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Trends in publication of general surgical research in New Zealand, 1996–2015

Cameron I. Wells,* Jason P. Robertson,† Gregory O'Grady* and Ian P. Bissett*‡

*Department of Surgery, Faculty of Medical and Health Sciences, The University of Auckland, Auckland, New Zealand
†Department of Surgery, Palmerston North Hospital, Mid-Central District Health Board, Palmerston North, New Zealand and
‡Department of Surgery, Auckland District Health Board, Auckland, New Zealand

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Correspondence
Professor Ian P. Bissett, Department of Surgery, Faculty of Medical and Health Sciences, The University of Auckland, Private Bag 92019, Auckland Mail Centre 1142, New Zealand.
Email: i.bissett@auckland.ac.nz

C. I. Wells; **J. P. Robertson** MBChB, MMedSc; **G. O'Grady** MBChB, PhD, FRACS; **I. P. Bissett** MBChB, MD, FRACS.

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Abstract

Background: Recent analyses of the surgical literature have suggested a general trend towards increasing numbers of published articles and an improved quality of evidence produced. The aim of this bibliometric analysis was to identify trends in the publication of general surgical research in New Zealand from 1996 to 2015.

Methods: Ovid MEDLINE was searched for general surgical publications by New Zealand authors. Two investigators screened results, and a range of data were collected for included articles. Descriptive statistics were used to summarize data and identify significant trends.

Results: A total of 601 articles were identified, with a progressive increase in the number of publications from 1996 to 2015. Randomized trials and systematic reviews accounted for 33 and 97 publications, respectively. The median number of authors per paper rose from 3.0 to 5.0 ($P < 0.001$). There was an exponential increase in the publication of randomized trials ($P = 0.001$) and systematic reviews ($P < 0.001$), while publication of basic science articles remained relatively steady ($P = 0.22$). The median impact factor for published articles increased from 1.5 to 2.6, which was equivalent to organic growth of the journal impact factors over the 20-year period.

Conclusion: The quality and quantity of surgical research in New Zealand has substantially increased over the past two decades. These results reflect the successful growth of a culture of academic surgery and the ongoing support of partner organizations.

Introduction

More than 20 years ago, surgical research was deemed a 'comic opera' by the editor of *The Lancet*, because of a lack of high-quality randomized-controlled trials (RCTs), and a purported poor quality of evidence.[1] Since this time, the quality and quantity of research conducted by general surgeons has dramatically increased. Recent bibliometric analyses of surgical research have shown an increasing number of published articles, improvements in the quality of evidence and a greater number of RCTs.[2–5]

Academic surgery and surgical research have faced a number of challenges in New Zealand and Australia, but continue to grow and develop, with the support of the Royal Australasian College of Surgeons (RACS), the Universities and District Health Boards (DHBs). Contribution to the generation of new knowledge is encompassed in the RACS core competency of 'Scholarship and Teacher',[6] and experience in research is now required for all specialties in the Surgical Education and Training (SET) programme, including general surgery.

Peer-reviewed publication is a key performance indicator by which academics are measured, and is generally considered the 'gold standard' of academic success for both surgical and non-surgical researchers.[7] International analyses of surgical publications have previously ranked New Zealand between 4th and 14th when adjusted for population size.[3,8] Despite this, trends in the publication and quality of research over time were not evaluated in these studies. It is unknown whether surgical research in New Zealand is improving, declining or has remained unchanged over the past two decades.

The aim of this bibliometric study was to analyse all general surgical research publications by New Zealand authors from 1996 to 2015, and to identify significant trends in research quality and publication practices during this period.

Methods

A literature search for publications from 1996 to 2015 inclusive was conducted using Ovid MEDLINE. Queries for 'surgery' and 'New Zealand' were combined in order to capture all relevant

articles published during this period. The search term 'New Zealand' was limited to the investigator affiliation (ia) and institution (in) fields in the MEDLINE database, while 'surgery' was applied to the title (ti), abstract (ab) and keyword heading (kw) fields, in addition to investigator affiliation and institution.

Clinical and laboratory research related to adult general surgery and its associated sub-specialties, was included, while research related to other surgical specialties (e.g. vascular, plastic or paediatric surgery) was excluded. For an article to be included, the author(s) were required to be affiliated to a general surgical department in a New Zealand hospital or university. Only English language articles were included. Systematic reviews and meta-analyses were included, whereas editorials, comments, letters, case reports, review articles, consensus statements and historical articles were excluded. International multicenter studies that did not have a New Zealand-based first- or last-author were also excluded.

