radiation science demonstrated lower average rates of international collaboration than the other allied health occupations sampled. The average rate of international collaboration in nursing was far below that of the allied health occupations sampled. Overall, the UK had the highest average rate of international collaboration, followed by Australia and the USA, the lowest. **Conclusion:** Overall, medical radiation science is lagging in international collaboration in comparison to other allied health fields.

### Introduction

If medical radiation sciences is to evolve as an evidence-based profession, we must increase research productivity and publication in our field. Research collaboration has been shown to increase both research quality and output. The importance of research collaboration has been recognised and strongly supported by research organisations and policy makers alike<sup>1</sup> and there has been a marked rise in international collaboration in numerous industries over the last three decades.<sup>2</sup> International collaboration is recognised for enhancing the ability to approach complex problems from a variety of perspectives, increasing development of a wider range of research skills and techniques, and improving publication and acceptance rates.<sup>3</sup> These benefits could be leveraged

to increase research capacity in medical radiation science and support the further development of our professional knowledge base. The aim of this paper is to describe the current status of international collaboration in medical radiation science and compare this to other allied health occupations.

### Background

Collaboration has been defined as individuals working together to reach a common goal. Individuals may be identified as research collaborators if they: (1) work on the same project, (2) aid in the research proposal, and/or (3) make decisions regarding the plans for the research project.<sup>4</sup> Kimiloglu et al.<sup>3</sup> studied the most crucial requirements for collaborative research. They determined

that for collaboration to be effective, each researcher should be allocated clearly defined tasks, prior to conducting research (i.e. all members agreeing how responsibilities will be shared) and collaborators should willingly share their knowledge, experience and resources with all group members. As interest has grown over the years, researchers have attempted to define international collaboration. Melin and Persson<sup>5</sup> defined international collaboration as 'collaboration with one or more institution(s) in other countries excluding all other national institutions.' With the recent intensification of collaboration, specific groups and countries have been more engaged in the trend than others. Additionally, some fields are more international than others.<sup>6</sup>

The rate of international collaboration has grown significantly over the last 35 years. There are a variety of reasons countries and fields become involved with international collaborations, ranging from sharing expensive research equipment to using unique country-specific data. Wagner and Leydesdorff<sup>7</sup> identified several internal and external factors contributing to this growth. Researchers in some countries may seek to improve a lagging research capacity in a field by cooperating with leading researchers in other countries. International collaboration may also allow researchers to partner with others with their own specialised focus who are not available in geographic proximity. Externally, increased financial support for international collaboration from nations and sponsors may have played a role in the increase, and the growth of Internet-based communication systems has certainly facilitated effective international collaboration. Historical ties and geographic proximity seem to play a decreasing role in the promotion of international collaboration, but may arise more from geographic funding such as that provided by the European Commission, than from a preference for co-location. Interactions may also be facilitated or discouraged by language, culture and political climate.<sup>5</sup> While we know that international scientific collaboration is on the rise, little is known about international collaboration within the medical radiation sciences community or how it compares to other health professions.

## Method

This study utilised a content analysis approach where co-authorship of a journal article was used as a proxy for research collaboration, and the papers were assigned to countries based on the corporate address given in the by-line of the publication. This method of analysis is well established and accepted across studies of research activity.<sup>8</sup> The content analysis focused on the major

professional journals published in the countries represented within our research team – Australia, the United Kingdom (UK) and the United States of America (USA). For medical radiation sciences, the three journals chosen for analysis were *Journal of Medical Radiation Sciences* the joint journal of Australia and New Zealand (AUS/NZ) (previously *The Radiographer*), *Radiography* from the UK and *Radiologic Technology* from the USA. A convenience sample method was employed and articles published in the three major medical radiation science journals over a 3-year period from 2012 to 2014 were inspected manually for author and author affiliation. Allied Health Professions Australia defines allied health professionals as a subset of healthcare professionals that do not include those of medicine, nursing or dentistry.<sup>9</sup> Physiotherapy, speech pathology and occupational therapy were chosen as comparisons for medical radiation science for international collaboration as all these occupations are included as allied health professionals. Nursing was also selected for comparison as this is a longer established health profession with a longer history of academic research. The journals chosen for comparison to the medical radiation science journals are detailed in Table 1. The content analysis on the frequency of international co-authorship was performed on all of these journals.

