Title: Social media in Interventional Radiology

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/1754-9485.13142

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Declaration
Funding: No funding was received for this study.
Conflict of Interest: The authors have no relevant conflicts of interest to declare.
Ethical approval: In compliance with the “National Statement on Ethical Conduct in Human Research (2007) – Updated 2015” by the National Health and Medical Research Council, this study is exempt from ethical review as it is a negligible risk study that involves the use of existing, publicly available data, presented in a non-identifiable format.

Abstract

Introduction: Social media provides opportunities for Interventional Radiologists to share research, communicate with colleagues, provide health information and advertise their clinical practice. This study aims to examine the online and social media presence of currently practicing Australian Interventional Radiologists.

Methods: Systematic Google searches were undertaken in May 2019 and updated in May 2020 to identify practicing Interventional Radiologists in Australia. Comprehensive searches of practice websites and social media platforms (Facebook, LinkedIn, Twitter, ResearchGate, YouTube) were undertaken for each Interventional Radiologist.
Results: There were 265 Interventional Radiologists identified as currently practicing in Australia, including 209 Interventional Radiologists (excluding Interventional Neuroradiologists), 49 Interventional Neuroradiologists and 7 that practice across both Interventional Radiology and Interventional Neuroradiology. 72% of Interventional Radiologists had at least one social media account, with LinkedIn the most widely used social media platform (60%). There was a significant negative correlation between the total number of social media accounts and years in practice \( p=0.04 \). Across the states, a higher population per IR was positively correlated with a higher average number of social media accounts per IR \( p=0.04 \). Interventional Neuroradiologists had a significantly higher average number of social media accounts compared to Interventional Radiologists \( 1.94 \text{ vs } 1.29, p<0.01 \).

Conclusions: Most Australian Interventional Radiologists have a readily identifiable social media presence. There is potential for further utilization of social media for academic, educational and business purposes.

Five key words
Interventional radiology, social media

Text

Introduction
Social media has overhauled online communication by enabling instantaneous sharing with large audiences. Social media comprises several online mediums where users contribute and explore content primarily generated by fellow users, such as Facebook, Twitter, ResearchGate, YouTube and LinkedIn.

The ability to rapidly disseminate information provides a platform to share research, communicate with colleagues and champion online campaigns – all of which have the potential to improve health outcomes and awareness of a particular medical specialty. Radiologists work in a rapidly evolving technological landscape and are thus well placed to use social media to engage with patients and establish relevant online
Social media can significantly augment the reach of radiology research beyond traditional publication avenues.\textsuperscript{3}

Social media may also be used by Interventional Radiologists (IRs) to share novel procedural techniques, improve public knowledge regarding procedures and advertise their clinical practice.\textsuperscript{4-7} Radiology conferences and journals have described a rapid increase in the uptake of social media, with some academic radiology departments using social media as a platform for radiology education.\textsuperscript{8-11} An increasing use of social media among surgical disciplines both nationally and internationally has been reported, however similar research examining the use of social media among Australian IRs has not previously been published.\textsuperscript{12-14} This study aims to examine the online and social media presence of currently practicing Australian IRs, including Interventional Neuroradiologists (INRs).

**Methods**

A list of IRs was generated using a systematic Google search of the terms ‘interventional radiologist’ and ‘interventional neuroradiologist’ combined with each state, territory and major city in Australia. IRs were defined as Radiologists who have completed an interventional radiology subspecialty fellowship and are competent at performing both basic (Tier A) and advanced (Tier B) procedures as defined by the Royal Australian and New Zealand College of Radiologists (RANZCR)\textsuperscript{15} and Interventional Radiology Society of Australasia (IRSA).\textsuperscript{16} Many IRs also hold the European Board of Interventional Radiology (EBIR) qualification. INRs were defined as Radiologists who have completed an interventional neuroradiology subspecialty fellowship and obtained Conjoint Committee for Recognition of Training in Interventional Neuroradiology (CCINR) qualification. The search was performed in May 2020. Search results including practice websites, hospital websites and individual social media accounts available to the public. This information was cross-referenced against publicly available registry data from the Australian Health Practitioner Regulation Agency (AHPRA), CCINR and EBIR databases.

Demographic data including gender, state of practice and years of practice (defined as the number of years since receiving a medical degree) was collected. IRs were classified as IRs or INRs. IRs were only included if they were working in Australia,
defined as having a publicly published site of practice in Australia, and an active
AHPRA registration.

