



## Review

## The 100 most-cited articles in urological surgery: A bibliometric analysis

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## ABSTRACT

**Background:** The purpose of this bibliometric analysis was to identify and assess the 100 most-cited articles (T100 articles) on urological surgery.

**Methods:** The Web of Science (WoS) Core Collection database was used to investigate the T100 articles in the field of urological surgery. Different aspects of the T100 articles, including the countries, journals, authors, and topics, were analyzed.

**Results:** The number of citations of T100 articles published between 1989 and 2016 ranged from 334 to 2189. The T100 articles originated from 28 countries, with more than half originating from the USA (n = 80). Professor Bill-Axelsson A from Uppsala University Hospital published the largest number of T100 articles as the first author (4) and as a coauthor (1). The Memorial Sloan Kettering Cancer Center from the USA is the top institution with the most T100 articles in the field of urological surgery. The special journal *Journal of Urology* published 41 of the T100 articles, which had a total of 19780 citations.

**Conclusions:** Our study analyzed the 100 most-cited articles in the field of urological surgery. The USA is the dominant country in terms of the number of T100 articles, scientists and institutions. Surgery related to urological cancer has garnered the most academic attention, especially prostate cancer and renal cancer.

## 1. Background

With the rapid development of technological innovations in the field of urology, surgeries for urological diseases have undergone substantial changes, resulting in improved perioperative results, facilitation of the recovery of functional outcomes and postoperative quality of life in a relatively short time interval, and, ultimately, advancement of our ability to treat specific diseases [1]. The adoption of new techniques, such as cavity systems, laser systems, plasma electric cutting systems and robotic systems, has made minimally invasive surgical techniques possible and changed the foundation of urological surgery [2–4]. Many publications related to urological surgery have been published and have added to our understanding of the field. To summarize our understanding, this first bibliometric analysis was performed to quantify and analyze the most-cited publications in the field of urological surgery.

Citation analysis is an important method of evaluating the impact of a research article. The number of citations reflects an article's

contribution to the field of interest and is often considered a proxy for how influential a work is [5]. Many special fields have published bibliometric analyses on the most-cited papers in their specialty, such as cardiac surgery [6], neuroimaging [7], gastric cancer [8]. The analyses performed within these publications help us better understand the influential works in the history of the specialty. The purpose of this study was to determine the characteristics of the most influential papers with the greatest impact factors in the field of urological surgery.

## 2. Methods

The Web of Science (WoS) Core Collection database was used to list all of the papers and citations related to urological surgery on September 30, 2019. To ensure that all relevant publications were included in the analysis, a large number of journals from related specialties were searched. Specifically, journals in the areas of oncology, surgery, anesthesiology, pathology, general and internal medicine,

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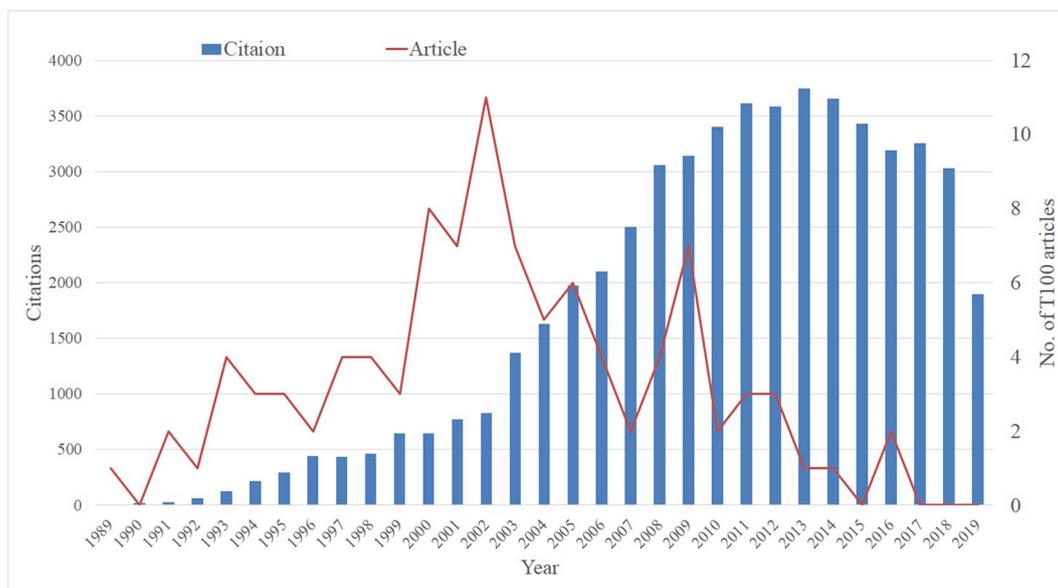


