ORTHOPAEDIC TRAUMA ASSOCIATION
OTA INTERNATIONAL
THE OPEN ACCESS JOURNAL OF ORTHOPAEDIC TRAUMA

OTA Committee Manuscript

OPEN

The Impact of National Orthopaedic Fracture Registries: A Systematic Review

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Abstract

Purpose: Large-scale registry data efforts are common in orthopaedic surgery; however, there is wide variation between registries and little known about registry impact. The purpose of this study was to assess the publication or "scholarly" impact of current national trauma/fracture registries.

Methods: A search was executed to identify potential national and international trauma/fracture registries and create a comprehensive list of registries. Thirty-four relevant national registries were identified. Searches were executed to identify any published articles published by or affiliated with the selected registries. Over 13,000 abstracts were screened by at least 2 reviewers. The full text of 650 articles were screened by at least 2 reviewers, and data were extracted from 383 articles. Citations were excluded if they were reviews and meta-analyses; referencing non–trauma-specific, insurance, institutional, or state-wide databases; describing facial, spine, or rib trauma; reporting nonregistry data; and did not report on fracture patients. Data were collected at the article level and registry level.

Results: The median number of articles per registry was 3.5 (range: 1–66) with a median impact factor of 3.2 (range per registry: 1.4–11.0). The National Hip Fracture Database (United Kingdom) had the highest publication rate per year of any registry (3.9). Twenty-four percent of registries had a publication rate of greater than 1 article per year, whereas only 8.8% had a publication rate over 2 per year. Only 8 registries had 10 or more publications in total. The National Trauma Data Bank (United States) had the highest number of fracture-specific publications overall (66) and an average citation rate of 29 per publication. The National Hip Fracture Database had the second highest number of article (62) with an average citation per article of 23.6.

Conclusion: With the exception of a few registries, most national trauma/fracture registries have low yearly publication and citation rates. Researchers must consider the utility of resources needed to sustain registry efforts in the context of the impact of registry data. Future studies will seek to identify salient features of the highest impact registries.

Key Words: fracture registry, trauma registry

1. Introduction

National database utilization is becoming more common in orthopaedic research.[1,2] In the setting of total joint arthroplasty, national registries were created to identify long-term outcomes of varying prostheses.[2] In the setting of orthopaedic trauma, registries are created for widespread prospective data collection

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Conflicts of Interest and Source of Funding: A.E.L. is the current Chair and member of the OTA Classification and Outcomes Committee, member of the AO Mentorship Committee, ORS Clinical Research Section Officer, and member of the ORS Nominations Committee. A.E.L. receives funding from the Loyola Research Funding Committee Young Investigator Grant and the National Institutes of Health (1R21AR084183-01). A.E.L. received no funding relevant to this work. M.M. is the former Chair and member of the OTA Classification and Outcomes Committee and a member of the OTA AI task force. M.N. is a consultant with AO North America, OTA Publication Committee member, and COTA Board Member. J.A. and R.S. are members of the OTA Classification and Outcomes Committee. The remaining authors declare no conflict of interest.

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Members of the OTA Classification and Outcomes Committee are included in an Appendix at the end of the article.

Source of funding: No funding was required for this study.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.otainternational.org).

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OTAI (2025) e361

Received: 31 July 2024 / Received in final form: 4 December 2024 / Accepted: 10 December 2024
Published online 3 February 2025

http://dx.doi.org/10.1097/OI9.0000000000000361

about various fracture patterns, treatments, and outcomes.[3] These data are intended to improve patient outcomes and safety and change clinical practice. Many countries now have their own trauma or fracture-specific registries.

Despite widespread belief in the promise and opportunity presented by registry data, there is significant variability in the quality and methodology behind orthopaedic registries, which has implications for their relative utility.[4–7] Little is known about the impact of these registries on clinical care. Small registry size, incomplete follow-up data, and variable implementation into the health system are significant limitations to many registries. Concerns have been raised about the generalizability of some registries given the variable nature of enrollment by geographic region, health care setting, and population.[1]

Given the diverse landscape of orthopaedic trauma and fracture-specific registries, there is a crucial need to discern which registries are successful in the endeavor to provide knowledge that can affect patient care. An initial step in evaluating this is determining the impact of national registries on the orthopaedic literature. Therefore, the purpose of this study was to assess the publication or "scholarly" impact of current national trauma/fracture registries.

