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Featured Article

# Bibliometric Scan of the 100 Most Cited Nursing Simulation Articles

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## KEYWORDS

bibliometric analysis;  
citation analysis;  
impact factors;  
nursing;  
publication analysis;  
simulation

## Abstract

**Background:** Bibliometrics involves statistical analyses of publication data, particularly citation analysis, to determine popularity/impact of articles and authors.

**Methods:** Citation analysis was conducted on the “top 100” cited nursing simulation articles in the Scopus database in April 2019.

**Results:** The median number of article citations was 84 (mean = 100.4; range, 53-557). Citations were steadily accumulated after publication; the majority between year four and year seven. Two-thirds of the articles were led by authors from the United States.

**Conclusions:** This report on bibliometric mapping helps to graphically illustrate the evolution of simulation articles in the field of nursing.

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In academia, scholarly publications are a way of sharing and disseminating new knowledge. Bibliometrics is the statistical analysis of written publications such as books or articles and is a common method used to evaluate academic literature (Ellegaard & Wallin, 2015). After the publication of an article, the report is used by other researchers as evidence for their own work and cited as a source. It is generally accepted that the number of citations of a particular article is a reflection of its impact in the scientific community (Durieux & Gevenois, 2010). Thus, the citation count of an article is a method of identifying and giving weight

to an article that has influenced subsequent publications (Choudhri, 2015). Citation analysis therefore becomes essential, typically aiming to identify the most important documents in a collection.

Historically, a manual collation of cited studies was required to assemble and assess publication collections, as instanced by Wong, Tam, Wong, and Cheung (2013) who searched nursing publications from 1956 to 2011 for top-cited article “classics.” In recent years, automated citation indexing has enabled better analysis, the methods including qualitative, quantitative, and computational techniques. A modern example is the online subscription program Web of Science (<https://www.webofknowledge.com/>) that includes citation indexing and thus allows for computation of various impact factors for scholars, based on citation

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data. Another example is the subscription-based Scopus database (Elsevier: <https://www.scopus.com/>) that offers a citation overview and various citation metrics, including for the health sciences. These two sources are useful in providing tracking for peer-reviewed article citation data.

### Key Points

- Citation analysis revealed 100 nursing simulation articles, each with  $\geq 53$  citations.
- Simulation articles in nursing have fewer citations than those in health care.
- Elapse of time since publication ( $>3$  years) is necessary to accumulate substantial citations.

We do know that published articles have a citation “lifecycle,” during which they accumulate citations over time, but patterns differ across fields of research (Walters, 2011). Galiani and Gálvez (2017) distinguished a number of patterns across 20 fields of literature noting that citations were influenced by citation inflation (citations becoming more common) and the postpublication periods of two years and five years. They showed that medicine and sciences had a citation surge in the first

two years after publication, whereas economics and finance gained less in this period and overall. Citations often continue for 15 years and even 25 years. Information was not available about nursing citation patterns.

## What are the Applications of Bibliometrics?

- Bibliometrics has many uses that are generally related to assessing productivity through analysis of publishing patterns (Ellegaard & Wallin, 2015).

This can include a number of broad and specialized analyses including geographical or institutional aspects and indicators of performance such as development over time (see Figure 1).

On a larger scale, bibliometrics outputs may help define faculty productivity, department, and university research rankings, or the choice of academic library holdings. On a more individual level, bibliometric outputs such as article publication count or citation rate may be used to test the research performance of a scholar, to identify top performers and to influence staff tenure arrangements. There are many different measures of scholarly productivity that may be applied (Choudhri, 2015). Ultimately, however, bibliometrics can also be used for higher level purposes such as: to assess the impact of top scholarly articles, to trace the development of a field of science or technology, or to identify major research issues and paradigms, especially in research fields that are in an emergent phase (Mustafee, Katsaliaki, & Taylor, 2010), such as simulation. Although bibliometrics are perhaps commonly applied in

science fields, little is known about the most influential articles related to simulation in nursing.