Fig. 1. Numbers of the most cited articles published from 1989 to 2019.

transplantation, infectious diseases, urology and nephrology and andrology were searched. All of the papers from these journals were ranked according to their citation number and then hand searched for their relevance to urological surgery. Articles mainly describing operative techniques, outcomes, or complications were included for further analysis. The following information was collected and analyzed: authorship, journal, publication year, country, total citations, citation density and topics.

3. Results

A total of 142685 papers fit the search criteria in the period from 1920 to 2019. The T100 articles were published between 1989 and 2016, as shown in Fig. 1 and Supplementary Table 1. The number of citations of T100 articles ranged from 334 to 2189, with a mean citation number of 534.83. The earliest T100 article was published in 1989 in the journal *New England Journal Of Medicine*, describing mortality and reoperation after surgery for benign prostatic hyperplasia (BPH). The most-cited paper was written in 2001 by Professor Stein JP, describing radical cystectomy in the treatment of invasive bladder cancer. The most recent two T100 articles were published in 2016: one described the 10-year outcome after three treatments for localized prostate cancer and the other was related to interventional treatment for urolithiasis.

A total of 28 countries worldwide contributed to the T100 articles, and 10 countries had more than 3 T100 articles, as shown in Table 1. The USA dominated the area with 80 of the T100 articles and 43701 citations; scientists in the USA collaborated with scientists in 21 countries/territories. Germany ranked second, with 10 T100 articles

Table 1 Countries of origin for the T100 articles in urological surgery.

Country	Articles	Citations
USA	80	43701
Germany	10	4620
UK	8	3780
Belgium	8	4888
Italy	7	3541
Netherlands	7	4063
France	6	3192
Finland	5	2897
Sweden	5	2897
Canada	3	1327

and 4620 citations (collaborated with scientists in 9 countries/territories), followed by the UK (8 T100 articles and 3780 citations) and Belgium (8 T100 articles and 4888 citations).

A total of 538 scientists from around the world contributed to the T100 articles. The most prolific scientists with more than 4 T100 articles and no fewer than 3 T100 articles as the first author or corresponding author are displayed in Table 2 and Table 3. Professor Kattan MW ranked first with 10 T100 articles (2 as first author, 2 as corresponding author) and Professor Scardino PT ranked second with 10 T100 articles (0 as first author, 3 as corresponding author) and they are from the same famous institution. Professor Walsh PC ranked third, with 8 T100 articles (3 as first author, 5 as coauthor). Notably, there were 7 scientists from Sweden and Finland contributing to the same 5 T100 articles with the same citations. Professor Bill-Axelsson A (Uppsala University Hospital) and Professor Ficarra V (University of Padua) published the most T100 articles as the first author.

More than 230 different institutions were represented, of those 18 were represented in more than 4 of the T100 articles, as seen in Table 4. Most of those 18 institutions are located in the USA (11 in total), Sweden (5 in total), Finland (1 in total) and Italy (1 in total). Memorial Sloan Kettering Cancer Center from the USA leads the list, with 15 T100 articles and 6976 citations. Johns Hopkins Medicine ranked second, with 12 T100 articles and 5689 citations. The Cleveland Clinic Foundation ranked third, with 10 T100 articles and 5096 citations (see Table 4).

There are 21 journals listed in Table 5, each with the number of T100 articles they published, their total citations, the average number of citations per article, the impact factor, and the 5-year impact factor (both impact factors were obtained from JCR 2018). The *Journal Of Urology* published the most T100 articles and had 19780 citations, followed by the *New England Journal Of Medicine*, with 12 T100 articles and 8546 citations. *European Urology* ranked third, with 10 T100 articles and 4680 citations.

According to the topics in the T100 articles, as seen in Table 6, 55 T100 articles were related to the prostate, 51 discussed radical prostatectomy, and 4 were related to transurethral resection of the prostate (TURP). Renal surgery ranked second, with 27 T100 articles, while 22 articles discussed nephrectomy. In the T100 articles related to the bladder, 7 articles discussed cystectomy. Regardless of the organ that was the focus, most of the T100 articles were related to cancer surgery.

