

The impact the COVID-19 pandemic on urology literature: a bibliometric analysis

Fabio Crocerossa^{1,2#}, William Visser^{1#}, Umberto Carbonara^{1,3}, Ugo Giovanni Falagario⁴, Savio Domenico Pandolfo^{1,5}, Davide Loizzo^{1,3}, Ciro Imbimbo⁵, Adam P. Klausner¹, Francesco Porpiglia⁶, Rocco Damiano², Francesco Cantiello², Riccardo Autorino¹

¹Division of Urology, VCU Health, Richmond, Virginia, USA

²Division of Urology, Magna Graecia University of Catanzaro, Catanzaro, Italy

³Department of Urology, Andrology and Kidney Transplantation Unit, University of Bari, Bari, Italy

⁴Urology and Renal Transplantation Unit, Department of Medical and Surgical Sciences, University of Foggia, Foggia, Italy

⁵Department of Neurosciences, Reproductive Sciences and Odontostomatology, University of Naples Federico II, Naples, Italy

⁶Division of Urology, San Luigi Hospital University of Turin, Orbassano, Italy

[#]equally contributed

Citation: Crocerossa F, Visser W, Carbonara U, et al. The impact of COVID 19 pandemic on urology literature: a bibliometric analysis. Cent European J Urol. 2022; 75: 102-109.

Article history

Submitted: Dec. 12, 2021

Accepted: Dec. 28, 2021

Published online: Jan. 13, 2022

Corresponding author

Riccardo Autorino
VCU Health
West Hospital
Division of Urology
1200 East Broad St.
23298 Richmond, VA, USA
phone: +1 804 8273 099
ricautor@gmail.com

Introduction The COVID-19 pandemic has caused wide-reaching change to many aspects of life on a worldwide scale. The impact of these changes on peer-reviewed research journals, including those dedicated to urology, is still unknown.

Material and methods The Web of Science database was queried to retrieve all COVID-19 urological articles written in English language and published between January 1st, 2020 and December 10th, 2021. Only original and review articles were considered. A bibliometric analysis of the total number of papers, citations, institutions and publishing journals was performed. Non-COVID-19 publications were also retrieved to compare the duration of publication stages.

Results A total of 428 COVID-19 articles and 14,874 non-COVID-19 articles were collected. Significant differences in the duration of all the publication stages were found between COVID-19 and non-COVID-19 articles (all $p < 0.001$). The most productive countries were the USA (100 articles), Italy (59 articles) and the United Kingdom (55 articles). The published literature has focused on four topics: COVID-19 genitourinary manifestations, management of urological diseases during the pandemic, repercussions on quality of life and impact on healthcare providers.

Conclusions A significant reduction in peer review time for COVID-19 articles might raise concerns regarding the quality of peer review itself. USA, Italy and UK published the highest number of COVID-19 related articles. Restrictive measures taken by governments to reduce the spread of infection had a strong impact on mental stress and anxiety of patients and healthcare professionals. A coerced deferral of diagnosis and treatment of emergencies and uro-oncological cases represented the most challenging task from a clinical standpoint.

Key Words: COVID-19 ↔ coronavirus ↔ bibliometric analysis ↔ urology ↔ trends

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic posed an unprecedented series of challenges to worldwide healthcare systems and severe repercussions

were also recorded on urologists and urological patients [1]. In most countries, practice has been limited for several months to emergent procedures and non-deferrable cancer surgeries, while other procedures have been largely discouraged with a tendency to postpone or not perform outpatient visits, interrupt

follow-up programs or omit in-person clinic appointments [2, 3]. Despite difficult times, Urology researchers have been eager to publish on this topic and several journals provided expedited review and publication processes for COVID-19 related articles.

A bibliometric analysis of the literature produced in two years of pandemic was performed to investigate publication trends and emerging issues regarding the impact of COVID-19 on the urology literature.