Results were exported into a reference management software program (EndNote X7, Thomson Reuters, Toronto, Canada). Screening of titles and abstracts was subsequently performed by two authors (CW and JR) to identify those meeting criteria for inclusion. The following data were extracted for each article: number of authors, journal name, year of publication and type of publication (RCT versus systematic review/meta-analysis versus basic science versus others). For each article, the journal impact factor (IF) in the year prior to publication was recorded from Journal Citation Reports. The Eigenfactor score and other metrics were available for less than 50% of identified articles and were therefore not analysed as part of this study. The year prior to publication was chosen as this represents the standing of the journal at the time of article submission. The mean annual increase in IF for the 10 most common journals was calculated from 1996 to 2015, and used to determine the expected growth in IF over a 20-year period.

Descriptive statistics were used to generate summary data. Univariate analysis was performed to identify significant trends over the investigated time period; the χ^2-test was used for categorical data. The Wilcoxon signed-rank test was used to determine the difference between the observed and expected change in IF over the 20-year period. A P-value <0.05 was considered statistically significant.

Results

The literature search yielded 3393 results, which was narrowed to 601 articles that satisfied the inclusion criteria. Of these, 33 (5.5%) were RCTs and 97 (16.1%) were systematic reviews and/or meta-analyses. A total of 88 basic science articles were identified (14.6%). The majority of identified articles reported other study designs (63.8%), predominantly cohort studies and case series.

There was a progressive increase in the number of articles published per year, from 10 in 1996 to 70 in 2015 (Fig. 1). The median number of authors per paper over the entire time period was 4.0, with a total of 1173 unique authors identified. The median number of authors rose from 3.0 for publications from 1996 to 2000, to 5.0 for those from 2011 to 2015 ($P < 0.001$).

Figure 2 demonstrates trends in publication of RCTs, systematic reviews and basic science research over the 1996–2015 period. Only three RCTs were published in the 1996–2000 time period, in contrast

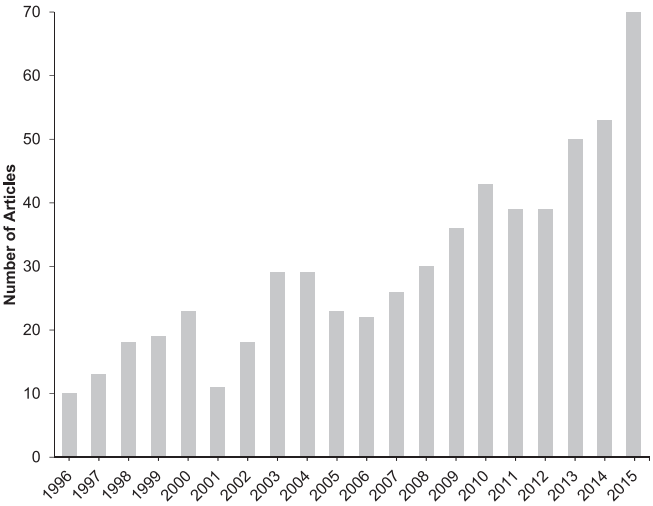

Fig. 1. Annual number of published studies, 1996–2015.

with 18 published between 2011 and 2015 ($P = 0.001$). A similar trend was demonstrated for systematic reviews and meta-analyses, which exponentially increased from four published from 1996 to 2000, to 54 from 2011 to 2015 ($P < 0.001$). No significant trend in the publication of basic science research was identified ($P = 0.22$).

The 601 identified articles were published in a total of 130 different journals. The most common journal in which identified articles were published was the *ANZ Journal of Surgery* (137 publications, 22%), followed by the *New Zealand Medical Journal* (72 publications, 12%) and the *British Journal of Surgery* (37 publications, 6%). There were 19 publications in *Annals of Surgery,* nine from the *Cochrane Database of Systematic Reviews* and two in *The Lancet*. The 10 most common journals accounted for more than 60% of all identified articles (Table 1).