International collaboration was determined by author's affiliation. Only articles where all authors did not share a country affiliation were counted as representing international collaboration in the study. Letters to the editor, corrigenda or errata, newsletters and conference papers were excluded to limit the study to only original published articles.

In total, 4057 articles from the five different occupations were examined for international authorship. Table 1 presents the breakdown of publications by professional field, publication country of origin, and publication year. To determine the rate of international collaboration, the number of articles having authors from two or more countries was divided by the total number of articles reviewed. While rates of publication vary by country and field, by examining the number of internationally collaborative articles as a percentage of the total articles published within that journal, we correct for variances introduced by fields and countries with differing publication rates and health occupation populations.

## Results

The data was analysed using Minitab 17 Statistical Software. Rates of international collaboration across the health professions have increased over the past 3 years.

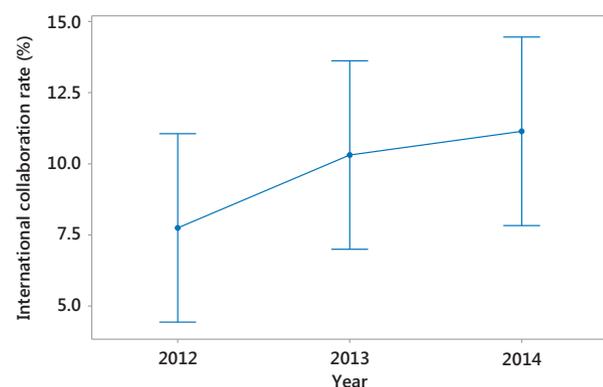
**Table 1.** Details of journals sampled.

	2012			2013			2014		
	Pub	IC	Rate	Pub	IC	Rate	Pub	IC	Rate
Journal of Medical Radiation Sciences (AUS/NZ)	16	0	0.0%	21	3	14.3%	27	3	11.1%
Radiography (UK)	63	7	11.1%	72	4	5.6%	68	11	16.2%
Radiologic Technology (USA)	89	2	2.2%	72	4	5.6%	68	5	7.4%
Medical Radiation Science	168	9	5.4%	165	11	6.7%	163	19	11.7%
Australian Occupational Therapy Journal (AUS)	67	7	10.4%	56	8	14.3%	68	8	11.8%
British Journal of Occupational Therapy (UK)	90	10	11.1%	85	10	11.8%	92	13	14.1%
American Journal of Occupational Therapy (USA)	103	12	11.7%	94	14	14.9%	34	3	8.8%
Occupational Therapy	260	29	11.2%	235	32	13.6%	194	24	12.4%
Journal of Physiotherapy (AUS)	68	4	5.9%	74	5	6.8%	79	6	7.6%
Physiotherapy (UK)	50	2	4.0%	55	7	12.7%	53	10	18.9%
Physical Therapy (USA)	137	18	13.1%	159	24	15.1%	152	28	18.4%
Physiotherapy	255	24	9.4%	288	36	12.5%	284	44	15.5%
International Journal of Speech-Language Pathology (AUS)	61	8	13.1%	69	12	17.4%	67	15	22.4%
International Journal of Language and Communication Disorders (UK)	62	12	19.4%	58	11	19.0%	58	13	22.4%
American Journal of Speech-Language Pathology (USA)	48	3	6.3%	52	5	9.6%	59	2	3.4%
Speech Pathology	171	23	13.5%	179	28	15.6%	184	30	16.3%
Australian Journal of Advanced Nursing (AUS)	27	2	7.4%	23	1	4.3%	20	0	0.0%
British Journal of Nursing (UK)	292	11	3.8%	291	8	2.7%	283	13	4.6%
American Journal of Nursing (USA)	196	1	0.5%	201	1	0.5%	178	4	2.2%
Nursing	515	14	2.7%	515	10	1.9%	481	17	3.5%
All Journals Combined	1369	99	7.2%	1382	117	8.5%	1306	134	10.3%

Journals listed by occupation and year of publication. Number of articles published (Pub), number of articles with international collaboration (IC) and the percentage of articles with international collaboration (Rate).