2. Methods

Two separate search strategies were created and executed by a medical librarian (E.H.) to locate the literature. The initial search was conducted to identify eligible national and international orthopaedic fracture or trauma registries. "National" registries were defined as those registries intended to include data from the entire country, rather than limited to a specific state, region, or health system, acknowledging that countries can have more than 1 "national" fracture registry. In an attempt to be inclusive of registries across the world, the registry identification search was executed in Scopus because of its keyword and affiliation search mechanisms as well as its international scope. Scopus includes Embase, MEDLINE, and other international indexes. This strategy used proximity operators to locate mentions of a registry near orthopaedic fracture or trauma in the available citation information; the entire strategy is available in Supplemental Digital Content 1 (http://links.lww.com/OTAI/A102). Scopus was searched from inception to May 2022. The Health Sciences Library staff extracted the registry names from the selected citations and provided the list to the rest of the team for review. To ensure the search strategy was appropriately capturing the relevant registries, the resulting list was compared with a list of known national fracture registries compiled by the authors.[8] Registries with a focus on solely arthroplasty, as well as state-wide or institutional registries were excluded. This resulted in 60 national fracture registries to bring forward to the second phase of the search strategy.

Search strategies containing the approved list of registry names were developed and executed to identify the potential studies. Because of the unique nature of search execution and database function of each database, phrase searching was used in only one of the databases. The strategies were executed in Scopus (Elsevier), PubMed (MEDLINE), Central Register of Controlled Trials (CENTRAL, Cochrane Library, Wiley), Cochrane Database of Systematic Reviews (Cochrane Library, Wiley) from the inception of the database through July 2022. These databases were selected because of their biomedical science coverage and international scope. Strategies for each database can be found in Supplemental Digital Content 2 (http://links.lww.com/OTAI/A103).

The above search resulted in 13,093 abstracts, excluding duplicates. Each abstract was screened for inclusion by at least 2 reviewers (C.E., P.L., A.B., N.L., A.H.) with a third reviewer (A.E.L.) acting as a tiebreaker for abstracts with discordant votes. Excluded articles were reviews/meta-analyses; referencing non–trauma-specific, insurance, institutional, or state-wide databases; describing facial, spine, or rib trauma; reporting nonregistry data; and did not report on fracture patients. Articles from non–fracture-specific trauma registries (eg, National Trauma Data Bank) were only included if the content was focused on extremity fracture or pelvic/acetabular fracture patients. Six hundred fifty full-text articles were selected for full-text review. After additional exclusions as per the above criteria, 383 articles were selected for inclusion in the study and underwent data extraction. Thirty-four relevant national registries were identified in the included articles. The selection process is demonstrated in the PRISMA flow diagram in Fig. 1. For the purposes of this review article, the term "fracture registry" will refer to all included fracture-specific registries and trauma registries in which data were evaluated specifically on orthopaedic trauma/fracture patients. Scholarly impact reported herein relates only to those publications and resultant citations related to the care of fracture patients.

At the article level, data were collected on registry name, year of publication, journal impact factor (IF), population, and reported outcomes. At the registry level, data were collected on country of origin, size (how many subjects or procedures), number of articles per registry, article citations, rate of publication and citation since the start of registry, whether the registry has an annual report, whether the registry is open access, and other special characteristics (military, children, and patient-reported outcomes). Registry IF was defined as the median IF of the journals in which all article from a registry were published. Registry-level data were captured from a thorough Web search of registry names that analyzed official registry Web sites as well as secondary research articles and yearly summaries detailing registry metrics.

