How does Canada stack up? A bibliometric analysis of the primary healthcare electronic medical record literature

Amanda L Terry PhD
Assistant Professor

Moira Stewart PhD
Distinguished University Professor
Centre for Studies in Family Medicine, Departments of Family Medicine, Epidemiology & Biostatistics, The University of Western Ontario, London, Ontario, Canada

Martin Fortin MD MSc CMFC (F)
Professor
Department of Family Medicine, Université de Sherbrooke, Sherbrooke, Québec, Canada

Sabrina T Wong RN PhD
Associate Professor
UBC School of Nursing and Centre for Health Services and Policy Research, University of British Columbia, Vancouver, British Columbia, Canada

Maureen Kennedy MLIS
Research Assistant
Centre for Studies in Family Medicine, Department of Family Medicine, The University of Western Ontario, London, Ontario, Canada

Fred Burge MD MSc FCFP
Professor and Research Director
Department of Family Medicine, Dalhousie University, Halifax, Nova Scotia, Canada

Richard Birtwhistle MD MSc FCFP
Professor and Director
Centre for Studies in Primary Care, Department of Family Medicine, Queen’s University, Kingston, Ontario, Canada

Inese Grava-Gubins MA
Director, Research
College of Family Physicians of Canada, Mississauga, Ontario, Canada

Greg Webster MSc
Director, Primary Health Care Information and Clinical Registries
Canadian Institute for Health Information, Toronto, Ontario, Canada

Amardeep Thind MD PhD
Professor
Centre for Studies in Family Medicine, Departments of Family Medicine, Epidemiology & Biostatistics, The University of Western Ontario, London, Ontario, Canada
Introduction

Canada has traditionally lagged behind other countries such as the United Kingdom and the Netherlands in electronic medical record (EMR) adoption in primary health care. However, the use of EMRs among Canadian primary care physicians rose from 37% in 2009 to 56% in 2012. Despite this increased adoption, only 10% of these physicians are using EMRs with ‘multifunctional’ capacity, indicating that challenges remain in how to best implement and use this technology in primary health care. Major initiatives are underway in Canada that are designed to further increase the implementation of EMRs in primary health care, and to assess the potential benefit of EMR use to patient care. However, realising these potential benefits is dependent on not just EMR acquisition, but by its comprehensive use by practitioners and integration into their practice. There is some research evidence which shows an association between EMR use and improved patient care, for example, in preventive care and the management of disease. However, the majority of these studies have been conducted outside Canada. The true potential promise of EMRs in primary health care practice will likely not be realised without knowledge of how to effectively implement this technology, and how to
maximise its use in patient care. EMR research specific to the Canadian context is a necessary building block to achieving these aims.

Responding to this situation, we conducted a study to identify gaps in research and knowledge regarding EMRs in the Canadian primary health care context. As part of the environmental scan completed for this larger study, we conducted a comprehensive search of the primary healthcare EMR literature. Subsequently, we embarked on a bibliometric analysis of this literature to understand the nature of the primary healthcare EMR literature in Canada and internationally, and to assess Canada's standing relative to other countries. Related bibliometric studies have focused on describing overall EMR publications, characterising electronic health record (EHR) research (1991–2005), and analysing studies that use the General Practice Research Database. However, to our knowledge, no other study has attempted to characterise the primary healthcare EMR literature as a whole. Therefore, the objectives of this study were to: (1) identify and describe the English language primary healthcare EMR literature, and (2) compare the Canadian and international primary healthcare EMR literature on the basis of content and publication levels.

Methods

Design and data collection

Bibliometric studies typically aim to quantify an aspect of the literature, examples in primary health care include: a description of primary care research within the context of publications in medicine, an analysis of general practice publications in Australia, the coverage of the concept of multimorbidity, and a comparison of primary care research in the UK with five other countries.

A literature search was conducted to identify relevant primary healthcare EMR publications in the following databases: Scholars Portal Arts and Humanities, Scholars Portal Social Science, Scopus, PubMed, Cumulative Index to Nursing and Allied Health Literature, EmBase, Medline and Cochrane Library databases. First, the following search terms were used: general practice, family medicine, primary care, ambulatory care, primary health care, GP [general practitioner], FP [family physician], general practitioner, family practitioner, nurse, nurse practitioner (combined with OR). Second, we searched using the following keywords: EMRs [electronic medical records], electronic health records, computerised medical record, electronic medical records, electronic patient records, computer record, computerised record, information technology and EHR [electronic health record] (combined with OR). These two strings were combined with AND. We limited the search to publications from 1999 to 2009 that were written in English, and that focused on human subjects. To be sure to identify all papers from Canadian authors, we also conducted a supplemental search for literature published in French by authors from Canada.