**Table 2**  
The most productive authors in T100 articles.

Author	Articles	Authorship				Affiliation	Country	Citations
		First Author	Corresponding Author	Second or Third Author	Others			
Kattan MW	10	2	2	2	4	Cleveland Clinic Foundation	USA	5433
Scardino PT	10	0	3	3	4	Memorial Sloan Kettering Cancer Center	USA	4982
Walsh PC	8	3	3 <sup>a</sup>	2	3	Johns Hopkins Medicine	USA	3636
Blute ML	7	0	0	4	3	Mayo Clinic	USA	3771
Eastham JA	7	1	1 <sup>a</sup>	4	2	Memorial Sloan Kettering Cancer Center	USA	3137
Menon M	7	3	1 + 3 <sup>a</sup>	0	3	Henry Ford Hospital	USA	2823
Novick AC	6	0	3	2	1	Cleveland Clinic Foundation	USA	3509
Adami HO	5	0	0	0	5	Karolinska Institute	Sweden	2897
Bill-Axelsson A	5	4	1 + 4 <sup>a</sup>	0	0	Uppsala University Hospital	Sweden	2897
Busch C	5	0	0	0	5	Uppsala University Hospital	Sweden	2897
Haggman M	5	0	0	0	5	Uppsala University Hospital	Sweden	2897
Holmberg L	5	1	0	4	4	Uppsala University Hospital	Sweden	2897
Nordling S	5	0	0	0	5	University of Helsinki	Finland	2897
Palmgren J	5	0	0	0	5	Karolinska Institute	Sweden	2897
Spangberg A	5	0	0	0	5	Linköping University Hospital	Sweden	2897
Clayman RV	5	1	1 + 1 <sup>a</sup>	1	2	Washington University	USA	2664
Epstein JI	5	2	1 <sup>a</sup>	2	1	Johns Hopkins Medicine	USA	2457

<sup>a</sup> Articles that the first author is both corresponding author.

**4. Discussion**

In this study, we evaluated the 100 most influential papers related to urological surgery in history. The USA is the dominant country in terms of contributions to the development of urological surgery, with the largest numbers of T100 articles, scientists and institutions. The special journal *Journal Of Urology* published the most T100 articles from 1991 to 2011. Surgery related to urological cancer has garnered the most academic attention in the T100 articles, especially prostate cancer and renal cancer. The prostate is the organ with the most T100 articles, which indicates that diseases related to the prostate, such as prostate cancer and BPH, were the hottest research topics in the field of urology.

As the largest high-tech power after the Second World War, the USA dominates many global research fields [9–11]. This held true in our study in terms of the numbers of T100 articles, institutions and scientists, demonstrating that US scientists have made the greatest contribution to the development of urological surgery. The effective impact of science and technology (S&T) policy [12], abundant financial support from public foundations and private enterprises [13], and the adoption of new or better devices developed in the USA might be the potential causes for the USA having the largest contribution [14]. Interestingly, the top two scientists, namely, Professor Bill-Axelsson A and Professor Ficarra V, who published the most T100 articles as first author, were from Sweden and Italy, respectively. Professor Bill-Axelsson A has published many articles related to the comparison between prostatectomy and watchful waiting [15,16]. Concurrently, the research area of Professor Ficarra V is surgery related to urological cancer, from

**Table 4**  
Top publishing institutions.

Institution	Articles	Country	Citations
Memorial Sloan Kettering Cancer Center	15	USA	6976
Johns Hopkins Medicine	12	USA	5689
Cleveland Clinic Foundation	10	USA	5096
Washington University	8	USA	4832
Mayo Clinic	8	USA	4499
Baylor College of Medicine	7	USA	4437
Henry Ford Hospital	7	USA	2823
Harvard University	6	USA	4140
University of Southern California	5	USA	5077
Karolinska Institute	5	Sweden	2897
University of Helsinki	5	Finland	2897
Linköping University Hospital	5	Sweden	2897
Uppsala University Hospital	5	Sweden	2897
Methodist Hospital	5	USA	2599
University of Texas	4	USA	3716
Borås Hospital	4	Sweden	2415
Örebro University Hospital	4	Sweden	2332
University of Padua	4	Italy	1871

robot-assisted radical prostatectomy [17] and radical cystectomy [18] to partial nephrectomy [19]. The scientist with the third highest number of T100 articles in this study is the well-known urologist Professor PC Walsh from Johns Hopkins. Professor PC Walsh is famous for his pioneering work in the development of “the anatomic approach to radical prostatectomy” [20]. Other scientists also have contributed significantly to development of urological surgery, such as Professor