Simulation-based education has become an increasingly essential pedagogy in nurse education. Role plays with computerized manikins, virtual patients, or patient actors can provide “real-life” clinical training experiences for learners (Bogossian et al., 2014), either in preparation for clinical practice or as a substitute permitted in some jurisdictions for clinical hours (Foronda, Liu, & Bauman, 2014; NCSBN, 2014). Few have mapped nursing simulation articles using bibliometric processes. Kokol, Vošner, and Železnik (2017) reported a bibliometric analysis of simulation publications over ten years in the journal *Clinical Simulation in Nursing*, with yearly descriptive averages and productivity, but no list or ranking of publication citations. Walsh et al. (2018) who conducted a bibliometric analysis of simulation articles across health care reported that all ten “most cited” articles between 1992 and 2010 were related to education in medicine (rather than nursing), each receiving between 662 and 1,411 citations. Of the top 100 cited articles, only five were specifically related to nursing. These data reflect a lack of knowledge about leading published sources of simulation evidence in nursing and high-profile nursing publications.

The current evidence summary will provide a publication performance indicator in the field of simulation in nursing based on the assumption that the impact of a particular article is reflected by the frequency of its citation in other articles.

## Methods

The aim of the present study was to describe contemporary scholarship and impact in the field of simulation in nursing using a bibliometric scan of the 100 most cited articles, their origin, publication source, citation rank, and authorship.

### Bibliometrics applications

#### • Purpose for authors:

- Measure the impact of publishing activity
- Provide evidence for curriculum vitae
- Grants: reporting to funding bodies and collaborative partners
- Identifying where to publish
- Identifying top performers for future collaborations

#### • Purpose for organisations:

- Recruitment: for promotion: tenure, grants
- Identify emerging areas for research
- Indicate research priorities
- Showcase group or institutional research
- Determine department/ university publication performance.

Figure 1 Purpose of bibliometrics.

The Scopus database was selected as the publication source. This was chosen because Scopus claims to be the largest abstract and citation database of peer-reviewed literature internationally. It comprises over 69 million records from 34,000 peer-reviewed journals in subject fields such as life sciences, social sciences, physical sciences, and health sciences. It also has the advantage of offering a citation overview and a list of citations for each entry, making a ranking of credited citations possible.

The database search was conducted in April 2019, using the keywords “nursing” and “simulation” with no year limit. The search was restricted to key terms in the article title, abstract, or keywords and to “article” or “research” paper types:

(TITLE-ABS-KEY ( nursing ) AND TITLE-ABSKEY ( simulation )) AND DOCTYPE (ar OR re).

A 15-year period 2004 to 2019 was identified as the reporting period as there were no nursing simulation citations ranked in the top 100 published articles before 2004.

## Synthesis of Included Documents

Of  $n = 4,915$  documents identified in the search list, many related to cross-discipline topics. At this stage, there were 3,199 documents listed in the nursing subject area, 2,075 in the social sciences, and 1,664 in medicine, indicating that a number of these documents were cross-indexed. All the documents were electronically ranked highest to lowest by number of citations, and then highlighted to select nursing studies.

Eligible articles were articles of any design that related to simulation-based education in nursing, including reviews of literature and descriptive articles of the theory and development of simulation techniques in nursing. Excluded articles were simulation-based education in “health care” or in disciplines other than nursing (e.g., midwifery, medicine, surgery), team-based multidisciplinary simulation (e.g., medicine with nursing), and service modelling exercises.

The citations of nursing articles ranged from a top of 557 (most cited) down to 53, at which point 100 studies were selected. The citations and abstracts were downloaded into an Endnote reference database. Available citation data such as document date/title/authors and article publication demographics (e.g., citations by year) were downloaded into Excel. Collected data were then reported using IBM-SPSS, version 24 (IBM Corporation, 2016), with descriptive statistics and Pearson’s correlation coefficient, plus inferential statistics: the Mann-Whitney test applied to dichotomized data, the Kruskal Wallis test to detect three-way differences, with  $p < .05$  regarded as significant. These elements form the basis of the result and discussion sections that follow.