3. Results

Thirty-four national fracture registries were identified from 383 articles. Six of thirty-four (18%) were from the United States, 3 of 34 (9%) were from the United Kingdom, 3 of 34 (9%) were from Sweden, 3 of 34 (9%) were from Norway, 3 of 34 (9%) were from Germany, 2 of 34 (6%) were from the Netherlands, 2 of 34 (6%) were from Denmark, and 2 of 34 (6%) were from Australia and New Zealand. Canada, China, Hong Kong, Iceland, Ireland, Israel, Japan, Korea, Scotland, and Spain each had 1 registry. The oldest fracture registry was the Reykjavik Study Fracture Registry (1967) and newest was the Spanish National Hip Fracture Registry (2017). The number of patients for each registry are outlined in Fig. 2. The median number of articles per registry was 3.5 (range: 1–66) with a median IF of 3.2 (range per registry: 1.4–11.0; Fig. 3). The number of publication citations per registry ranged from 8 (Own the Bone) to 2636 (Norwegian Hip Fracture Register), with a median of 96 (Supplemental Digital Content 3, http://links.lww.com/OTAI/A104).

The National Hip Fracture Database (United Kingdom) had the highest publication rate per year of any registry (3.9) followed by the Swedish Fracture Registry (3.3), Norwegian Hip Fracture Register (2.22), and the National Trauma Data Bank (1.9). Own the Bone by the American Orthopaedic Association (AOA), Dutch Nationwide Trauma Register, Crash Injury Research and Engineering Network, and Quebec Trauma Registry all had only