MATERIAL AND METHODS

The Web of Science database was queried on December 2021 to retrieve all COVID-19 urological articles written in English language and published between January 1st, 2020 and December 10th, 2021. Research area of urology was defined using the WC=(Urology & Nephrology) field tag. Only original and review articles were considered, whereas editorials, letters, and comments were excluded. Ultimately, the following search string was used to collect COVID-19 articles: TS=(‘2019-nCoV’ OR ‘COVID-19’ OR covid19 OR ‘SARS-CoV-2’ OR ‘HCoV-2019’ OR ‘hcov’ OR ‘NCOVID-19’ OR ncovid19 OR ‘severe acute respiratory syndrome coronavirus 2’ OR ‘severe acute respiratory syndrome corona virus 2’ OR ‘coronavirus’ OR ‘corona virus’) AND WC=(Urology & Nephrology) AND PY=(2020-2021) AND LA=(English) AND (DT=(Article) OR DT=(Review) OR DT=(EARLY ACCESS) OR DT=(NEWS ITEM)).

Bibliometric analysis was performed to quantitatively assess the total number of papers, citations, institutions and publishing journals. Non-COVID-19 publications in 2020 and 2021 were also retrieved for a comparative analysis. Publishing institution and country were defined based on the corresponding author data. Date of submission, revision, accep-

Table 2. Main characteristics of COVID-19 articles

Description	Results
Timespan	Jan. 2020–Dec. 2021
Sources (journals, books, etc.)	54
Documents	428
Average years from publication	0.393
Average citations per documents	6.911
Average citations per year per documents	4.48
References	8307
Document types	
Article	304
Article; early access	35
Article; proceedings paper	2
Review	78
Review; early access	9
Document contents	
Keywords plus (ID)	483
Top-10 IDs impact, care, management, risk, time, covid-19, outcomes, cancer, health, men	
Author's keywords (DE)	813
Top-10 DEs covid-19, urology, coronavirus, sars-cov-2, pandemic, telemedicine, prostate cancer, surgery, education, bladder cancer	
Authors	
Authors	2691
Author appearances	3491
Authors of single-authored documents	14
Authors of multi-authored documents	2677
Authors collaboration	
Single-authored documents	19
Documents per author	0.159
Authors per document	6.29
Co-authors per documents	8.16
Collaboration index	6.55

ID – Keywords plus; DE – Author keywords

Table 1. Top 10 most productive countries in COVID-19 literature

Country	Articles	Total citations	Citation impact
USA	100	587	5.9
Italy	59	810	13.7
United Kingdom	55	145	12.6
Turkey	38	139	3.7
China	29	517	17.8
Brazil	17	105	6.2
Germany	15	155	10.3
Canada	1	24	24
India	10	2	0.2
Iran	9	54	6

Table 3. Duration of publication stages for COVID-19 and non-COVID-19 articles published between January 2020 and December 2021

Publication stage	COVID-19 related	Mean	SD	p value
Submission-revision	0	84.455	59.962	<0.001
	1	64.827	43.855	
Revision-acceptance	0	16.011	15.623	<0.001
	1	12.357	16.675	
Acceptance-publication	0	30.549	29.913	<0.001
	1	23.000	21.250	
Submission-publication	0	131.016	74.125	<0.001
	1	100.184	55.927	