## Results

The individual article citation rate ranged from 53 to 557; the median was 80.5, the mean 100.4, and the most

commonly occurring number of citations was both 53 (5 articles) and 87 (5 articles). Overall, only eight articles had accumulated 200 or more citations. Two “landmark” articles (Jeffries, 2005; Cant & Cooper, 2010), described later, achieved five times and three times the average citation rate, respectively, and thus have provided pivotal information for the discipline.

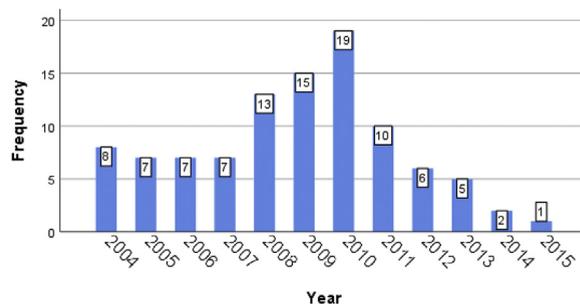
All articles addressed simulation in nursing; however, there were varying designs. Sixty-two (62%) articles addressed primary research, for example, reporting the educational outcomes of a simulation training experience. Eighteen (18%) were reviews of literature and the remaining 20 (20%) were centered on a description of issues pertaining to simulation “methods” such as integrating simulation into a curriculum or methods of debriefing. The articles included quantitative and qualitative studies of preregistration nursing students and of qualified nurses, although the latter were few.

A full list of included articles, their citation rank and number of citations can be seen in the supplementary file [Appendix A](#) online ([www.nursingsimulation.org](http://www.nursingsimulation.org)).

## Annual Publication Trend

There was a trend in the annual volume of highly cited articles over the period, which was represented by articles published between 2004 and 2015 (Figure 2). There were no highly cited articles before 2004 or after 2015. Data therefore suggest an elapse of time was necessary since the year of publication for an article to accumulate  $\geq 53$  citations in subsequent articles, to be in the “highly cited” collection.

This was confirmed by a statistically significant correlation between articles’ year of publication and the number of citations. A Pearson correlation coefficient of  $-0.233$  signified a weak negative correlation: as the years advanced, there were less highly cited articles ( $p = .02$ ). Figure 2 also indicates that there were decreasing numbers of articles achieving a highly cited ranking within the last five years (since 2013, and even since 2011). None achieved a highly cited rank after 2015 (up to 2019), suggesting insufficient time had elapsed or else there were fewer publications.



**Figure 2** Frequency of highly cited articles by year of publication.

All but one of the “top ten” cited articles were published in 2010 or prior (see Appendix A) with the average age of these articles being 10.5 years. The most cited article, by far, was

- **Jeffries’ (2005):** “A framework for designing, implementing, and evaluating: simulations used as teaching strategies in nursing,” with n = 557 citations.

Tracking of these citations by year indicates a fairly consistent annual citation rate since 2006; thus, time in the field of over 13 years has been important in achieving such recognition.

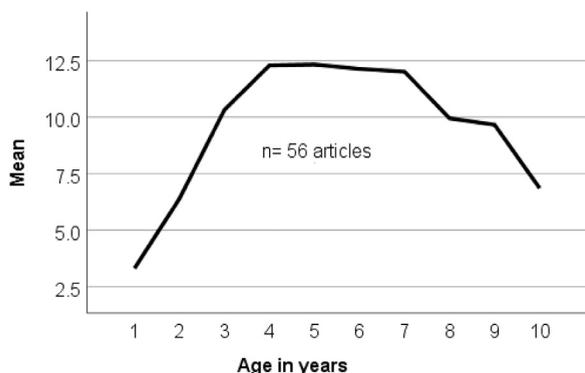
The publication trend shown in Figure 2, however, was not linear, as there was a peak in highly cited articles in the years 2008, 2009, and 2010. Nineteen highly cited articles were produced in 2010, followed by 15 in 2009 and 13 in 2008. Four articles in the top ten were published in this period.