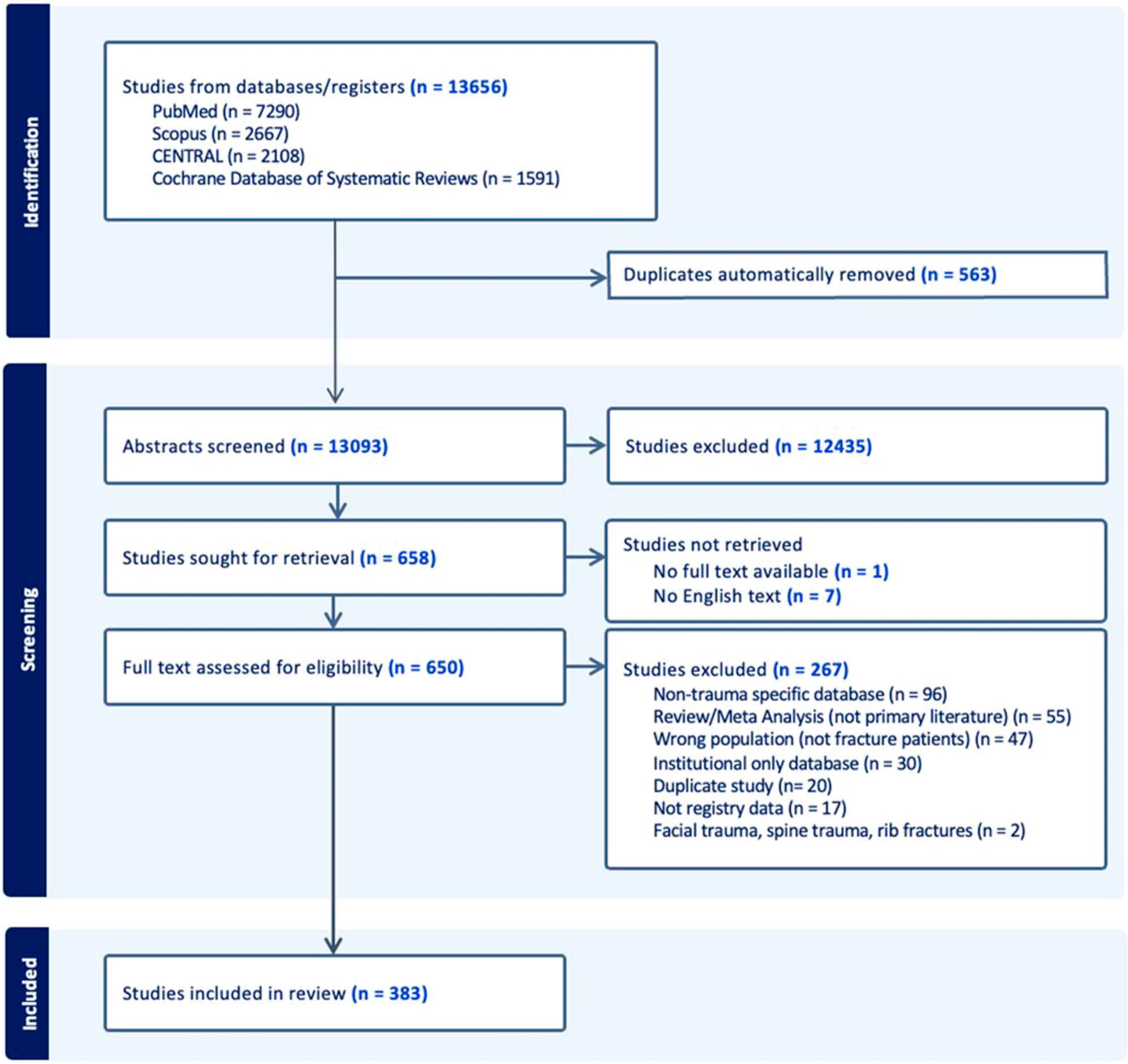
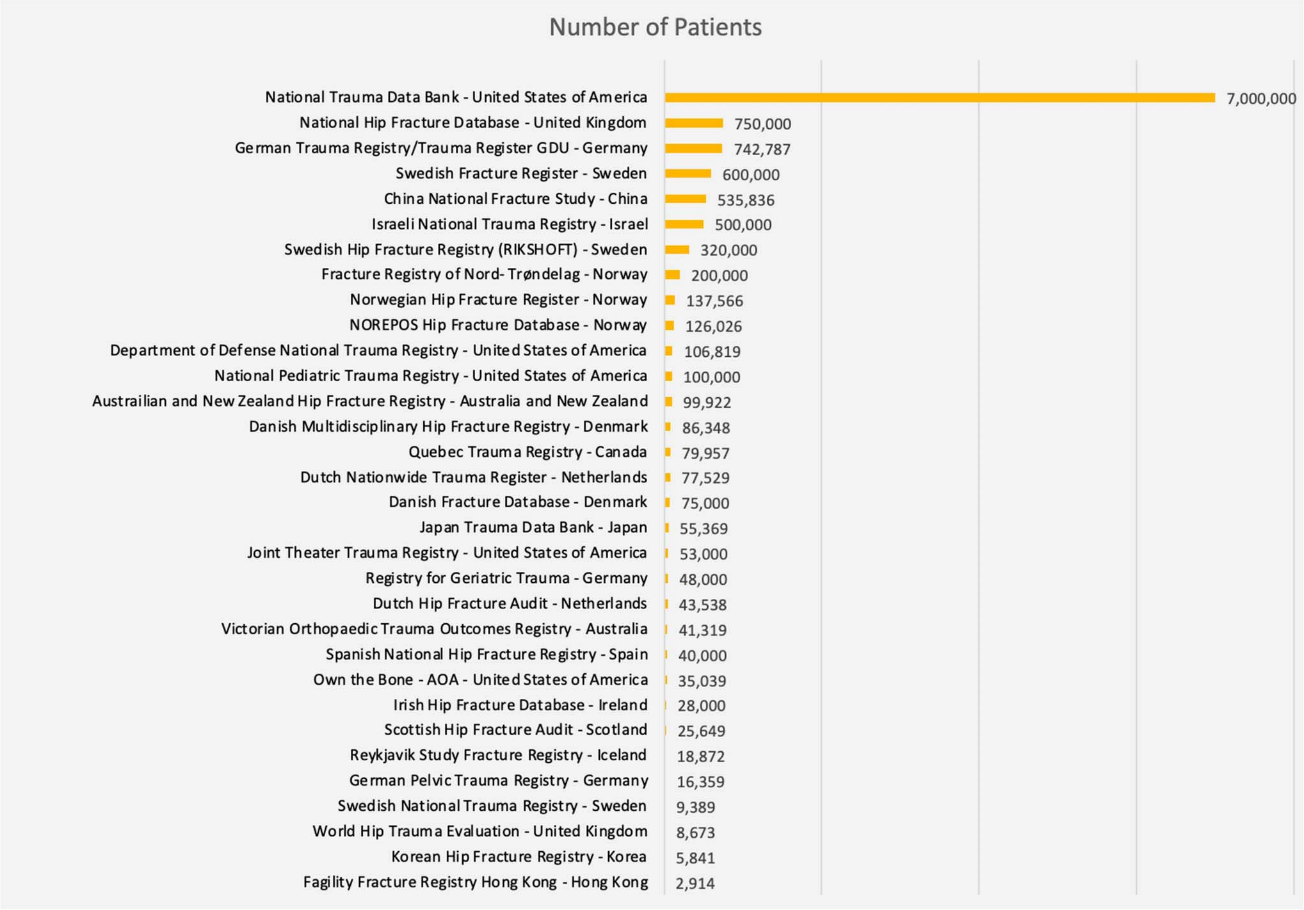


Figure 1. PRISMA diagram.