SD – standard deviation

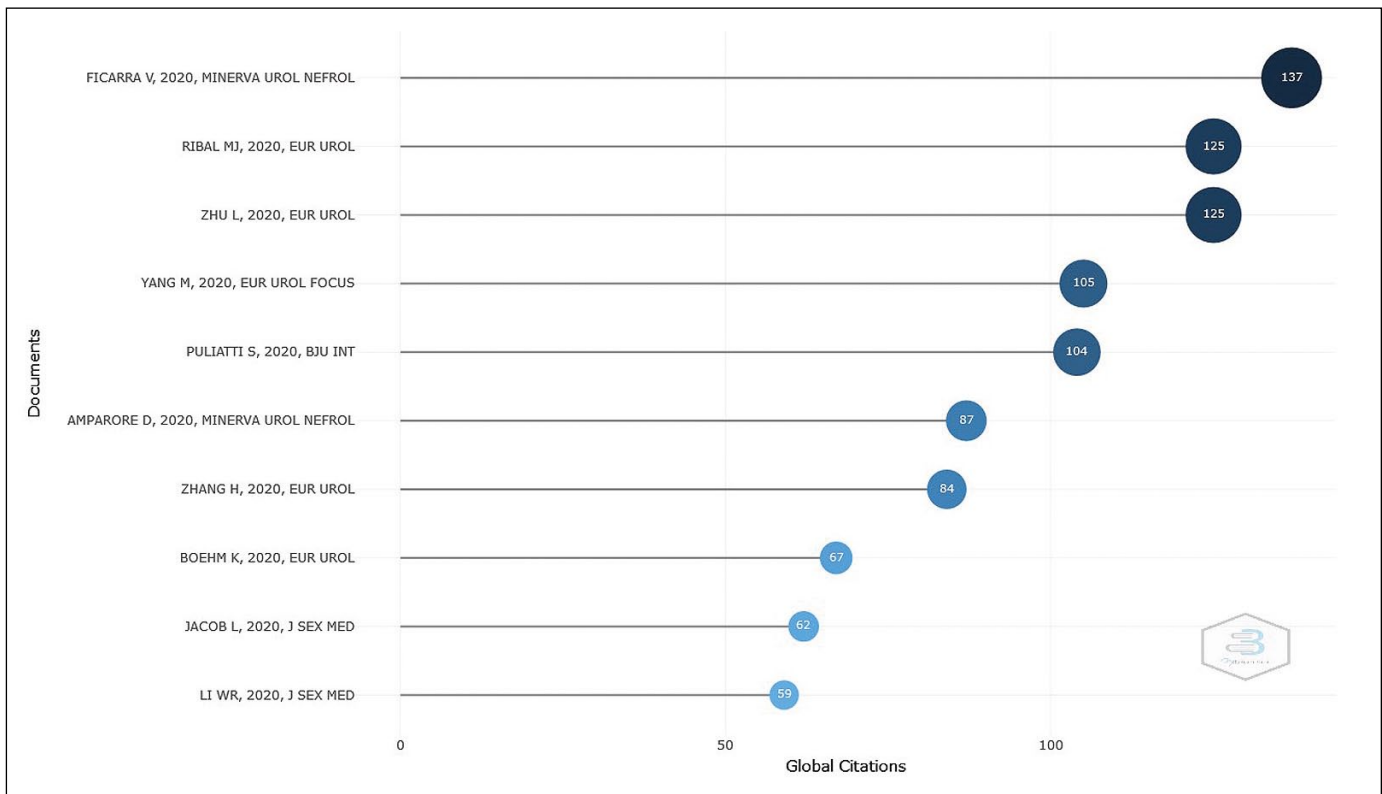


Figure 1. Most globally cited COVID-19-related articles published by urological journals in 2020–2021.

tance and online publication were obtained from the PUBMED database by using PHST and DEP fields. Differences in days between publication stages are reported as mean \pm standard deviation and compared by using the Mann-Whitney U test.

The bibliometrix R package was used for data extraction and analysis [4].

RESULTS

A total of 428 COVID-19 articles and 14,874 non-COVID-19 articles were published between January 2021 and December 2021. COVID-19 related publications included 341 original articles and 87 reviews (Table 2). Significant differences were found between COVID-19 and non-COVID-19 articles in the days required for all stages of publication, including the time from submission to review, from review to acceptance, and from acceptance to publication (all $p < 0.001$) (Table 3).

Overall, 428 articles received 2,958 citations, with a mean of 6.9 citations per article, which was near 5-times more than contemporaneous non COVID-19 articles (1.46 citations per article). The 10 most cited articles are shown in Figure 1.

The countries most involved in COVID-19 research are shown in Table 1. The highest citation impact val-

ues, defined as the ratio of citations received to the number of publications produced, were attributed to China, Italy, and United Kingdom. The most cited countries were Italy (810 citations), USA (587 citations) and China (517 citations). The most productive institutions are showed in Figure 2.

In the authorship pattern analysis, 19 articles were classified as single-authored and 409 as multi-authored documents. Between multi-authored articles, analysis of collaboration network found that the most frequent cooperation was between USA and UK (23 articles) and Italy and USA (20 articles) (Figure 3).