- **Cant and Coopers’ (2010)** systematic review: “Simulation-based learning in nurse education” was the overall second most cited article with n = 371 citations;
- **Dreifuerst’s (2009):** “The essentials of debriefing in simulation learning: A concept analysis,” ranked third, with n = 207 citations;
- **Decker, Sportsman, Puetz, and Billings’ (2008):** The evolution of simulation and its contribution to competency (184 citations);
- **Bambini, Washburn, and Perkins’ (2009):** Outcomes of clinical simulation for novice nursing students: Communication, confidence, clinical judgment (172 citations).

The cluster of highly cited publications in this period 2008 to 2010 represented almost half (47%) of the highly cited articles.

### Citation Life Cycle

To examine the life cycle of citations, the number of citations were examined year by year for the 56 articles



**Figure 3** Citation trajectory over 10 years.

that were aged at least 10 years since publication (up to 2019). Figure 3 shows the citation trajectory over a 10-year period since publication based on mean numbers of citations.

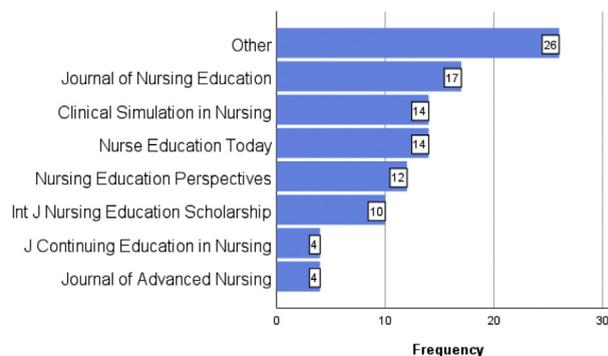
Numeric citation data over 10 years indicate that 13% of the citations were accumulated in the first two years after publication, 55% after five years, 80% after seven years, and 100% at ten years (although the articles were still being cited after this period). For the top 10 articles, 13% of the citations were accumulated in the first two years after publication; 37% within the first five years, 55% by seven years, and 77% by the time ten years had elapsed. Data thus indicate a protracted citation “life cycle” with a steady accumulation of citations over the first seven years, a constant high rate between years four to seven and a reducing trend thereafter.

### Citations by Design

A nonsignificant trend of lower citation rates was noted in the primary research articles ( $M = 93.6$ ,  $CI: 80.2-107.0$ ;  $Md = 74$ ) compared with reviews of literature ( $M = 107.6$ ,  $CI: 71.9-143.3$ ;  $Md = 90.5$ ) or descriptive and method articles ( $M = 114.7$ ,  $CI: 63.5-165.9$ ;  $Md = 84.5$ ) ( $p = .19$ ).

### Journal Choice

Of the 100 highly cited articles, the majority were published in nursing education–focused journals that had an “impact factor” (Figure 4). These included Journal of Nursing Education (17%); Clinical Simulation in Nursing (14%); Nurse Education Today (14%); Nursing Education Perspectives (12%); International Journal of Nursing Education Scholarship (10%); Journal of Continuing Education in Nursing (4%); or Journal of Advanced Nursing (4%). Highly cited articles will benefit the journal through supporting the journal’s overall citation rate and influencing the journal’s impact factor (a computation of the number of articles cited).



**Figure 4** Frequency of highly cited nursing simulation articles by publishing journal.

## Wide Authorship

There was widely disparate authorship with 91 individual first authors across the 100 cited articles. Of these, only one first author had published three nursing simulation articles as a first author (W. M. Nehring: 2004, 2008, 2009). Seven other first authors each published two articles (G. Alinier: 2004, 2006; S. Decker: 2008, 2013; S. Lasater: 2007, 2007; M. A. Seropian: 2004, 2004; K. T. Dreifuerst: 2009, 2012; P. R. Jeffries: 2005, 2008; S. Lapkin: 2010, 2011). The latter three authors were also coauthors of other articles, indicating a simulation-based focus in their published work.