1 publication each within the studied time line. Figs. 4 and 5 summarize publication rates, number of articles, and time line of founding for each registry. Forty-one percent of registries publish an annual report separate from the peer-reviewed articles identified in this study.

Twenty-four percent of registries had a publication rate of greater than 1 article per year, whereas only 8.8% had a publication rate over 2 per year. Only 8 registries had 10 or more publications in total. The National Trauma Data Bank, one of the oldest registries, beginning in 1989, had the highest number of fracture-specific publications overall (66) and an average citation rate of 29 per publication (median IF 2.3, ranked 26th among the registries for IF). The National Hip Fracture Database had the second highest number of articles (62) with an average citation per manuscript of 23.6 (median IF 2.6, ranked 20th among all registries for IF). IF among the registries was widely variable. The registries with the highest median IF (>4.5) each had fewer than 10 publications (Fig. 3). Among registries with greater than 10 publications, the highest median IF was 3.7: Norwegian Hip Fracture Register (40 publications), Danish Multidisciplinary Hip Fracture Registry (29 publications), and Swedish Hip Fracture Registry (14 publications).

Only 3 registries (Swedish Fracture Register, Norwegian Hip Fracture Register, and Australian and New Zealand Hip Fracture Register) included patient-reported outcome measures. A minority of registries with fracture-specific content have additional data reported. The Department of Defense National Trauma Registry also reports data on infectious diseases, traumatic brain injury, vision, and hearing. Own the Bone contains information on nutrition, physical activity, lifestyle, pharmacotherapy, and bone mineral density. The Crash Injury Research and Engineering Network included crash engineering and physics data.



*No information was found on the Trauma Audit and Research Network and Crash Injury Research and Engineering Network

Figure 2. Number of patients included in national fracture registries.

4. Discussion

Trauma and fracture registries provide researchers access to large amounts of data that is intended to be generalizable to the national population. Based on our results, the National Hip Fracture Database (United Kingdom), Swedish Fracture Registry, Norwegian Hip Fracture Register, and National Trauma Data Bank (United States) were the fracture registries with the most "scholarly impact" in the orthopaedic literature as evidenced by highest publication and citation rates. The National Trauma Data Bank had the most patients overall (although the total number of fracture patients is not calculated here) and most overall number of publications.

While many registries have relatively few publications, their value may be assessed in other ways such as how the data have been used to affect patient care. The National Hip Fracture Database in the United Kingdom allowed for the creation of a protocol that enabled the standardization of care for patients with fragility fractures.[9] Another clinically impactful recommendation was made after analyzing the Norwegian Hip Fracture Registry which found that cemented hemiarthroplasties after femoral neck fractures had lower reoperation rates and no differences in 1-year mortality compared with uncemented hemiarthroplasties.[10] Members of the Swedish Fracture Register noted that their registry has been successful in both clinical and research domains.[11]

Review of our data suggests that registries with mandatory reporting (eg, National Trauma Data Bank) or within nations with centralized health care (eg, National Hip Fracture Database) have had the highest "scholarly impact" and that most national trauma/fracture registries have low yearly publication and citation rates in regard to orthopaedic trauma. The correlation between dissemination of data in the published literature and a registry's ability to affect change in clinical practice is not clear. However, the findings raise the question as to whether the data generated from many of these registries requiring more intensive data collection efforts is worth the resources required to maintain them.