Keyword and topic analysis

The analysis of most frequently used keywords and their co-occurrence network identified 4 clusters (Figure 4), representing the following publication topics:

Urological manifestations of COVID-19 infection

Early evidence of the presence of the virus in semen and urine fuelled research on urogenital organ involvement in COVID-19 infection, including testis, kidney and bladder [5, 6, 7]. Studies have been further conducted on the pathogenetic mechanisms underlying COVID-19 urological symptoms or their

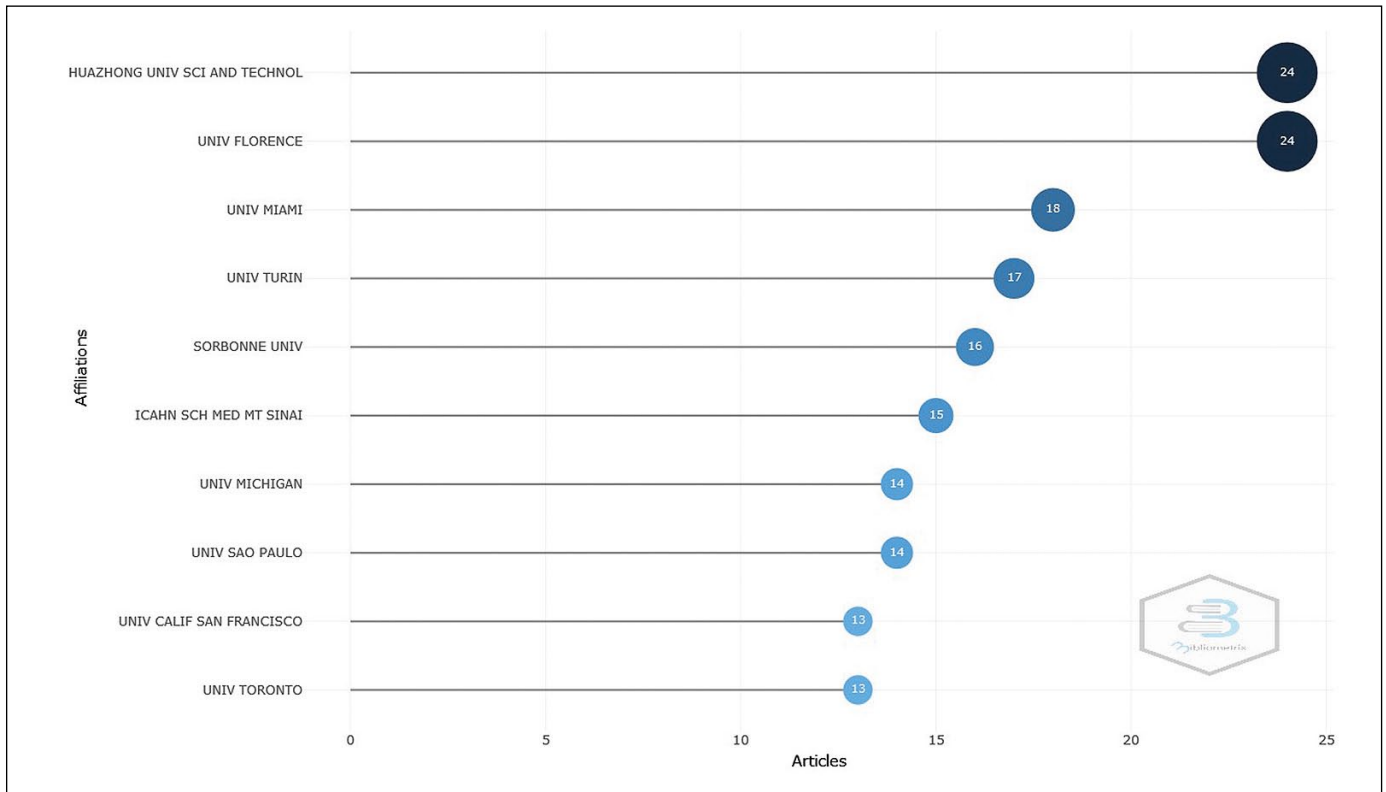


Figure 2. The top 10 institutions that published most of COVID-19 related articles.

influence in pre-existing urological diseases. The frequent reporting of COVID-related orchitis, possibly due to the high concentration of ACE-2 receptors in the testes, led the authors to explore the extent of testicular damage, frequently finding a significant inflammatory response but rarely associated with the direct presence of the virus in the testicles [8].

