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## Trends in the Authorship of Peer Reviewed Publications in the Urology Literature

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### Abstract

**INTRODUCTION**—We evaluated the authorship count of all original research and review articles published in prominent Urology journals to trend patterns in authorship over the last decade. Secondly, we evaluated bibliometric assessments and sought to understand whether authorship count was associated with citation rate and each article’s field-normalized measure of impact.

**METHODS**—Information on authorship count, date of publication, study type, journal of publication, citation rate, and relative citation ratio (RCR) was collected for all original research and review articles published in *European Urology*, *Journal of Urology*, *Urology*, and *British Journal of Urology International* between 2006 and 2016. We examined trends in authorship count over the past decade, as well as between journals and article types.

**RESULTS**—21,336 articles were analyzed, of which 19,527 (91.5%) were original research and 1,809 (8.5%) were review articles. Overall, number of authors increased 46.1% from 2006 to 2016. Authorship counts in original research articles increased by an average of 2.45 per manuscript (43.3% increase) over the decade analyzed. More dramatically, authorship counts in review articles increased by an average of 3.14 per manuscript (92.6% increase). Articles with higher authorship counts were associated with more citations and greater RCR ( $r=0.13$ ,  $p<0.001$ ).

**CONCLUSION**—There is a global trend towards more authors per article in urology publications-in both original research publications and review articles, and across each of the individual journals evaluated. An increase in author count has also been associated with increased citations and measures of article impact.

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## Keywords

Journals; Manuscripts; Citations; Impact factor; H-index; Academic urology

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## INTRODUCTION

The number of authors contributing to a single publication has been increasing across various academic disciplines.<sup>1-4</sup> A recent article in *The Economist* reported the average number of authors per scientific paper increased from 3.2 to 4.4 over the last 20 years.<sup>5</sup> Multiple explanations have been offered, with author inflation and increasing complexity of research as the main opposing theories.<sup>6, 7</sup> Author inflation is defined as “the growth in number of people receiving authorship credit on published reports in biomedical sciences”.<sup>6</sup> Alternatively, advances in research may have lead to more complex designs requiring greater collaborative efforts and more contributors.<sup>7</sup> While there is a moderate body of data on authorship trends in certain specialties, little has been produced within the discipline of Urology, with only one study addressing authorship in urology specific journals.<sup>8</sup> Increased knowledge of trends in authorship within urologic research would help editors and readers alike compare the author contributions of various publications and journals in the field. This comparison may be useful in assessing the quality of individual research papers and the impact of various journals in the discipline. This could lead to a better body of literature and in-turn improves references that lead to better patient care. In this study, we will compare the number of authors of all original research publications and review articles published over the last decade in four prominent journals in the field of urology: *European Urology (EU)*, *Journal of Urology (JU)*, *Urology*, and *British Journal of Urology International (BJUI)* and investigate possible explanation of trends.

## MATERIALS AND METHODS

For this analysis, we queried PubMed for data on journal, date of publication, study type, and authorship count for all original research papers and review articles in *EU*, *JU*, *Urology*, and *BJUI* from January 2006 through December 2016. All other types of published material in these journals including case reports, letters to the editor, guideline statements, editorials, errata, and biographical works were omitted. These urology journals were selected for their broad readership, high impact factors, and breadth of general urology and urologic subspecialty topics. The period of analysis was selected as the past decade to allow for contemporary relevance, provide adequate sample size, and maintain consistent data parameters collection using the search tools employed. There was a policy limiting the quantity of authors associated with certain publications in PubMed though mid-year 2005.<sup>9</sup>

iCite, the National Institutes of Health (NIH) Office of the Director’s portfolio analysis platform, was queried for linked data on article citation rate and relative citation ratio (RCR). RCR is a field-normalize measure of citation impact that accounts for discipline and time of publication.<sup>10</sup> We examined trends in authorship count over the past decade in all four journals combined as well as trends between each journal. We also analyzed how trends

changed between publication types. Finally, we correlated the number of authors to the RCR for those articles with such data available for analysis.

Author count was treated as a continuous variable, and means were compared using the appropriate statistical tests: ANOVA with Tukey's post hoc test for comparison between journals and T-test for comparison between study type and time. Statistical significance was defined at a p-value threshold of 0.05. Correlation between RCR and manuscript characteristics was evaluated using univariate linear regression for nominal variables and univariate logistic regression for categorical variables. IRB approval was not necessary, as our study did not involve human subjects.