When all the professions were combined, the rates of international collaboration steadily rose over the 3-year period from 7.2% to 10.3% (see Fig. 1).

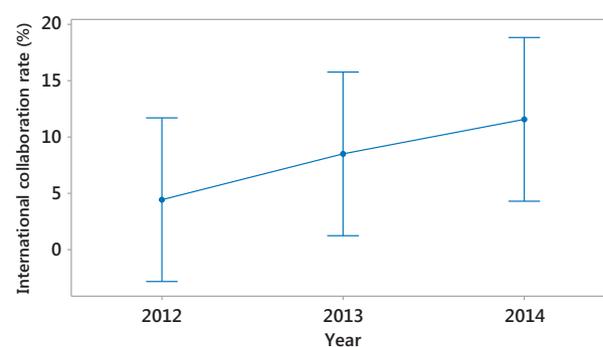
Likewise, rates of international collaboration in medical radiation science journals from AUS/NZ, the UK and the USA have steadily increased over the 3-year period sampled



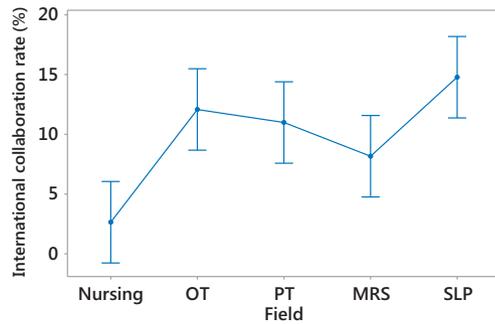
**Figure 1.** Interval plot of international collaboration rate for all health occupations sampled by year. This figure demonstrates the overall change in international collaboration seen across the allied health occupations over the 3-year period studied. 95% confidence interval for the mean. The pooled standard deviations were used to calculate the intervals.

from 2012 to 2014 (see Fig. 2). Overall, the journal published in the UK had the highest average rate of international collaboration (11.0%), the USA the lowest (5.1%) with AUS/NZ demonstrating an average of 8.5%.

Using one-way analysis of variance (ANOVA) analysis, the mean rate of international collaboration was



**Figure 2.** Interval plot of international collaboration rate for medical radiation sciences by year. This figure illustrates the changes seen in international collaboration rate within the medical radiation sciences over the 3-year period studied. 95% confidence interval for the mean. The pooled standard deviations were used to calculate the intervals.



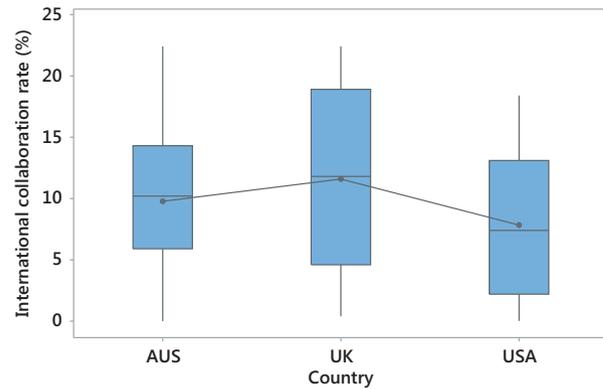
**Figure 3.** Interval plot of international collaboration rate by health occupations sampled. This figure compares rates of international collaboration for the fields of Nursing, Occupational Therapy (OT), Physiotherapy (PT), Medical Radiation Sciences (MRS), and Speech Language Pathology (SLP). 95% confidence interval for the mean. The pooled standard deviations were used to calculate the intervals.

compared across the selected health fields. This analysis employed the null hypothesis that all means are equal and the alternative hypothesis that at least one mean is different. A significance level of  $\alpha = 0.05$  was used. Equal variances were assumed for the analysis. In the same 3-year period, the mean international collaboration rate for nursing was significantly lower than that for speech pathology, occupational therapy and physiotherapy. Medical radiation science demonstrated lower average rates of international collaboration (7.9%) than the other allied health occupations sampled, but there was not a statistically significant difference in the means between medical radiation science and any of the other fields. Speech pathology had the highest average rate with 15.1%, followed by physiotherapy (12.5%) and occupational therapy (12.4%). The average rate of international collaboration in nursing of 2.7% was far below that of the allied health occupations sampled (see Fig. 3).