There are significant monetary and temporal costs associated with initiating and maintaining registries which require constant upkeep.[10] For example, the Scottish Hip Fracture Audit had been performing regular audits of all patient data up until recently when it trialed an intermittent "snapshot" data audit approach. They found that aspects of the registry's performance deteriorated without the prior continuous audit model and made the data less valid, an effect that was apparent within only a few months.[12] Researchers must balance the resources needed to sustain constant registry efforts against the specific goals of the registry. Registry administrators should periodically re-evaluate their registry to ensure that resources are correctly used to maintain a complete, valid, and accessible database.

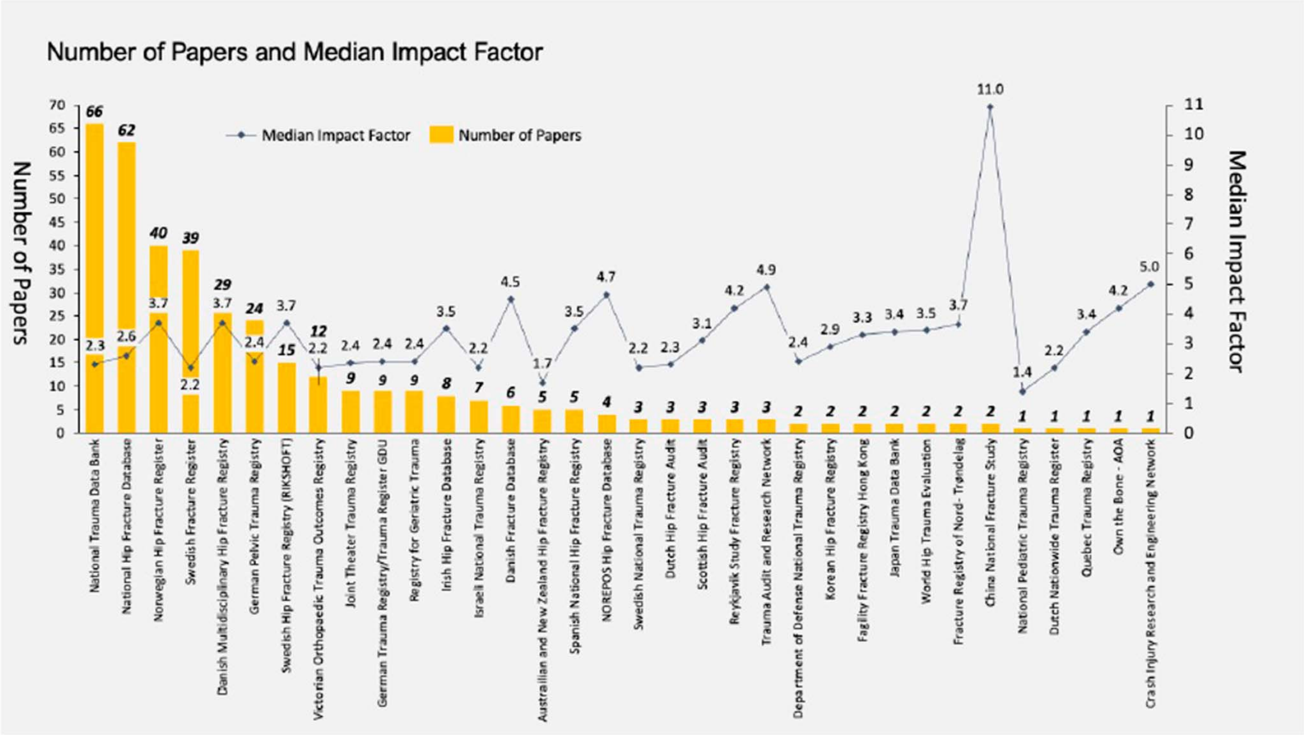


Figure 3. Summary of number of publications and median publication impact factor by registry.