**Table 3**  
The most productive authors as first author or corresponding author in T100 articles.

Author	Articles	Authorship				Affiliation	Country	Citations
		First Author	Corresponding Author	Second or Third Author	Others			
Bill-Axelsson A	5	4	1 + 4 <sup>a</sup>	0	0	Uppsala University Hospital	Sweden	2897
Ficarra V	4	4	4 <sup>a</sup>	0	0	University of Padua	Italy	1871
Menon M	7	3	1 + 3 <sup>a</sup>	0	3	Henry Ford Hospital	USA	2823
Kattan MW	10	2	2	2	4	Cleveland Clinic Foundation	USA	5433
Walsh PC	8	3	3 <sup>a</sup>	2	3	Johns Hopkins Medicine	USA	3636
Scardino PT	10	0	3	3	4	Memorial Sloan Kettering Cancer Center	USA	4982
Gill IS	4	3	1 <sup>a</sup>	0	1	University of Southern California	USA	2036
Catalona WJ	4	2	1 + 2 <sup>a</sup>	0	1	Northwestern Medical Faculty Foundation	USA	1804
Novick AC	6	0	3	2	1	Cleveland Clinic Foundation	USA	3509

<sup>a</sup> Articles that the first author is both corresponding author.

**Table 5**  
Journal distribution of T100 articles in urological surgery.

Journal	Articles	IF as of 2018	5-Year's IF	Citations	Average Citations/Article
Journal Of Urology	41	5.65	4.96	19780	482.44
New England Journal Of Medicine	12	70.67	70.33	8546	712.17
European Urology	10	17.30	15.45	4680	468.00
Journal Of Clinical Oncology	6	28.25	22.44	4420	736.67
Urology	6	1.86	2.08	2589	431.50
JAMA Journal Of The American Medical Association	5	51.27	46.31	2894	578.80
Lancet	3	59.10	54.66	2820	940.00
BJU International	2	4.52	4.02	700	350.00
Cancer	2	6.10	6.41	972	486.00
JNCI Journal Of The National Cancer Institute	2	10.21	11.80	1286	643.00
American Journal Of Surgical Pathology	1	6.16	5.86	441	441.00
Anesthesiology	1	6.42	6.77	348	348.00
Annals Of Surgery	1	9.48	9.36	408	408.00
BMJ British Medical Journal	1	27.60	24.55	342	342.00
British Journal Of Cancer	1	5.42	5.93	362	362.00
Cochrane Database Of Systematic Reviews	1	7.76	7.95	468	468.00
Journal Of Endourology	1	2.27	2.07	365	365.00
Journal Of The National Cancer Institute	1	13.76	14.54	897	897.00
Mayo Clinic Proceedings	1	7.09	7.23	542	542.00
Progres En Urologie	1	0.59	0.48	778	778.00
World Journal Of Surgery	1	2.77	2.98	334	334.00

**Table 6**  
Topic distribution among the T100 articles in urological surgery.

Organ/other item	Articles	Surgery/other item	Articles
Prostate	54	Prostatectomy	50
		Transurethral Resection of Prostate (TURP)	4
Renal	27	Nephrectomy	22
		Percutaneous Nephroscope Lithoipsy (PCNL)	2
		(High-Intensity Focused Ultrasound) HIFU	1
		Kidney Donation	1
		Pyeloplasty	1
Bladder	9	Cystectomy	8
		Cystoplasty	1
Urethra	4	Treatment for Stress Incontinence	4
Adrenal gland	2	Adrenalectomy	2
Urinary tract	1	Treatment for Upper Tract Transitional Cell Carcinoma	1
Penny	1	Circumcision	1
Urolithiasis	1	Interventional Treatment	1
New device	1	Balloon Dissector	1

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Menon M who published 7 T100 articles (3 as first author and 1 as corresponding author) related to robotic surgery and robotic prostatectomy [21,22].