The same trends as those seen in the medical radiation science journals by country of publication continued when all the professions were combined. While the differences in the means were not significantly different, those published in the UK had the highest average rate of international collaboration of 11.8%, followed by Australia (9.8%), then the USA (8.0%) (see Fig. 4).

## Discussion

The increase in the rate of international collaboration in medical radiation science is to be expected as it mirrors the trends in numerous other branches of science over recent years.<sup>2,10,11</sup> The increase is closely aligned with the increase of globalisation and improved IT communication facilities so to see a decrease in international collaboration would defy the global trend.



**Figure 4.** Boxplot of international collaboration rate for all allied health occupations by country of publication. This figure illustrates the differences and overlap between international collaboration rates by country of publication Australia (AUS), the United Kingdom (UK) and the United States of America (USA).

However, the medical radiation science community is lagging in developing international collaborations in comparison to other allied health fields. While the differences are not currently significant, we should act to remedy the situation before the gap widens. Analysis of strategies employed by other health professions can be instructive for improving international collaboration in medical radiation sciences. Initiatives developed within the European medical radiation sciences community may account for the increased rate of international collaboration growth in the UK in comparison to Australia and the USA.

The USA is the third largest country by area,<sup>12</sup> the third most populated in the world<sup>13</sup> and has over 50 jurisdictions.<sup>14</sup> A country with the diversity of the USA would allow ample opportunity to collaborate on research projects without the need to seek co-researchers from overseas, which may contribute to the lower rates of international collaboration found in journals from that country. Historically, the USA is a very nationalistic country<sup>15</sup>, which may be another possible explanation for their lower rates of international collaboration. These possible explanations are a topic for possible further research.

There are several possible explanations why the UK has a higher average rate of international collaboration. Time zone differences are a significant barrier to international collaboration<sup>16</sup> and the UK's geographical location with its proximity to numerous other countries with comparable time zones lessens this burden. The European Union has also developed programmes to promote international collaboration like the European Institute of Innovation and Technology, the European Higher Education Area and the Erasmus Mundus Programme.<sup>17</sup>

The greatest increase in the rate of international collaboration in medical radiation science journals sampled was in the UK journal *Radiography* from 2013 to 2014 increasing from 5.6% to 16.2%, the highest rate in the medical radiation science journals sampled, close to the rates of other allied health occupations. This increase coincided with the first offering of the annual 'Optimisation of image quality and X-radiation dose in medical imaging' (OPTIMAX) residential summer school held at the University of Salford in Manchester, England.<sup>18</sup>

Due to the increasing emphasis on collaboration and raising the profile of research in the medical radiation science profession,<sup>19,20</sup> the OPTIMAX summer school programme was initiated. The programme is open to BSc, MSc and PhD students from the disciplines of radiography, nuclear medicine, biomedical science and physics, and is funded by the Erasmus Mundus Programme. The programme strives to develop team-based radiography research on an international level by enabling students to experience international collaboration first-hand and develop multinational/cultural partnerships early in their careers.<sup>18, 21</sup>

The Universities and professional associations can play a large part in raising the profile of research in the medical radiation sciences throughout the world by promoting international collaboration within the profession. Universities can follow the lead taken by those who formed the OPTIMAX summer school programme, while medical radiation science professional associations can encourage collaboration with similar associations as has been done in physiotherapy<sup>22</sup> and occupational therapy<sup>23</sup>, which may contribute to those professions' higher rate of international collaboration.

## Limitations

This study focused on internationally collaborative articles, published in the most widely accepted professional journals in only three countries studied, as these are the most likely to impact practice in the allied health fields of those countries. This could have resulted in missing some significant collaborations with medical radiation science professionals published in less specific journals. However, it is the evidence informing professional practice that we most hoped to capture.

## Conclusion

Overall, medical radiation science is lagging in international collaboration in comparison to other allied health fields in their respective journals, although the mean international collaboration rate for the medical radiation sciences journal in the UK is quite competitive

with physiotherapy and occupational therapy. The medical radiation science community needs to examine the strategies for encouraging international collaboration if goals of increasing research capacity in the profession and developing a more robust professional knowledge base are to be realised.

## Conflict of Interest

The authors declare no conflict of interest.

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