Website analysis
After obtaining a list of IRs practicing in Australia, a Google search was performed
by using the radiologist’s name and the term ‘interventional radiologist.’ This
identified whether each radiologist had a private practice website. Each website was
also assessed for any links to social media accounts.

Social Media Analysis
Accounts of IRs on Facebook, Twitter, LinkedIn, ResearchGate and YouTube were
individually searched for using the radiologist’s name and the term ‘interventional
radiologist.’ A profile was deemed as belonging to an IR only if the name fully
matched and the profile was self-identified as belonging to the IR, or if there was a
photo of the IR that could be clearly verified against that shown on their private
practice website. Once an IR was identified, their profile was assessed for links to
other Australian IRs. All social media accounts were assessed for number of
‘followers’ and people ‘followed.’ Twitter profiles were also analysed for number of
tweets. Facebook profiles were categorised as ‘public’ (open to viewing by anyone) or
‘private’ (accessible only to ‘friends’ of the IR), as well as whether the Facebook
profile was for personal or professional use, based on publicly viewable information
on the profile. The number of LinkedIn posts, groups and connections to other users
were recorded, as were the number of videos per YouTube account. ResearchGate
profiles were also analysed for the number of reads.

Statistical Analysis
Data was tabulated using Microsoft Excel version 16.15 (Microsoft, Redmond, WA,
USA) and statistical analysis was performed using SPSS version 23 (IBM, New York,
NY, USA). P<0.05 was considered to indicate statistical significance. Pearson’s
correlation coefficient and independent t-tests were used to compare social media use
with state of practice, gender, speciality (IR and INR), years of practice and use of
other social media platforms.

Results

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As of May 2020, 265 IRs were identified as currently practicing in Australia (247 males, 18 females), this included 209 IRs, 49 INRs and 7 that practice across both IR and INR. The Northern Territory was the only state or territory that did not have an IR listed, based on their primary state of practice (Table 1). Most Australian IRs are associated with a private business website [n=155, 58.5%], of which 90.3% were group practice websites [n=140] and 9.7% were single IR practice websites [n=15].

Across Australia there was one IR for every 110,780 people (Table 2). ACT had the highest number of IRs per population (1 per 40,910) and Tasmania the lowest (1 per 130,025). Across the states, higher population per IR was positively correlated with a higher average number of social media accounts per IR [p=0.04].

At least one social media account was identified for 191 IRs [72%]. LinkedIn was the most prevalent form of social media by Australian IRs [n=159, 60%] (Figure 1). Males and females had a similar number of social media accounts per IR [mean 1.43 and 1.44 respectively].

Ninety IRs [34%] had an identifiable Facebook account, of which 60 were private [69%] and 27 were public [31%]. Three business profiles were identified [3%]. Seventy-eight IRs had a ResearchGate profile [29%] with an average of 19.4 followers per account [median 16, IQR: 6-37]. Each IR was following an average of 22.2 other ResearchGate accounts [median: 17, IQR: 3-33.5]. The average number of reads on ResearchGate was 2424 [median: 986, IQR: 360-2293]. Forty-two IRs had a Twitter account [16%], with an average of 96 tweets [median: 7, IQR: 1-67], 80 followers [median: 31, IQR: 8-64] and 124 accounts being followed [median: 72, IQR: 19-134].

Ten IRs maintain a YouTube account [4%] with an average of 6.6 videos posted [median: 3, IQR: 3-8]. Seventy-four IRs did not have a social media account [28%] and 29 had neither a social media account or personal website [11%]. There was an average of 201 LinkedIn connections per IR [median: 142, IQR: 46.5-356.5]. The exact number of LinkedIn connections displayed online is limited to 500, with higher numbers of connections reported as 500+, which was recorded as 500 in this study for
the purposes of statistical analysis. Two IRs had all five forms of social media accounts.

IRs practicing medicine between 9-19 years had a significantly higher utilisation rate of Facebook \( [p=0.03] \) and Twitter \( [p=0.01] \) compared with individuals practicing for 20 years or more. In addition, there was a significant negative correlation between total number of social media accounts and years in practice \( [r=-0.129, p=0.04] \), with IRs practicing for the least amount of time having the greatest average number of social media accounts (Table 3). IRs practicing for 30-39 years were the most likely to have a ResearchGate account \( [p=0.01] \).

IRs located in New South Wales (NSW) had the most social media counts per Radiologist \( [1.6] \) and were most likely to have a LinkedIn account \( [72\% \text{ of NSW IRs}, p<0.01] \), with South Australian IRs having the lowest rates of LinkedIn accounts \( [33\%, p<0.01] \).