No significant correlation was found between the number of authors of each article and the number of citations, although there was a positive trend ( $p = .71$ ) to higher citations when there were fewer authors. Over the 75 multiauthored articles (ranging up to 12 authors), there were  $n = 189$  secondary authors, whereas  $n = 25$  articles were from a single author alone. One-quarter of articles ( $n = 26$ ) had four or more authors, indicating a team-based scholarship. Such varied data suggest that, to date, there are no established highly cited simulation scholarship groups in this field.

## Pre-eminent Nursing Simulation Publication Countries

The first authors for each article represented only six countries of article origin (Figure 5). The main country of origin was the United States (67% of articles) followed by the United Kingdom (14%), Australia (12%), and Canada (5%). It is recognized, however, that authorship in other countries may be represented in the lesser cited publications not currently reported.

Based on first authorship, approximately the same ratio was maintained by country in respect of the most cited research articles and review of literature articles. This changed slightly in regard to “methods” articles where the USA had authored 70%, the UK 25%, and Canada 5%.

## Discussion

Scholarly articles that are highly cited are said to be associated with research quality in the fields of science (Levitt & Thelwall, 2008). Although this could be debated in the field of simulation in nursing, it is likely that the findings in highly cited articles may be influential and can help us understand the factors that can produce a quality article.

In detecting landmark publications in the field of simulation in nursing, we identified the top 100 articles according to citation rates and also eight high-profile authors who have published highly cited articles. This evidence demonstrates the publication productivity of academic departments. It is noteworthy, however, that all of the top 100 articles achieved 53 or more citations. Also of

interest, our results indicate that there was little difference in the citation rates between reviews of literature and other descriptive and research articles.

In describing contemporary scholarship and impact in the field of simulation in nursing literature, we note two things. The list of top articles for simulation in nursing remains on a developmental trajectory that requires time since publication to be a highly cited and influential. The highly cited articles were all published at least five years ago and the top ten averaged 10.5 years since publication. Although some studies suggest high citation rates occur in the first two years or the first five years after publication (Galiani and Gálvez, 2017), this was not apparent in the current nursing study. We noted a protracted citation cycle with approximately 55% of citations awarded within five years and 80% within seven years. Furthermore, there may be excellent and pivotal simulation articles in nursing that have been published but have not yet received multiple citations or that are too recently published to have accumulated a great number. This reflects the fact that bibliometric citation counts are one way of measuring publication impact and reporting the ranking of author productivity but that the method has limitations of this kind. Self-citations are included when perhaps they are extraneous, as they may artificially inflate citation rates to some extent. However, duplicate publications are excluded. Scholars have made efforts to balance the shortcomings of author publication counts or citation counts with other metrics such as the h-index, m-quotient, i-10 [i-n] index, and journal evaluation measures such as impact factor, Eigen factor, and others (Choudhri, 2015). The work of Farooq, Khan, Iqbal, Munir, and Shahzad (2017) explores these indices and suggests a “DS-index” can accommodate the ranking of each author more effectively. Differences in research approaches and citation outcomes between fields of research have shown that bibliometrics should not be used to compare researchers or research groups across specialties (Durieux & Gevenois, 2010). Thus, to evaluate article publication productivity, there needs to be a good understanding of the derivation and application of each metric. Preferably, more than one measure should be used

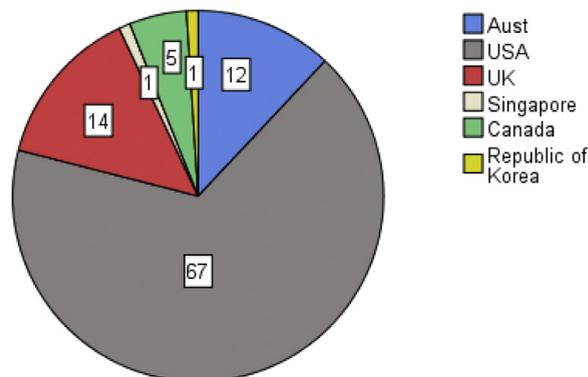


Figure 5 Countries of origin of first authors.

in any evaluation (Davidson et al., 2014). Additional tools for calculating these parameters from multiple publications may be of value. The rise of social media for data sharing may also change the nature of author productivity evaluation in the future (Davidson et al., 2014).