## RESULTS

Overall trends in authorship of urology manuscripts published between 2006-2016 are summarized in Table 1 and Figure 1. A total of 21,336 publications fit the inclusion criteria for analysis and were reviewed. Of these, 19,527 (91.5%) were original research publications and 1,809 (8.5%) were review articles. Original articles had greater authorship count when compared to review articles (6.80 vs. 5.43,  $p < 0.001$ ). For original research manuscripts, authorship count increased by an average of 2.45 authors (43.5%) from 2006 to 2016. Similar, but more dramatic results were observed in review articles. Authorship increasing by 3.14 authors (92.6% increase) during the same study period.

Trends in authorship by journal is displayed in Figure 2. Over the decade-long analysis period, *EU* consistently had the greatest authorship count for both original research and review articles compared to the three other high-impact general urology journals: *EU* (9.01 and 7.47, respectively) *BJUI* (7.12 and 4.65, respectively), *JU* (5.72 and 4.58, respectively), and *Urology* (5.98 and 4.51, respectively). The post hoc test revealed a significant difference ( $p < 0.001$ ) between all journals. Amongst the four journals, *EU* published the highest percentage of review articles, while *JU* published the lowest: *EU* 19.5%, *BJUI* 11.0%, *Urology* 5.45%, and *JU* 5.29%,  $p < 0.001$  between all journals. For original research manuscripts, the greatest absolute authorship and percent increase were seen in *EU*, while *Urology* displayed the smallest increase: *EU* 4.27 authors (64.6%), *BJUI* 3.39 authors (61.7%), *JU* 2.36 authors (41.3%), *Urology* 0.95 authors (17.3%),  $p < 0.001$  between all journals. Similar to the trends seen in original articles, the greatest absolute authorship and percent increase were seen in *EU* for review articles: *EU* 5.44 authors (142%), *JU* 2.81 authors (96.2%), *BJUI* 2.52 authors (86.6%), and *Urology* 0.29 (7.6%),  $p < 0.001$  between all journals.

Trends in impact metrics is displayed in Table 2. Citation and RCR data for articles published in 2016 was not available at the time of this analysis. Furthermore, data for articles published *BJUI* were not analyzed by iCite. Number of citations was  $18.94 \pm 32.45$  for the original research publications and  $40.8 \pm 58.44$  for review articles. RCR for original research was lower than that of review articles, 1.53 vs. 3.57. For original research publications, citations were highest in *EU*: *EU* 36.98, *JU* 20.48, *Urology* 10.97. RCR, as expected, followed similar trends as citation rate between the respective journals with *EU* having the greatest: *EU* 3.06, *JU* 1.60, *Urology* 0.92,  $p < 0.001$  between all journals. For

review articles, citations were highest in *EU*: *EU* 64.8, *JU* 33.42, *Urology* 12.73. RCR followed similar trends as citation rate: *EU* 5.93, *JU* 2.53, *Urology* 1.12,  $p < 0.001$  between all journals. There is a positive linear relationship between the number of authors and the RCR ( $r = 0.13$ ,  $p < 0.001$ ). There was also a significant correlation between journal and RCR ( $p < 0.001$ ) The type of manuscript, original research versus review articles, was not predictive of a publication's RCR value ( $p = 0.24$ ).

## DISCUSSION

Publications in peer-reviewed journals are the primary means of communication amongst medical professionals and the major mechanism for forging scientific progress. Urology, like many specialties, is a discipline in which academic endeavors are highly valued. In all areas of academic medicine, the more papers one writes the further one's career progresses. Increases in authorship have been well documented in other specialties.<sup>1-3</sup> Although this trend has been suspected in urology literature, no research has previously examined this hypothesis.