INRs had significantly higher average number of social media accounts \( [1.94] \) compared to IRs \( [1.29] [p<0.01] \) [Table 4], with this difference particularly pronounced when comparing rates of Twitter \( [37\% \text{ vs } 11\%] [p<0.01] \) and ResearchGate accounts \( [54\% \text{ vs } 23\%] [p<0.01] \).

**Discussion**

Social media has revolutionised communication, providing doctors with a platform to educate both patients and colleagues by promoting research, sharing procedural techniques and combating misinformation. Additionally, social media has shown to be a successful advertising medium, with patients increasingly likely to research a doctor using both social media and doctor-rating websites prior to consultation.\(^ {17, 18} \)

Nevertheless, social media is not without its risks which include clinician and patient privacy, maintenance of professionalism and accuracy of widely shared information. These have led to the formation of guidelines by regulatory bodies that govern social media use.\(^ {4, 19-24} \)

Previous studies have demonstrated a rapid rise in the uptake of social media among Radiology and surgical specialties worldwide.\(^ {25-27} \) This present study is the first to
assess the online and social media presence of IRs across an entire country. Our study demonstrates that the majority of Australian IRs are using at least one form of social media, in line with other specialties such as Australian and New Zealand urologists [70.1%), colorectal surgeons [68%), otolaryngologists [66%) and the Australian medical community in general [74.3%]. The mean number of social media accounts per IR was also comparable with other surgical specialties. The significantly higher average number of social media accounts among INRs when compared with IRs may reflect that the vast majority of INRs practice in public neuroscience units with an emphasis on research, and less commonly work exclusively in private practice. The pronounced difference in ResearchGate and Twitter accounts may reflect the directed role these formats can provide in disseminating research.

Our finding that IRs are more likely to use social media the earlier they are in their career is consistent with previous literature and may reflect the idea that younger people are more likely to use these platforms. These IRs may have also used social media for self-promotion and advertisement, both to colleagues and potential patients. However, high rates of ResearchGate utilisation for academic purposes among senior IRs was also evident.

Our study found that social media use was higher in states with a larger population per IR, with no evidence substantiating our initial theory that higher competition, as measured by a smaller population per IR, is a significant driver of social media use. This may reflect a nationwide demand for IRs, in line with the demand for Radiologists across Australia, potentially reducing the need for professional social media advertising in order to attract job opportunities or patients. Alternatively, social media use may reflect a ‘perception’ of competition, rather than actual competition, with social media use trending higher in the more populous states. The trend towards higher social media use in states with a higher population per IR could also be explained by an increased social media and research engagement among IRs that service a large patient base. Varying professional culture and training pathways between states likely also influence this trend.
IRs appear to focus their social media presence on establishing professional connections in addition to sharing and learning new knowledge, evidenced by the fact that LinkedIn was the most commonly used social media platform. LinkedIn accounts were often utilised to facilitate a high number of interprofessional connections, with the average of 201 connections per IR likely underestimating the true amount, as ‘500+’ connections were treated as 500 for statistical analysis. The rates of Twitter accounts were lower in comparison, however, Twitter has displayed rapidly growing engagement among IRs worldwide, with an abundance of various IR hashtags and the frequent discussion of popular topics such as embolisation, ablation and stent placement. Twitter provides a useful platform for prompt dissemination of interesting cases, however the cases published by IRs may be subject to publication bias and collective results should be interpreted with caution. Facebook can serve a valuable role in ‘branding’ for an IR, practice or department, in addition to serving as a valuable education mechanism through groups and pages. Despite this, a minority of IRs had Facebook accounts, and whilst this may not include all accounts with high privacy settings, this may reflect a lost opportunity for IRs in Australia. As IRs become more engaged with active patient management, including the increasing frequency of interventional radiology clinic appointments, the requirement for self-promotion in the private practice setting may continue to increase and be a driver of future social media use. Although user rates of YouTube were notably low in comparison, and Instagram use was not included in this study, the use of visual mediums is particularly valuable with Radiology. Patient images can be utilised in teaching and patient education provided appropriate consent has been obtained. The use of social media platforms for patient and collegial education purposes can complement other highly valued and collaborative online learning resources such as Radiopaedia.