Second, nursing simulation publications are still an emerging resource. Over two-thirds of the top 100 publications (70%) were a collaboration between a small group of authors (numbering one to three persons) and few had merged into a larger and/or a nationally competitive research team. Despite this, by far, most articles (62%) reported primary research. This is contrary to the findings of a bibliometric analysis of the 100 most cited simulation articles in health care by Walsh et al. (2018), noting that 42% of publications were reviews of the literature, whereas 28% were interventional reports. Similarly, Azer (2015) reviewed the 50 most cited medical education publications, with the majority being reviews (48%) and articles (34%) rather than research reports. We found that the top 100 nursing simulation articles had a much lower citation rate ( $M = 100.4$ ) than that reported for the top 100 “health care” simulation articles ( $M = 361$ ) (Walsh et al., 2018). These data suggest that nursing simulation articles may be reflecting the development phase of simulation and the techniques applicable in nursing and therefore may report relatively more investigative “how to” research interventions. These highly cited nursing articles peaked during 2008 to 2011, which coincides with the main development period for simulation in nursing curricula, with, for example, the establishment of high-fidelity simulation laboratories in academia between 2008 and 2014 in Australasia (Bogossian et al., 2018). Alternatively, however, citation rates may simply be higher in a larger publication field (such as medicine) because there is greater opportunity to cite based on more journals and additional publications. Nevertheless, we note that although nursing simulation citation rates have been escalating and the number of simulation publications increasing (Kokol et al., 2017), a number of reviews of nursing simulation literature have called for stronger research designs in future. This includes more experimental evidence, multi-centre rather than single cohort studies, and more objective assessments (Cant & Cooper, 2010, 2017; Larue, Pepin, & Allard, 2015; Yuan, Williams, & Fang, 2012).

Bibliometrics outputs are reliant on the database used for publication extraction and this choice can be considered a limitation of any such study. We chose to use the Scopus database as this is known to be a world leader in the number of journals indexed. The Web of Science has a similar citation analysis capability but will have access to a slightly different set of scholarly journals as both databases rely on the subscription of individual journals. There may be some journals that are not indexed in either of these databases and therefore publications may be missed. Of interest, the citation analysis of Google Scholar web search engine (available freely since 2004: [scholar.google.com](http://scholar.google.com)), although well recognized as a tracking device, indexes an array of publishing formats from multiple websites but is less specific in reporting

peer-reviewed publications and in filtering duplicate publications. Benefits and barriers can be seen at [https://en.wikipedia.org/wiki/Google\\_Scholar](https://en.wikipedia.org/wiki/Google_Scholar). Their number of citations commonly exceeds that of Scopus for similar citation searches and h-indexes. For example, the most highly cited publication in the current data set by Jeffries (2005) with  $n = 557$  citations in Scopus has more than double this number in Google Scholar ( $n = 1,351$ ). Therefore, it will be important for readers to critique any outcome metric.

## Conclusion

In conclusion, in this study, we make use of the reference handling capabilities of the Scopus database to collate and extract data for a bibliometric analysis of selected simulation articles in the field of nursing. We report a publication trend for the 100 most cited simulation in nursing articles that peaked in the years 2008 to 2010, with approximately 80% of citations awarded within the first seven years. Owing to the inherent risk of inaccuracy in citation counts, this metric is not a finite measure of quality but can be regarded as an indicator of article performance. Our systematic mapping of the field of simulation helps graphically illustrate the evolution of simulation in nursing articles published over time. Time in the field, increased awareness of metrics used by authors, and larger, more collaborative research teams may help produce pivotal articles with higher citation counts.

## Supplementary Data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ecns.2019.06.004>.

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