The relationship between male reproductive hormones and COVID-19 has been extensively investigated in studies on the risk of mortality or adverse outcomes in men with COVID-19 infection and testosterone deficiency or in androgen deprivation therapy (ADT) [9]. The use of ADT to lower TMPRSS2 expression in the lungs to prevent viral entry and to reduce the severity and duration of infection has been investigated, especially in prostate cancer patients [10]. BCG vaccination and PDE5 drugs were tested as protective factors for COVID-19 mortality [11, 12].

Elevated renal ACE-2 expression and the presence of viral mRNA in urine have shown possible mechanisms of COVID-19 kidney damage, mostly mediated by the activation of a cytokine storm and immune complex deposition [13]. The increased mortality and ICU admission for patients with COVID-19 infection and chronic kidney disease (CKD) and/or acute kidney injury (AKI) prompted investigations on the as-

sociation between COVID-19, CKD, haemodialysis, and other kidney disorders [14]. Worse COVID-19 outcomes in immunosuppressed patients have raised concerns about the management of kidney transplant recipients and renal cell carcinoma patients who deserved or were already undergoing immunotherapy during the pandemic [15].

Indirect effect of COVID-19 on urological conditions

These studies evaluated how the enforced safety measures applied have affected the management of urological diseases. During the pandemic, the referral patterns of people seeking help for urological conditions changed quantitatively and qualitatively [16]. Various Authors reported that major procedures and follow-up visits were more than halved, including emergencies [17]. Diagnostic delay or misdiagnosis may have a major impact on disease extent, clinical presentation and treatment, as well as risk of progression and survival in case of cancer.

Numerous studies focused on prioritization strategies for oncological or non-oncological procedures and produced general recommendations for deferring treatment or resumption of elective surgeries [2, 18–23]. Several authors described the adverse outcomes of delaying emergent cases of urinary stones and drew up