There are some limitations to our study. A national register of all IRs is not publicly available in Australia and thus it is likely that not every IR or every social media account was identified. In addition, on certain social media accounts, it was not possible to discern between strong privacy settings versus inactivity of the account. Validation of professional qualifications of each practitioner was also limited, as
membership with each qualifying body, although stipulated and recommended in
standards of practice documents produced by professional bodies such as RANZCR,
is not strictly mandatory. These limitations are inherent consequences that arise from
using freely available public data, as opposed to officially verifiable data.
Nonetheless, this serves to represent the perspective of the ordinary consumer or
colleague seeking to engage with IRs. Furthermore, this source of data is not subject
to selection or recall bias.

Conclusion
Social media has become a core component of the developed world, presenting
numerous opportunities for medical professionals and, in particular, Radiologists.
This study presents a unique dataset not previously analysed in the literature,
demonstrating that the majority of Australian IRs have at least one publicly
identifiable social media account, and there is a diverse breadth of purposes available
to IRs engaging in social media. Future research may elicit the effectiveness of these
platforms in reaching target audiences and examine the attitudes and aims of IRs
using social media.

Acknowledgements
Nil.

References
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**Appendices**

Nil.

**Figure Legends**

Nil.

**Tables**

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Table 1 – Number of social media accounts by state

<table>
<thead>
<tr>
<th>State/Country</th>
<th>Average number of social media accounts</th>
<th>Total number of IR and INR</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSW</td>
<td>1.64</td>
<td>85</td>
</tr>
<tr>
<td>VIC</td>
<td>1.39</td>
<td>54</td>
</tr>
<tr>
<td>QLD</td>
<td>1.48</td>
<td>56</td>
</tr>
<tr>
<td>WA</td>
<td>1.34</td>
<td>29</td>
</tr>
<tr>
<td>SA</td>
<td>1.00</td>
<td>27</td>
</tr>
<tr>
<td>TAS</td>
<td>1.50</td>
<td>4</td>
</tr>
<tr>
<td>ACT</td>
<td>1.00</td>
<td>10</td>
</tr>
<tr>
<td>NT</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>All</td>
<td>1.43</td>
<td>265</td>
</tr>
</tbody>
</table>

Table 2 – Population density by state

<table>
<thead>
<tr>
<th>State/ Country</th>
<th>Population</th>
<th>Number of IR and INR</th>
<th>Population per IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSW</td>
<td>7,837,700</td>
<td>85</td>
<td>92,208.2</td>
</tr>
<tr>
<td>VIC</td>
<td>6,290,700</td>
<td>54</td>
<td>116,494.4</td>
</tr>
<tr>
<td>QLD</td>
<td>4,907,600</td>
<td>56</td>
<td>87,635.7</td>
</tr>
<tr>
<td>WA</td>
<td>2,576,000</td>
<td>29</td>
<td>88,827.6</td>
</tr>
<tr>
<td>SA</td>
<td>1,721,000</td>
<td>27</td>
<td>63,740.7</td>
</tr>
<tr>
<td>TAS</td>
<td>520,100</td>
<td>4</td>
<td>130,025.0</td>
</tr>
<tr>
<td>ACT</td>
<td>409,100</td>
<td>10</td>
<td>40,910.0</td>
</tr>
<tr>
<td>NT</td>
<td>245,000</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>All</td>
<td>29,356,710</td>
<td>265</td>
<td>110,780.0</td>
</tr>
</tbody>
</table>

Table 3 – Number of social media accounts by years in practice

<table>
<thead>
<tr>
<th>Years in practice</th>
<th>Average number of social media accounts</th>
<th>Total number of IR and INR</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 - 19</td>
<td>1.65</td>
<td>88</td>
</tr>
<tr>
<td>20 - 29</td>
<td>1.41</td>
<td>85</td>
</tr>
<tr>
<td>30 - 39</td>
<td>1.31</td>
<td>64</td>
</tr>
<tr>
<td>40 - 49</td>
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<tr>
<td>50 - 59</td>
<td>0.0</td>
<td>4</td>
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Table 4 – Number of social media accounts by interventional subspeciality

<table>
<thead>
<tr>
<th>Field</th>
<th>Mean social media level</th>
<th>Total number of IR and INR</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR</td>
<td>1.29</td>
<td>209</td>
<td>78.9%</td>
</tr>
<tr>
<td>INR</td>
<td>1.94</td>
<td>49</td>
<td>18.5%</td>
</tr>
<tr>
<td>Both</td>
<td>2.00</td>
<td>7</td>
<td>2.6%</td>
</tr>
</tbody>
</table>

Figures

Figure 1 – Proportion of different social media platforms
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