IF is the most commonly used metric for evaluating the bibliometric impact of published articles, and is defined as the number of citations in a given Journal Citation Report year divided by the total number of articles published in the preceding two years.[9] IF data was available for more than 99.5% of all identified articles. The

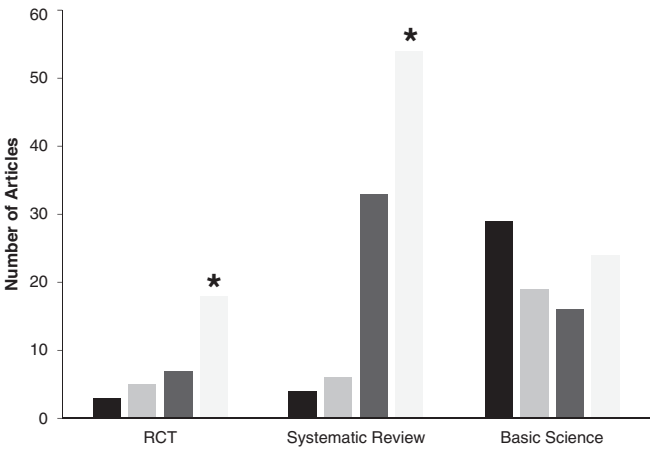

Fig. 2. Number of randomized trials, systematic reviews and basic science articles. *$P \leq 0.001$. RCT, randomized-controlled trial. (■) 1996–2000, (■) 2001–2005, (■) 2006–2010, (□) 2011–2015.

Table 1 Frequency of publication in the 10 most common journals

Journals	*n* (%)
ANZ Journal of Surgery	137 (22.6%)
New Zealand Medical Journal	72 (11.9%)
British Journal of Surgery	37 (6.1%)
Diseases of the Colon & Rectum	34 (5.6%)
Annals of Surgery	19 (3.1%)
World Journal of Surgery	19 (3.1%)
Colorectal Disease	18 (2.9%)
HPB	18 (2.9%)
Obesity Surgery	16 (2.6%)
Journal of Surgical Research	13 (2.1%)

median IF for included studies increased from 1.5 in 1996 to 2.6 in 2015. However, the mean annual increase in IF for the 10 most common journals in this study was 2.9% per year. This corresponds to an expected increase of the median IF from 1.5 to 2.7 over a 20-year period. The observed increase in median IF was therefore not significantly different from the expected organic growth of journal IFs over time ($P = 0.28$).

Discussion

Academic surgery and surgical research were in their infancy in the early 1990s in New Zealand, and have since developed in size, scope and quality. Although New Zealand was ranked 14th globally with respect to general surgical publications per 10^6 inhabitants from 2000 to 2005,[8] considerable progress has been made since this time. This study has shown a steady increase in the number of general surgical publications attributed to New Zealand authors from 1996 to 2015, associated with increasing publication of systematic reviews and RCTs (graded as level 1 and 2 evidence, respectively, according to the Oxford Levels of Evidence), suggesting a trend towards publication of higher-level evidence.[10] Although the median IF for included studies increased during this time, this was attributable to organic growth in journal IFs, rather than publication in higher impact journals. The publication rate of basic science research was relatively steady over the investigated period, with the overall increase accounted for by an expanding volume of clinical research. The median number of authors per article significantly increased over the 20-year period, in keeping with an international trend towards increasingly collaborative surgical research.[11]

This study identified a seven-fold increase in the annual number of publications and a six-fold increase in publication of RCTs by New Zealand general surgical researchers. Few other studies have longitudinally investigated national trends in publication of general surgical research. A recent bibliometric analysis of Irish general surgical publications demonstrated a 67% increase in publication rate from 2000–2004 to 2005–2009.[3] Ali *et al*. identified a 50% increase in publication of surgical RCTs from 1999 to 2009, with an increase of 160% in the Asia/Oceania region.[5] Similarly, Brooke *et al*. investigated trends in the quality of highly cited surgical research from 1985 to 2004, and demonstrated an increase in the proportion of RCTs from 26% to 48%.[2] While the results of this study compare favourably with other published analyses, it remains unclear whether similar trends in publication of surgical research have occurred in other countries over the past two decades.

There are many factors contributing to the rapid growth of general surgical research in New Zealand. During the investigated time period, a number of academic surgical units have been established across New Zealand, partnered with both universities and DHBs, who are likely responsible for much of the growth in the publication rate.[12,13] The contribution of registrars is also considerable, with compulsory participation in research and audit for SET trainees. Registrars may contribute to surgical research during protected time spent pursing a higher degree,[13–15] or in the form of clinical, laboratory or other dedicated research.[16] Trainee-led research collaboratives have had marked success in the UK, wherein registrars are responsible for leading and recruiting for multicenter randomized trials, with guidance and support from senior academics.[17,18] Adoption of a similar model in New Zealand and Australia may further enhance the generation of high-quality research and contribute to the development of future academic surgeons.