Analysis

Literature was excluded where there was no abstract, the subject was not focused on EMRs or primary health care, or because the publications were, for example, conference proceedings, dissertations or commentaries, i.e. not research studies. Three of us (ALT, AT, MK) and a research assistant reviewed 25 abstracts from the search and through an iterative process that involved theme identification and discussion, created 10 content categories within which the studies could be classified. This categorisation scheme was then tested within a subset of 25 additional abstracts and subsequently refined for use with the full set of citations (see Table 1 for categories). Next, working in pairs, we reviewed each citation obtained from our search. Those selected for inclusion were classified into one of the identified categories. We independently assessed the citations for inclusion and categorisation, and then met to compare and record the results. Disagreements were discussed and resolved by achieving consensus on the appropriate category or a decision was made regarding study exclusion. First author affiliation was used to identify country of origin. We compared proportions of Canadian and international abstracts within each category using Fisher's exact test. For those countries having 10 or more primary healthcare EMR publications, we identified their respective counts of full-time equivalent (FTE) researchers from the Organisation for Economic Co-operation and Development (OECD) Main Science and Technology Indicators database. Using this information, we calculated a rate of publications per 10 000 FTE researchers to estimate each country's relative contribution. This approach has been used in a previous bibliometric study. In addition, we describe each country's current level of EMR adoption.

Results

Overall, we identified 3199 abstracts from our search after duplicates were removed. A further 2449 abstracts were excluded, yielding a final set of 750 abstracts (see Figure 1).
Table 1 illustrates the proportion of publications in each of the 10 content categories for abstracts of papers written by Canadian and international authors. Twenty-two (3%) of the publications were written by Canadian authors. We did not identify any relevant literature from Canadian authors that was published in French only. In the total set of publications, more than one-third used primary healthcare EMRs as a study data source. Of the remaining 476 publications, 13% focused on the impact of EMRs on patient care, 13% on EMR implementation and adoption, 11% on research, and a smaller proportion on EMR data quality, development, use, patient views, privacy and education. Levels of publications in three categories: ‘EMR as a Data Source’; ‘EMR Implementation & Adoption’; and ‘EMR Use’ were significantly different between the international and Canadian literature.

Table 2 lists the countries that had 10 or more primary healthcare EMR publications, as well as the population of each country, their levels of EMR use and rate of publication per 10 000 FTE researchers. Using the latter measure, the Netherlands ranks first in primary healthcare EMR publications, while Canada ranks eighth of the nine countries for which we could make calculations. Both Canada and the USA have lower levels of EMR adoption in comparison with the remainder of the countries in Table 2. With the exception of Italy, countries with higher levels of EMR adoption also have a higher rate of primary healthcare EMR publications.
Discussion

Principal findings

In this study, we describe the overall primary healthcare EMR literature, and compare the level of publications from Canadian authors with levels from authors in other countries. Our findings indicate that while a body of literature exists regarding primary healthcare EMRs, more than one-third of publications simply reported on studies using EMRs as a data source, and there were very few publications that explored the views of patients. Of those that focused on EMRs as a subject, the highest proportion dealt with the impact of the EMR on patient care or EMR implementation and adoption. We also found that the level of primary healthcare EMR publications by Canadian authors was relatively low. However, it should be noted that in 2009, only 37% of Canadian primary care physicians used EMRs in their practice. There were some differences among the topics focused on by Canadian authors vs. non-Canadian authors. With one exception, countries with high levels of EMR adoption in PHC also had high relative rates of primary healthcare EMR publications.

Implications of the findings

In terms of the overall findings, the lack of publications regarding patient’s views with regard to EMRs
is concerning given the evolving nature of patient’s roles in their own health care and increased interest in the development of patient portals and EMR-linked personal health records. In addition, we identified few publications that focused on methods of educating primary healthcare trainees on the use of EMRs in practice. This is a definite gap in research which needs to be addressed, given the eventual ubiquity of EMRs in primary health care and the need to use this technology in effective ways during patient encounters.