Rather than having multiple registries that provide redundant information, there is the potential option of merging registries to consolidate resources. In those registries that collect similar data, such as the ones focused on hip fractures, there may be the opportunity to reduce the resource burden. While this pathway would necessitate agreement on a methodology and a shared long-term goal, it may decrease the total resources required for maintenance. This approach was successfully trialed by existing vascular registries in Scandinavia, Northern Ireland, New Zealand, and the United Kingdom who were able to take steps in consolidating their individual databases to enhance data collection and analysis.[13] Within the field of orthopaedics, the German

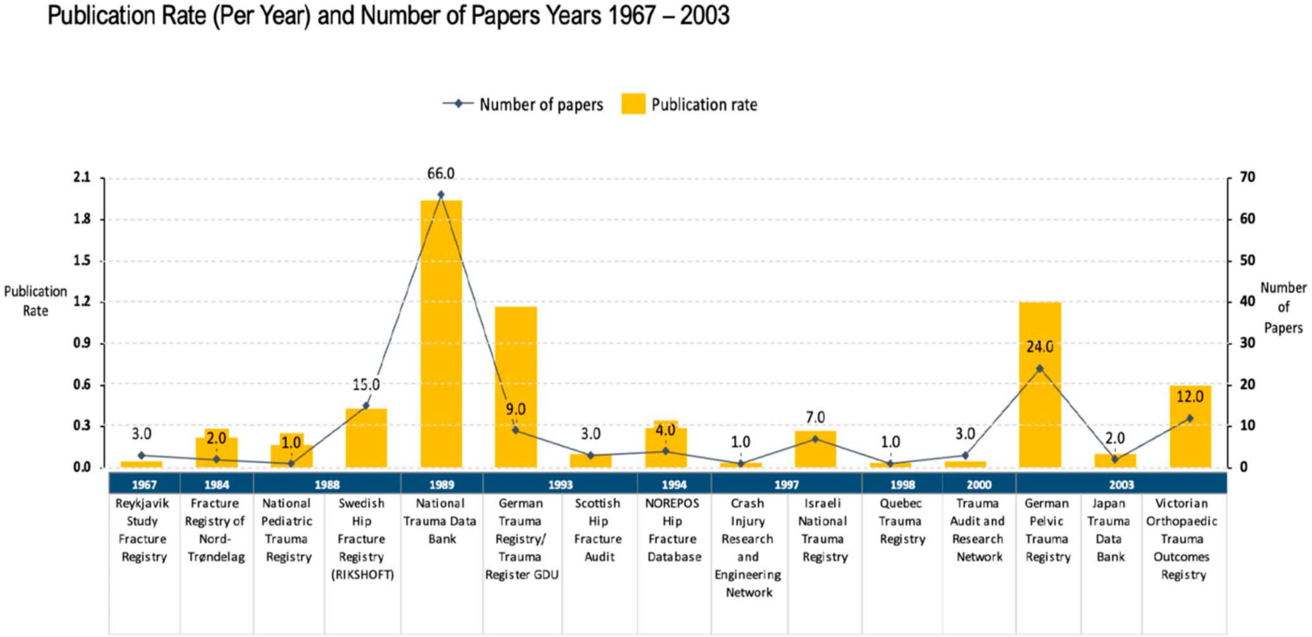


Figure 4. Publication rate per year, number of articles, and time line of founding through 2000.