The RACS has shown a clear commitment to the development of academic surgery and surgical research with the inclusion of 'Scholarship and Teacher' in the nine core competencies, and its ongoing support of the Section of Academic Surgery. The Developing a Career and Skills in Academic Surgery course was first held in 2009, and has since supported the growth of academic surgery, inspiring a number of young surgical researchers in New Zealand and Australia.[19–21] Of note is also the provision of numerous substantial grants for surgical research from the RACS and several specialty societies, providing financial support for many trainees and fellows conducting full- or part-time research.[15]

Both medical students and junior medical staff are also capable of making a meaningful contribution to surgical research. Indeed, British medical students with an interest in surgery are more likely to pursue research opportunities.[22] This may account for the recent success of the student-led STARSurg research collaborative, who has supported medical students to collect data in several large multicenter observational studies.[23–25] Unpublished data from the summer studentship programme at the University of Auckland, New Zealand, suggests that students completing surgical projects are more likely to publish than those from other departments.[26] Furthermore, 98% of junior doctors in a New South Wales study were interested in being involved with research in the future, and this may be similar among New Zealand graduates.[27] Involvement of medical students and trainees in research appears to be a 'virtuous cycle', wherein early research experience is strongly predictive of later research productivity and pursuit of academic careers.[28,29] Mentorship is crucial for these individuals, and presence of a mentor has been shown to predict publication, research productivity and success.[30] It is imperative that senior academic surgeons continue to provide mentorship and to support the ongoing development of junior researchers in order for surgical research continue to develop in New Zealand.[31]

Dissemination and discussion of research in high-quality surgical journals is crucial for the continued development of surgical research and academia. For general surgical research in New Zealand, the *ANZ Journal of Surgery* was found to be the most popular journal among authors, accounting for over 20% of all published articles in this bibliometric analysis. The RACS Annual Scientific Congress is another avenue for the dissemination of surgical research in New Zealand and Australia, and although the quality of research

presented at this meeting is increasing,[32] the rate of subsequent full-text publication remains unknown. Together with the New Zealand Association of General Surgeons and Surgical Research Society annual conferences, and a growing number of specialty meetings, surgical researchers in New Zealand have a growing number of opportunities to present their work at local and international forums.

There are several limitations of this study. Only publications in MEDLINE-indexed journals were evaluated, and therefore this study may not represent a complete analysis of New Zealand general surgical publications. The utility of IF has been vigorously debated, with many authors challenging its validity as a measure of research quality.[33,35] However, IF is the best-established metric, is commonly used by academics and is appropriate for comparisons within a scientific field, if corrected for the organic growth in journal IF over time.[35] Finally, while this study described the progress made by surgical researchers in New Zealand from 1996 to 2015, the lack of an international control group limits direct comparison with other countries.

Conclusions

This study has demonstrated substantial improvements in the quality and quantity of surgical research in New Zealand over the 1996–2015 period. There has been a seven-fold increase in number of publications per year, a six-fold increase in the publication of RCTs and a 13-fold increase in the number of systematic reviews. The number of authors per article has significantly risen, demonstrating a trend towards increasingly collaborative research. Ongoing support from the RACS, funding bodies, the universities and DHBs is essential for the continuing growth and development of surgical research in New Zealand.