Among urological cancers, prostate cancer has attracted attention in the urology community worldwide due to its heavy health burden and high degree of heterogeneity [23,24]. Prostatectomy is the most common method of treatment for localized prostate cancer. Before the 1990s, most surgeries for prostate cancer were retropubic radical prostatectomy, but the first laparoscopic radical prostatectomy was described in 1992 [25]. The laparoscopic radical prostatectomy quickly expanded in Europe after 2000, while US urologists have been hesitant to embrace this technique because it does not result in better outcomes compared with those of open surgery, and it has a long learning curve [14,26]. With the development of the robotic system, robot-assisted radical prostatectomy became popular, with better functional outcomes and a relatively short learning curve [27]. With the improvements in equipment and a new understanding of adjuvant therapy and neoadjuvant therapy, urologists undertook surgery for locally advanced or oligometastatic prostate cancer [28]. Although an increasing number of

prostatectomies have been performed with different approaches worldwide, urologists have continued to reconsider overtreatment for early-stage cancer, and many published works have compared watchful waiting and active surveillance with prostatectomy [15,16,28]. Research has shown no significant differences in overall survival (OS) or cause-specific survival (CSS) at 10 years between radical prostatectomy and watchful waiting with screening for clinically organ-confined prostate cancer [28]. Many studies are ongoing and might update the current opinion regarding the application of surgery for prostate cancer.

In recent decades, the standard treatment of urological diseases has been affected and updated by the results of important studies, such as the T100 articles, in the areas of indications, procedures, outcomes and complications. In addition to prostatectomy, the same trends can be seen regarding surgery for renal cancer. Professor Clayman RV described the first laparoscopic nephrectomy in 1991 [29], leading to the common adoption of laparoscopic nephrectomy for the treatment of renal masses. Nephron-sparing nephrectomy was first explored in 1990 and has become the first-line treatment for localized renal cell carcinoma [30,31]. Now, laparoscopic and robot-assisted nephrectomy and nephron-sparing nephrectomy, in addition to open surgery, are also recommended as first-line methods for the treatment of renal masses [31]. And the same could be seen in cystectomy [32]. It is noteworthy that the laparoscopic and robotic systems only affect perioperative morbidity, hospitalization duration, blood loss, and transfusion rates; they do not change the oncologic outcomes [28,31,33].

Our study also has several limitations. First, the 'obliteration by incorporation' phenomenon, in which a truly classic paper is less frequently cited as the body of information becomes integrated into current knowledge, likely affected our results [6]. Second, some recently published but important articles were excluded because they have not had sufficient time since publication to accrue as many citations as have the T100 articles. Third, articles in older journals may receive more citations [8].

## 5. Conclusions

We identified and bibliometrically analyzed the 100 most-cited articles in the field of urological surgery. The USA is the dominant country in terms of the numbers of T100 articles, scientists and institutions. The special journal *Journal of Urology* published the most T100 articles from 1991 to 2011. Surgery related to urological cancer has garnered the most academic attention, especially prostate cancer

and renal cancer. The prostate is the organ featured in the most T100 articles, which means that diseases related to the prostate, such as prostate cancer and BPH, have been the hot topics in the field of urological surgery.

#### Provenance and peer review

Not commissioned, externally peer-reviewed.

#### Consent for publication

Not applicable.

#### Availability of data and materials

All data generated or analyzed during this study are included in this published article and its supplementary information files.

#### Ethical approval

Not applicable.

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#### Research registration unique identifying number (UIN)

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1. Name of the registry:
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#### CRedit authorship contribution statement

**Lugeng He:** Writing - original draft, Conceptualization, Investigation, Data curation, Formal analysis. **Hui Fang:** Investigation, Data curation, Formal analysis, Methodology, Visualization, Writing - original draft. **Xuliang Wang:** Data curation, Investigation, Formal analysis. **Yuyong Wang:** Investigation, Data curation, Formal analysis. **Hongwei Ge:** Formal analysis, Investigation, Data curation, Writing - review & editing. **Chao Chen:** Writing - original draft, Methodology, Methodology, Visualization, Writing - review & editing. **Yuehua Wan:** Conceptualization. **Huadong He:** Conceptualization, Methodology, Visualization.

#### Declaration of competing interest

The authors declare that they have no competing interests.

#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijssu.2019.12.030>.

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