We were able to demonstrate a significant increase in authors per Urology publications over the last decade- 46.1% increase overall. There was a greater percent growth in the number of co-authors for review articles as compared to review articles- 43.3% increase in original research manuscripts, and 92.6% increase in review articles. Interestingly, this differs from trends seen in the radiology literature, which has had a greater increase in authorship seen in original research publications over review articles (25.8% vs 14.0%,  $p = 0.006$ ).<sup>2</sup> When analysis was stratified by journal, increased authorship was observed for both original research and review articles in all four journals. *EU* consistently had the greatest authorship count and the greatest percent increase in authorship. An increase in author count was also associated with increased citations and measure of article impact, RCR. Although many reasons have been postulated for the cause of increasing authorship, the most common explanation has been academic pressure to publish. An academic urologist's publication list is often a critical factor for career advancement, as it is frequently viewed as a fiduciary of their research productivity.<sup>11</sup> In addition, there has been decreased NIH funding for medical sciences since the start of the millennium.<sup>12-15</sup> These two factors however are not entirely negative. While it may result in author padding, the desire to both appear in impactful journals and gain access to increasingly scarce resources also encourages collaboration to allow for the more complex projects.<sup>2, 7, 16</sup>

In our study, we found that number of authors is correlated with the RCR papers ( $r = 0.13$ ,  $p < 0.001$ ). This gives support to the theory of increasing specialization and drawing of experts for more impactful studies. As medical knowledge advances there is increased collaboration among departments and institutions in both medical practice and research.<sup>17-19</sup> It is likely that multidisciplinary and multi-institutional efforts would garner a higher number of authors even if not in the setting of randomized trials. For instance, multi-institutional consortia reporting large datasets for clinical outcomes or comparative effectiveness requires authors to be represented from a number of different departments or institutions. In a study looking at biological scientific literature found the number of tables and figures in the average scientific paper has dramatically increased- almost double the

number 2 decades ago.<sup>20</sup> Furthermore, the number of pages per manuscript has also increased, as did the number of references.<sup>20</sup> Although speculative, it is reasonable to venture that authors are more inclined to submit their more extensive and complex studies to journals with the highest possible readership exposure. It may also be possible that EU and BJUI are receiving more submissions from non-US researchers who are conducting more multi-institutional or even international collaborations.

Another explanation for the increasing number of authors is the increasing scientific requirements of peer-reviewed publications. Most clinical-based physician researchers do not have formal training in difficult statistical methods and computer programming language needed for contemporary research. Ancillary staff such as research coordinators, statisticians, database managers, and nurses is often added to the list of authors if they had major contributions to research efforts. Increase in the competitiveness of urology training spots have also led to more medical students and residents to pursue research. Although we cannot definitively quantify this hypothesis, we can extrapolate from observations seen at academic centers and from interviewees. Lastly, developments in contemporary technology have improved the research process, workflow, and collaborative efforts via the Internet. Extensive academic networks have developed, opening opportunities for online collaboration, and more collaborators per work. Online resources for research are increasing and improving; there will likely be even more web-based collaborations in the coming future.

There are two primary limitations of our study. First, our analysis was only limited to four journals within Urology. These journals were selected for their quality and readership. Although our findings were likely to be representative, they may not apply to all Urology journals. Furthermore, it did not include literature from our field published in non-urology designated journals. For the purposes of this analysis, however, we believe this limitation did not affect our results substantially. Contributors to those excluded manuscripts were likely the same group who published manuscripts included in this analysis. Secondly, we were not able to assess and adjust for the increasing complexity in contemporary research. Quantifying and normalizing a metric to evaluate complexity, multidisciplinary efforts, and multi-institutional studies- even within one discipline- is immensely difficult. Therefore, our study was not able to objectively quantify research complexity and correlate this with author number.

Our growing fund of medical knowledge has allowed us to conduct large-scale scientific inquiries that are often cross-discipline. The pressing need for publication in an competitive academic environment has led to more awareness over the appropriateness of authorship based upon contribution to any given publication. To ensure that authorship is fair and commensurate with the level of intellectual contribution, there have been revisions to authorship guidelines.<sup>21</sup> The International Committee of Medical Journal Editors (ICMJE), which published its first set of guidelines in 1979, began revising their recommendations annually in 2013.<sup>22</sup>

Despite updated criteria for authorship in peer-reviewed scientific publications, the practice of “honorary authorship” is believed to have continued. Future directions include expanding

our study to include additional journals and comparing single institution to multi- institution studies as well as studies with collaboration across multiple disciplines. As our research environment, tools, and practices continue to evolve, it may become worthwhile to correlate authorship trends with a field normalized measurement of research complexity. Addressing study design changes over time, once such analytical capabilities become available, could enhance our understanding of these trends. Another future direction include expanding our study to include and compare surgical subspecialties. These findings are likely not limited to our field of expertise, and may be of interest. Comparing publication practices with similar specialties may help us postulate whether what we observed is from general research advancement, or from practice changes within the specialty. It may also be useful for the academic medical community to implement new standards to guide authors to appropriately determine deserved authorship.