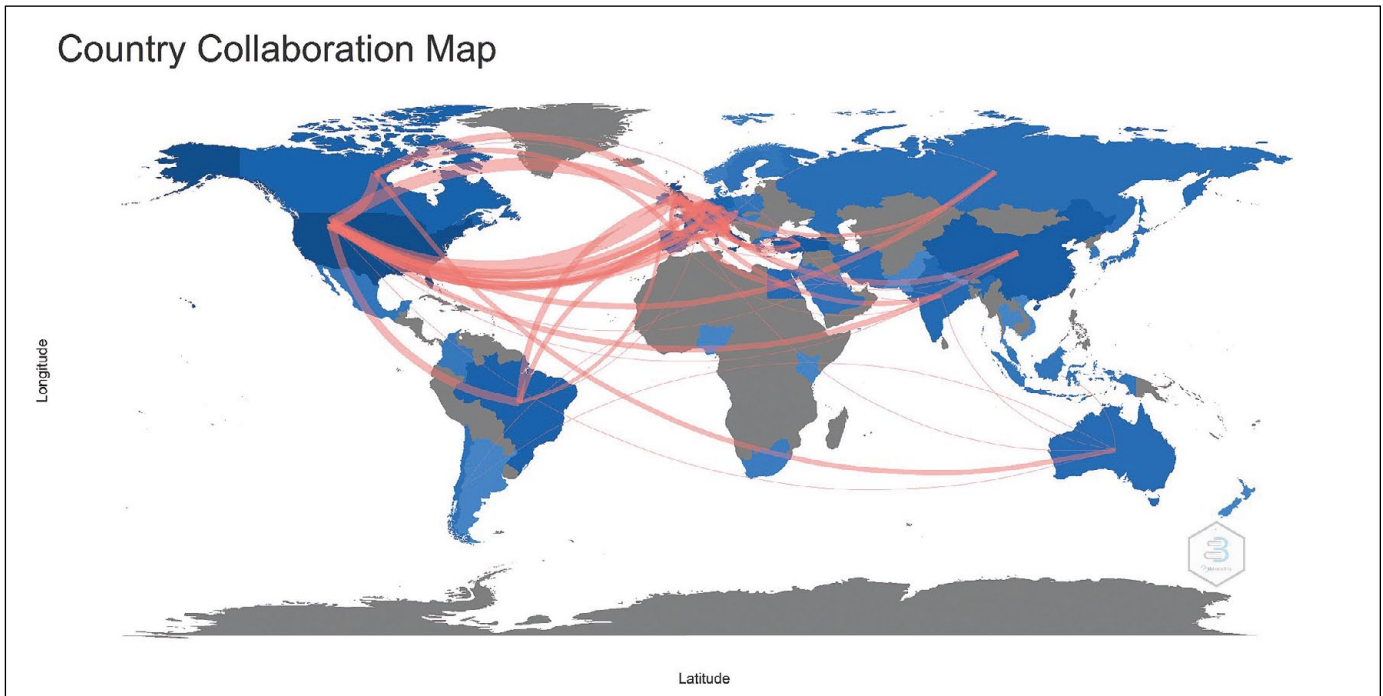


Figure 3. Country collaboration map.