References

1. Horton R. Surgical research or comic opera: questions, but few answers. *Lancet* 1996; **347**: 984–5.
2. Brooke BS, Nathan H, Pawlik TM. Trends in the quality of highly cited surgical research over the past 20 years. *Ann. Surg.* 2009; **249**: 162–7.
3. Robertson I, Corrigan M, Sheikh A, Lehane E, Hill A. An evaluation of Irish general surgical research publications from 2000 to 2009. *Surgeon* 2010; **8**: 314–7.
4. Chua TC, Crowe PJ, Morris DL. Trends in surgical oncology research in Australia during the period 1998–2009: a bibliometric review. *J. Surg. Oncol.* 2011; **104**: 216–9.
5. Ali UA, Van Der Sluis PC, Issa Y *et al.* Trends in worldwide volume and methodological quality of surgical randomized controlled trials. *Ann. Surg.* 2013; **258**: 199–207.
6. Gough IR. New paradigms in surgical education. *Surg. Pract.* 2012; **16**: 2–5.
7. Bierer SB, Chen HC. How to measure success: the impact of scholarly concentrations on students—a literature review. *Acad. Med.* 2010; **85**: 438–52.
8. Van Rossum M, Bosker B, Pierik E, Verheyen C. Geographic origin of publications in surgical journals. *Br. J. Surg.* 2007; **94**: 244–7.
9. Garfield E. The history and meaning of the journal impact factor. *JAMA* 2006; **295**: 90–3.
10. OCEBM Levels of Evidence Working Group. *The Oxford 2011 Levels of Evidence*. Oxford, UK: Oxford Centre for Evidence-Based Medicine, 2011.
11. Goldsack JC, Sonnad SS. Changing trends in surgical research: an analysis of 30 years of collaborative practices. *JAMA Surg.* 2014; **149**: 873–4.
12. Roake J. Academic surgery in New Zealand: dodo or phoenix? *ANZ J. Surg.* 2008; **78**: 343–4.
13. Kahokehr A, Srinivasa S, Yu T-C, Hill AG. Surgical research after medical school: get registered and then get on with it. *ANZ J. Surg.* 2011; **81**: 404–5.
14. Sammour T, Hill AG. Full-time research during surgical training: career killer or stepping stone? *ANZ J. Surg.* 2014; **84**: 104–5.
15. Windsor JA. Sir Gordon Bell Memorial Lecture 2008: academic surgery: a turning tide? *ANZ J. Surg.* 2009; **79**: 425–30.
16. Loveday B, Mittal A, Sharma A, O'Grady G. Trainees reignite academic surgery. *ANZ J. Surg.* 2008; **78**: 1137.
17. Bhangu A, Fitzgerald JE, Kolias AG. Trainee-led research collaboratives: a novel model for delivering multi-centre studies. *ANZ J. Surg.* 2014; **84**: 902–3.
18. Pinkney TD, Calvert M, Bartlett DC *et al.* Impact of wound edge protection devices on surgical site infection after laparotomy: multicentre randomised controlled trial (ROSSINI Trial). *BMJ* 2013; **347**: f4305.
19. Hanney RM, Hill AG, LeMaire SA, Van Rij A, Windsor JA. Developing academic surgeons: the focus of a new course. *ANZ J. Surg.* 2009; **79**: 872–5.
20. Wells CI. Across the ditch and back again. *Surg. News* 2015; **5**: 18.
21. Delbridge L, Hanney R. Surgical Research Society 2014: leading edge research from young surgeons. *ANZ J. Surg.* 2015; **85**: 208.
22. Nikkar-Esfahani A, Jamjoom AAB, Fitzgerald JEF. Extracurricular participation in research and audit by medical students: opportunities, obstacles, motivation and outcomes. *Med. Teach.* 2012; **34**: e317–24.
23. Chapman SJ, Glasbey JCD, Khatri C *et al.* Promoting research and audit at medical school: evaluating the educational impact of participation in a student-led national collaborative study. *BMC Med. Educ.* 2015; **15**: 1–11.
24. STARSurg Collaborative. Impact of postoperative non-steroidal anti-inflammatory drugs on adverse events after gastrointestinal surgery. *Br. J. Surg.* 2014; **101**: 1413–23.
25. STARSurg Collaborative. Multicentre prospective cohort study of body mass index and postoperative complications following gastrointestinal surgery. *Br. J. Surg.* 2016; **103**: 1157.
26. Wells CI, Wallace HB, McLaughlin SJP, Alexander HC, Shelling AN. Rate and predictors of publication following the Faculty of Medical and Health Sciences summer studentship programme. Paper presented at the University of Auckland HealtheX Conference, 9 Sep 2016, New Zealand.
27. Kieu V, Moore E, Hunter-Smith D, Spychal B, Nestel D. How can we improve research opportunities for Australian junior doctors? *ANZ J. Surg.* 2011; **81**: 852–4.
28. Dunn JCY, Lai ECK, Brooks CM, Stabile BE, Fonkalsrud EW. The outcome of research training during surgical residency. *J. Pediatr. Surg.* 1998; **33**: 362–4.
29. Robertson CM, Klingensmith ME, Coopersmith CM. Long-term outcomes of performing a postdoctoral research fellowship during general surgery residency. *Ann. Surg.* 2007; **245**: 516–23.
30. Sambunjak D, Straus SE, Marušić A. Mentoring in academic medicine: a systematic review. *JAMA* 2006; **296**: 1103–15.
31. Srinivasa S, Sapre NS. Nurturing of surgical careers by the Wellington surgical interest club. *ANZ J. Surg.* 2009; **79**: 227–9.
32. Srinivasa S, Hill LS, Yu TC, Hill AG. An overview of the Annual Scientific Congress. *ANZ J. Surg.* 2011; **81**: 101.
33. Seglen PO. Why the impact factor of journals should not be used for evaluating research. *BMJ* 1997; **314**: 498.
34. Kurmis AP. Understanding the limitations of the journal impact factor. *J. Bone Joint Surg. Br.* 2003; **85**: 2449–54.
35. Neuberger J, Counsell C. Impact factors: uses and abuses. *Eur. J. Gastroenterol. Hepatol.* 2002; **14**: 209–11.