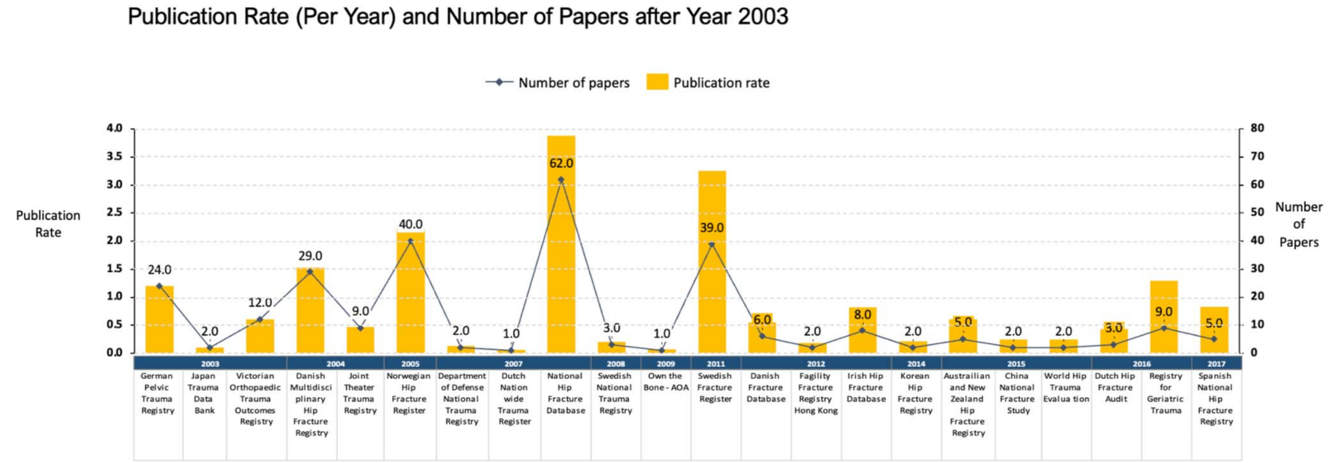


Figure 5. Publication rate per year, number of articles, and time line of founding after 2000.

Arthroplasty Registry collaborated with the National Joint Registry of England, Wales, and Northern Ireland to create an Arthroplasty Library that provides a larger database from which the impact of hip and knee arthroplasties can be better studied.[14] In our study, multiple registries were found to have merged such as the National Pediatric Trauma Registry joining with the National Trauma Data Bank. Nguyen et al[8] suggested that countries with similar health systems and injury characteristics should consider sharing resources to maximize outreach and reduce resource burden which allows for broader data interpretation and generalizability.

Although fracture registries have been shown to have many advantages, a drawback of the newer registries is lack of long-term follow-up. Another drawback of many international registries is a lack of standardized measurement and reporting of outcomes between each database, which poses a hurdle during inter-registry comparisons of data.[10] Registries also should have a clear objective. Although not a focus of this particular study, a survey of the Australia New Zealand Trauma Registry showed that there was a discordance between its current uses and future priorities.[15] Survey respondents noted that they were more interested in their own site-specific data for quality improvement purposes. Although identified as a priority, the epidemiological data from the registry were not being used for public health purposes.

Our review has several inherent limitations. First, not all trauma and fracture-related registries were evaluated. There are many regional and other non–fracture-specific national registries available but not included in our analysis. In addition, we focused on registries that were primarily based on the topic of pelvic/acetabular and extremity fractures, and as such, the data are not generalizable to registries on spine or maxillofacial fractures. The American Spine Registry (formerly known as the Quality Outcomes Database) is the largest spine registry in North America and has been instrumental to neurosurgical quality improvement and research.[16] Some information was also difficult to attain if a registry did not have a dedicated Web site (14 registries). In these cases, articles about the registry were used. Furthermore, "scholarly impact" in the form of registry publications, citations, and IFs was used as an initial metric of dissemination of information from registry data. IF affords an imperfect evaluation given that many highly regarded orthopaedic trauma–specific journals with a readership base focused on this subspecialty may have lower IFs than journals with a broader focus. However, many registries are developed with different goals in mind, and successful publication does not necessarily correlate with an impact on patient care or quality improvement. By contrast, high scholarly impact does not guarantee quality data.

Many national trauma and fracture registries exist around the world, requiring significant financial resources, including staff time and monitoring overhead, to maintain a complete, valid, and effective data set. Our study shows that with the exception of a few registries, most national trauma and fracture registries have low yearly publication and citation rates related to fracture care. Registry developers must consider the utility of resources needed to sustain registry efforts in the context of the individual goals of the registry and impact of registry data. Solutions such as integration of multiple registries may enhance the utility of data in the future. Further studies will seek to identify salient features of the highest impact registries.

Acknowledgment

Christopher Beger, BA (Access Services and Operations Manager, Health Sciences Library, Loyola University Chicago), assisted with extracting registry names from the systematic search and obtaining full-text articles.

Appendix 1. Collaborators

The following OTA Classifications and Outcomes Committee members should be listed as contributors to this manuscript: Stephen Sims, MD (Atrium Health Carolinas Medical Center, Charlotte, NC); James Kellam, MD (Department of Orthopaedic Surgery, University of Texas Health Science Center—Houston, McGovern Medical School, Houston, TX); Jarrod Dumpe, MD (Atrium Health Navicent, Macon, GA); Zachary Working, MD (Oregon Health & Science University, Portland, OR); Kyle Schweser, MD (Missouri Orthopaedic Institute and Department of Orthopaedic Surgery, School of Medicine, University of Missouri, Columbia, MO).

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