We cautious that these are preliminary findings and may require further study before firm conclusions can be made regarding the causes and implication. However, findings such as ours are likely not limited to our field of expertise, and it may be of interest to conduct similar studies in other medical and surgical specialties. It may be of interest for the academic medical community to determine whether similar patterns are pervasive in other fields, in order to implement new standards to guide authors to appropriately determine deserved authorship.

Contemporary advances in research technology and improved medical knowledge have accelerated these academic endeavors. However, the cost associated with generating high value medical research, funding restrictions, risks associated with medical publishing, and the pressures to publish more papers may have pushed academic urologists to adapt to new strategies. These factors may have motivated academic urologists to increase collaborative efforts within and outside of urology in order to pool together resources, and to fractionate the risk through co-authorship.

## CONCLUSIONS

In summary, our descriptive study documented a global trend towards more authors per article in urology publications over the past decade. This trend holds true in both original research publications and in review articles, and across each of the individual journals evaluated. The causes of these trends are complex, but likely relates to the changing medical specialization and academic environment.

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## ABBREVIATIONS

<b>BJUI</b>	British Journal of Urology International
<b>EU</b>	European Urology

**JU** Journal of Urology  
**RCR** Relative Citation Ratio

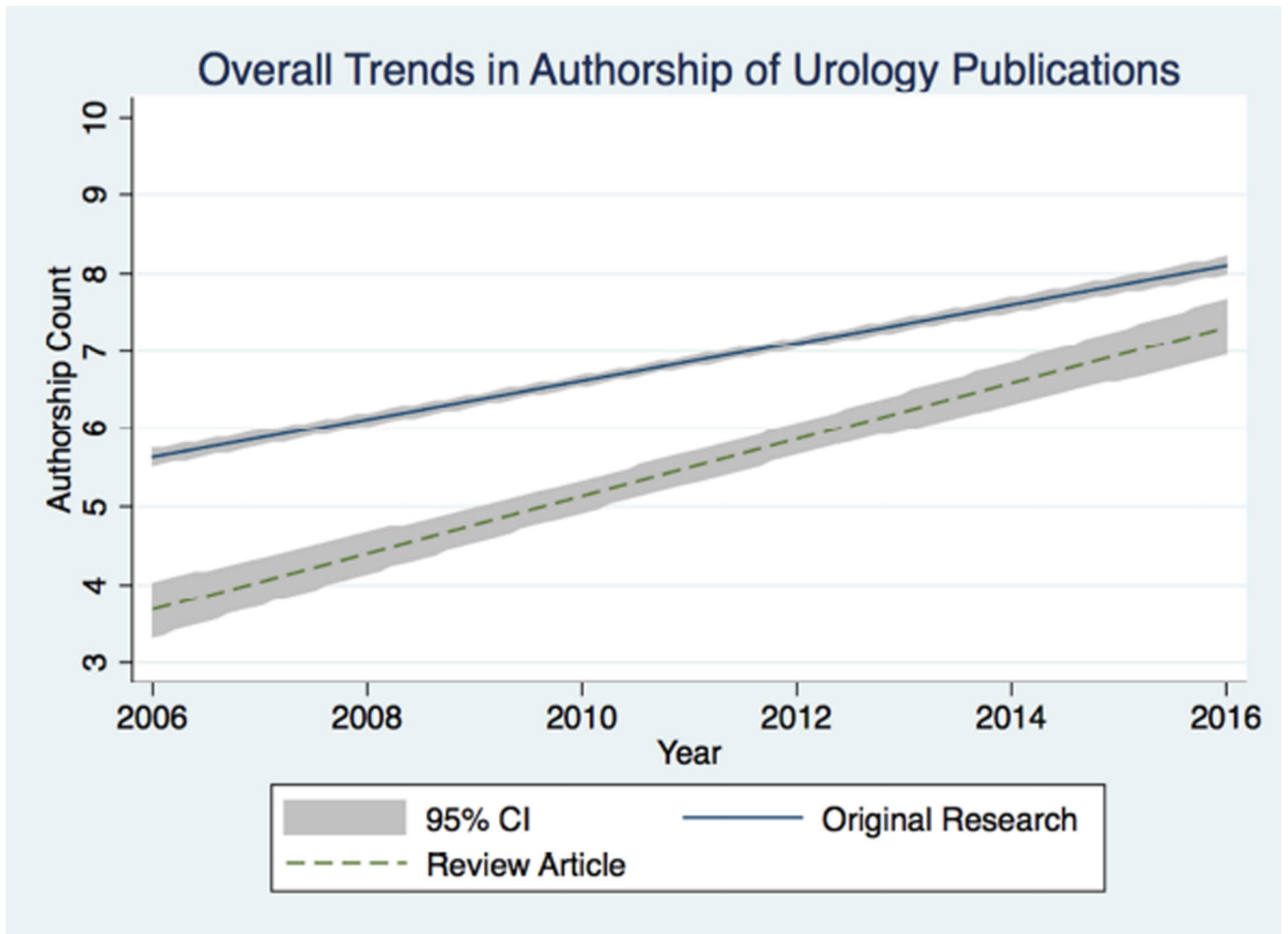
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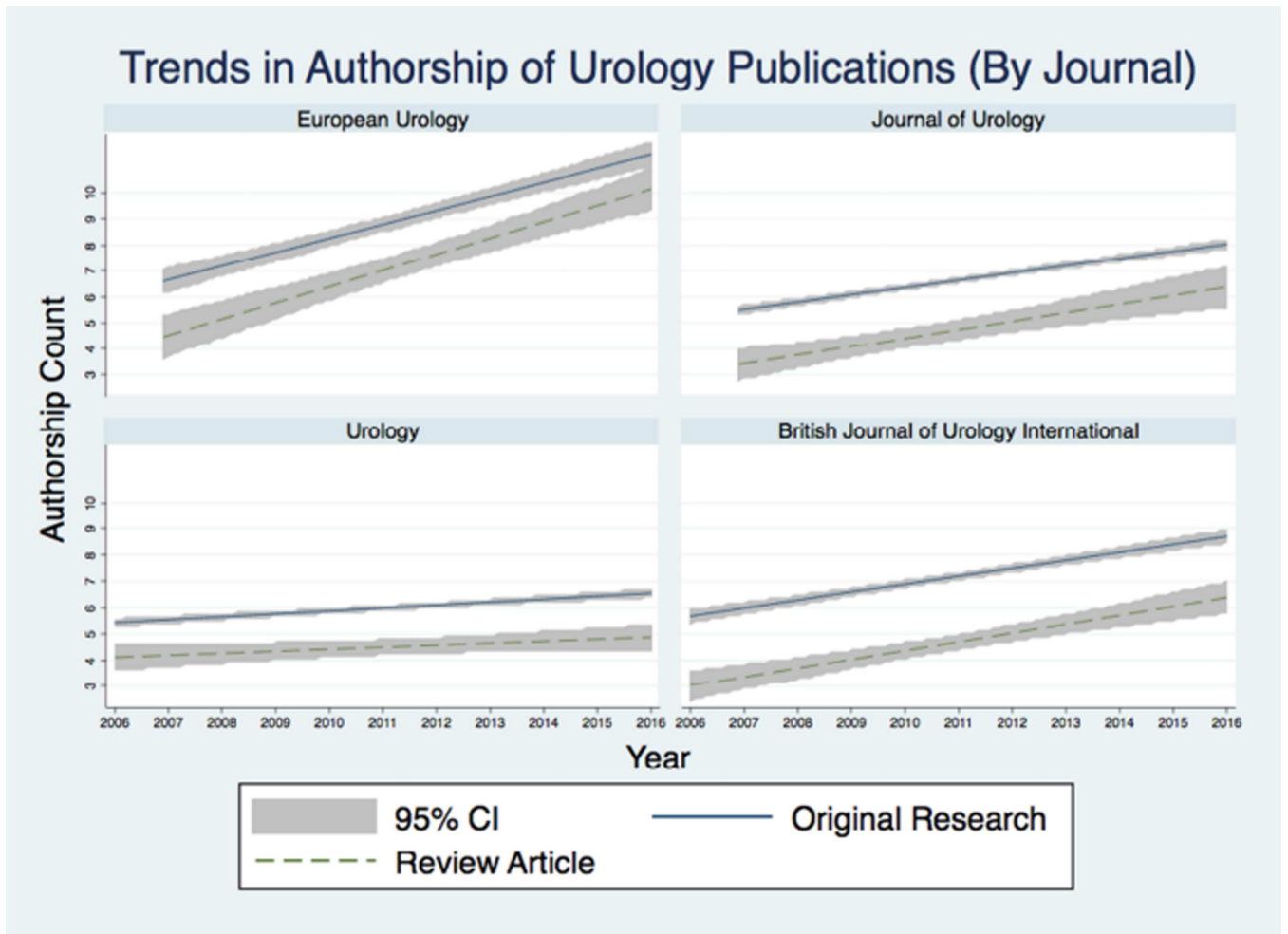
**Figure 1.**  
Overall trends in authorship of urology publications