This study found significantly higher levels of Canadian-authored publications focused on EMR implementation and EMR use, in comparison with those authored by researchers from other countries. This may reflect a past need for Canadian researchers to study these topics, given our historical low levels of EMR adoption. Similarly, the lack of studies using EMR data as an information source for research may be explained by the relative paucity of EMR data prior to the period of this study. The overall findings point to a lack of Canadian-authored primary healthcare-focused EMR publications. This is the case particularly in comparison with other countries such as the Netherlands and New Zealand, which have both more extensive EMR use and a longer history of EMR adoption in primary health care.

Finally, it may be that the high rates of EMR adoption in some countries have influenced the production of primary healthcare EMR literature through mechanisms such as access to large collections of EMR data in researchable databases, for example the General Practice Research Database in the UK, or a stronger network of researchers and resources dedicated to this topic. Conversely, although unlikely, greater levels of available primary healthcare EMR literature specific to particular countries may facilitate adoption. This was not identified as a factor in a study examining the drivers of EMR adoption in countries with high levels of primary healthcare EMR use.

These findings illustrate the need for increased evidence with which to support the implementation and effective use of EMRs in primary health care, particularly in the Canadian setting.

**Comparison with the literature**

We identified two bibliometric studies that examined publications related to EHRs and EMRs. In the first study, Wen et al described the production of EHR literature through mechanisms such as access to large collections of EMR data in researchable databases, for example the General Practice Research Database in the UK, or a stronger network of researchers and resources dedicated to this topic. Conversely, although unlikely, greater levels of available primary healthcare EMR literature specific to particular countries may facilitate adoption. This was not identified as a factor in a study examining the drivers of EMR adoption in countries with high levels of primary healthcare EMR use.

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by topic, they did identify the first author’s country of origin. Similar to our findings, the USA, UK and Netherlands were the top three countries with the greatest number of EHR publications, while Canada was in fifth place. In the second study, Moorman et al conducted an inventory of EMR publications present in PubMed prior to 2008; publications were categorised and country of author affiliation was identified. While overall direct comparison of publication content with our study was not possible due to differences in categorisation, Moorman’s study also found a cluster of studies which used data from EMRs. Of the nine countries with more than 100 EMR publications, six (USA, UK, Netherlands, Canada, Australia and Italy) were also found in our study to have greater than ten primary healthcare EMR publications.

Limitations of the method

Using a keyword search, rather than a more focused MeSH only (subject heading) search, resulted in the identification of citations that were later excluded for non-relevance, for example, in many cases EMRs were mentioned as a solution to a problem within the text of the abstract but were not the focus of the study. In addition, we excluded many publications which were not research studies, such as commentaries. However, our intention with this search was to capture the primary healthcare research EMR literature as comprehensively as possible. The search concluded with literature published in 2009; therefore, this study does not include publications beyond this period. Using ‘English’ as a limit to the search meant that we likely excluded publications which could have been authored by residents of countries with higher levels of EMR adoption (such as Italy). We did conduct a supplemental search to ensure we captured any relevant literature published in French by Canadian authors. In an ideal situation, we would have preferred to use a more refined measure of publication output among countries, for example by including in the denominator only researchers studying EMRs/using EMR data. However, to our knowledge, this information does not exist and therefore we have used a more crude measure of publications per 10 000 FTE researchers. By reviewing abstracts only we may have missed relevant content which could have resulted in changes to our topic categorisation. This approach would not have changed the overall numbers of studies found from each country.

Call for further research

Currently, there is a rising tide of interest in EMRs on the part of Canadian primary healthcare practitioners, policymakers and researchers. However, our evidence base is not sufficiently strong to support both best practice EMR use in patient care, and secondary uses such as policy making and planning. This analysis highlights the critical need in the Canadian context for high-quality evidence that can help guide the coming expansion and effective use of EMRs in Canada.

Conclusion

This study found a relatively small body of literature focused on EMRs in primary health care. Within this literature, the majority of studies were those that used EMRs as a data source. Publications by Canadian authors were relatively low, and there were significant differences in the level of publications by Canadian versus non-Canadian authors for the topics of EMR implementation and use. Given the emerging nature of EMRs in Canadian primary health care, this study highlights the need to develop a strong evidence base which can support the optimal use of EMRs in this setting.

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REFERENCES


ADDRESS FOR CORRESPONDENCE
Amanda L Terry PhD
Assistant Professor
Centre for Studies in Family Medicine
Department of Family Medicine
Department of Epidemiology & Biostatistics
Schulich School of Medicine & Dentistry
The University of Western Ontario
100 Collip Circle, Suite 245
The U.W.O. Research Park
London, Ontario
Canada N6G 4X8
Email: aterry4@uwo.ca

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