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**Figure 2.** Trends in authorship of urology publications (by journal)

**Table 1**

Authorship trend in urology manuscripts between 2006–2016, by journal

	Overall	Eur Urol	J Urol	Urology	BJUI	p-value, between journals
Original and review articles, n	21,336	2,769	7,089	6,661	4,817	
No. authors, overall	6.69 (0.28)	8.69 (6.04)	6.53 (3.41)	5.90 (2.76)	6.85 (3.87)	<0.001
No. authors, 2006	5.49 (2.43)	6.11 (2.71)	5.53 (2.44)	5.32 (2.28)	5.33 (2.45)	
No. authors, 2016	8.02 (4.49)	10.57 (6.10)	8.01 (3.68)	6.30 (3.20)	8.67 (4.45)	
p-value, 2006 vs 2016	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
Authorship change	2.53	4.46	2.48	0.98	3.34	
Percent change 10yr, %	46.1	73	44.8	18.4	62.7	
Original articles, n (%)	19,527 (91.5)	2,228 (80.5)	6,714 (94.7)	6,298 (94.6)	4,287 (89.0)	<0.001
No. authors, overall	6.80 (3.84)	9.01 (6.16)	6.64 (3.37)	5.98 (2.75)	7.12 (3.87)	<0.001
No. authors, 2006	5.66 (2.39)	6.61 (2.62)	5.72 (2.37)	5.49 (2.40)	5.49 (2.40)	
No. authors, 2016	8.11 (4.44)	10.88 (6.14)	8.08 (3.68)	6.44 (3.19)	8.86 (4.44)	
p-value, 2006 vs 2016	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
Authorship change	2.45	4.27	2.36	0.95	3.39	
Percent change 10yr, %	43.3	64.6	41.3	17.3	61.7	
Review articles, n (%)	1,809 (8.5)	541 (19.5)	375 (5.29)	363 (5.45)	530 (11.0)	<0.001
No. authors, overall	5.43 (4.10)	7.41 (5.32)	4.58 (3.50)	4.51 (2.48)	4.65 (3.17)	<0.001
No. authors, 2006	3.39 (1.97)	3.83 (1.80)	2.92 (2.00)	3.81 (2.02)	2.91 (1.88)	
No. authors, 2016	6.53 (4.86)	9.27 (5.77)	5.73 (3.08)	4.10 (2.35)	5.43 (3.12)	
p-value, 2006 vs 2016	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001	p<0.001
Authorship change	3.14	5.44	2.81	0.29	2.52	
Percent change 10yr, %	92.6	142	96.2	7.6	86.6	

Values are expressed as means (standard deviation) unless otherwise specified

EU= European Urology; JU= Journal of Urology; BJUI= British Journal of Urology International.

**Table 2**

Journal and manuscript impact metrics, by journal

	Overall	Eur Urol	J Urol	Urology	BJUI	p-value
JCR Impact Factor 2015		14.98	4.7	2.1	1.69	
Original Research						
No. citations	18.94 (32.45)	36.98 (54.80)	20.48 (30.94)	10.97 (16.95)	*N/A	<0.001
RCR per manuscript	1.53 (2.51)	3.06 (4.71)	1.60 (2.12)	0.92 (1.19)	*N/A	<0.001
Review Articles						
No. citations	40.85 (58.44)	64.80 (74.71)	33.42 (39.61)	12.73 (19.94)	*N/A	<0.001
RCR per manuscript	3.57 (5.80)	5.93(7.90)	2.53 (2.90)	1.12 (1.28)	*N/A	<0.001

Values are expressed as means (standard deviation) unless otherwise specified.

\* Citation rate and RCR were not available at the time of this analysis from the iCite database.

RCR= Relative Citation Ratio JCR=Journal Citation Reports<sup>13</sup>; EU= European Urology; JU= Journal of Urology; BJUI= British Journal of Urology International.