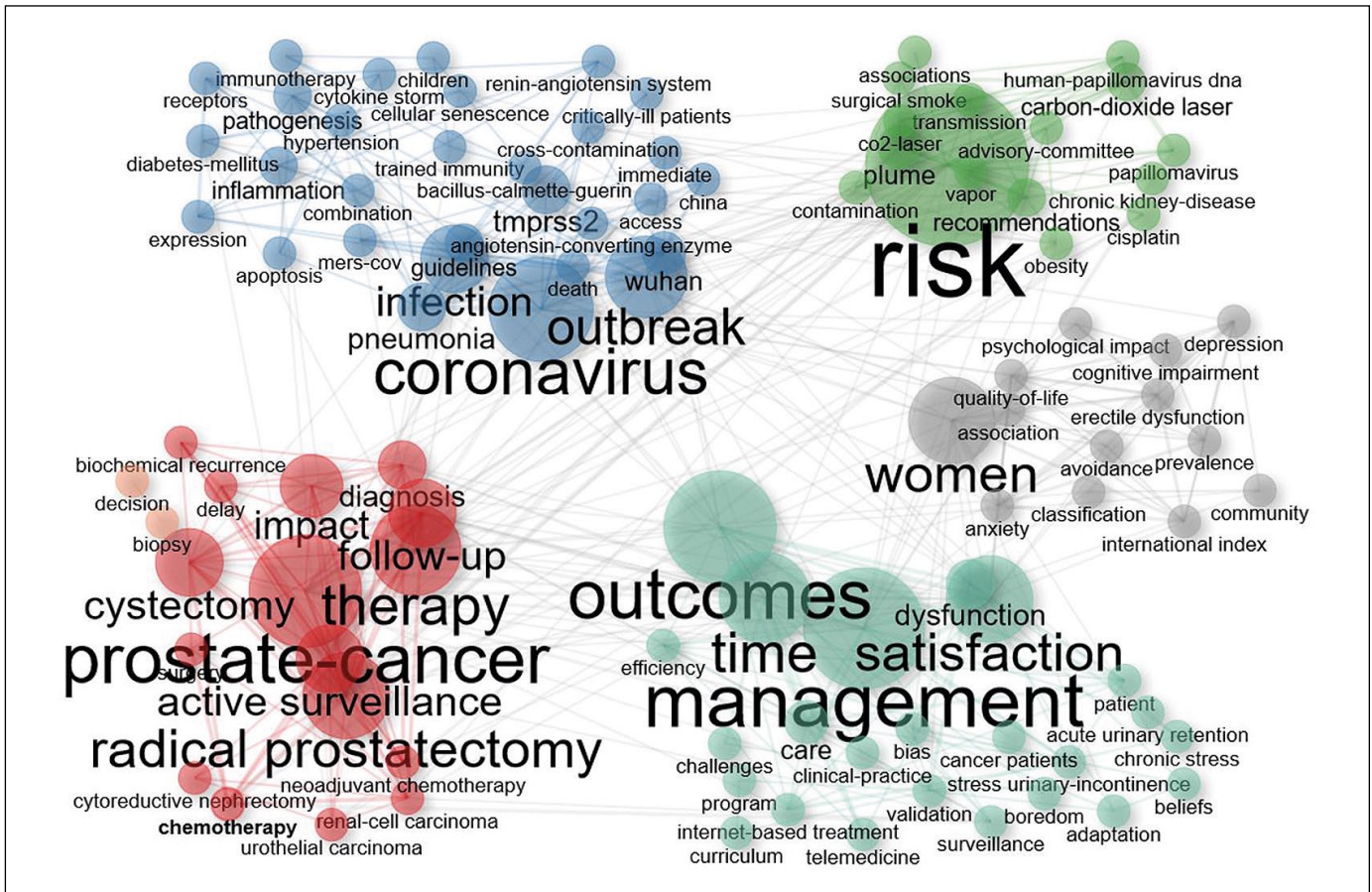


Figure 4. Thematic Map. Keywords were grouped according to the frequency of co-occurrence; for each cluster, the most used keywords were highlighted in a larger font.

guidelines for perioperative evaluation and treatment choice [24, 25]. The oncological and functional risk of treatment deferral for intermediate and high risk prostate cancer patients has been extensively studied [26]. Bladder cancer management was strongly influenced by the reorganization of surveillance schedules for non-muscle invasive bladder cancer and delay of chemioradioterapy for muscle-invasive bladder cancer [27]. To cope with the sharp decrease in admissions to surgery and outpatient services, researchers investigated alternative forms of assistance, mainly through telemedicine, evaluating which urological conditions were amenable to its use and the degree of acceptance by patients and healthcare professionals [28, 29, 30].

Repercussions on mental health, quality of life and sexuality

Studies focused on the effects of social distancing on sexual desire, activity and satisfaction, which led to anxiety, depression, especially in women and elderly [31, 32].

Impact on healthcare providers

High impact on mental stress, anxiety, and changes in sexual attitudes was reported also among health professionals [33]. Several studies assessed the safety and protection measures adopted by urologists, including knowledge of protocols, use of protective devices and strategies to reduce the risk of viral transmission [34]. Attention was paid to high-risk procedures, such as minimally invasive surgery, during which the infection could spread through fumes or CO₂ pneumoperitoneum [35].

The impact on training, particularly for residents, was weighted by the decrease in outpatient caseload, surgical exposure and the adoption of digital learning methods to compensate for training disruption [36, 37, 38].

DISCUSSION

As within other areas of scientific knowledge, an impressive number of COVID-19 (n = 428) articles have been published in urology in the past two years. For the same time frame, 14,874 non-COVID-19 urological articles were retrieved. These numbers demonstrate the effort made by the urological community to collect evidence and disseminate knowledge. Of the 428 COVID-19 articles, a relatively high proportion (20%) consisted of narrative or systematic reviews. The high average citation rate (6.9 citations per article) suggests worldwide attention on this top-

ic and how researchers and clinicians have sought to gather all available evidence to summarize and address emerging needs. A ratio of 0.34 was calculated between local citations (citations received from another urological article on COVID-19) and global citations (citations received from any other publication). This relatively high ratio can be explained by the high number of reviews, which tend to increase local citations mostly by synthesizing evidence gathered from other articles. However, this may also reflect how little these articles have contributed to increasing knowledge of pathophysiology, clinical manifestations, and treatments of COVID-19.

Significant differences were found between COVID-19 and non-COVID-19 articles in the days required for all stages of publication, including the time for review, for acceptance and for publication. The overall time from submission to publication was 100 ± 56 days for COVID-19 and 131 ± 76 days for non-COVID-19 related articles (p < 0.001). The faster peer review and publication process reflects the unique nature of the COVID-19 pandemic, however it could profoundly affect the accuracy and quality of the articles [39].

Higher number of citations and citation impact values were attributed to the countries who experienced the first (China) and secondary (Europe and USA) spread of COVID-19 [40]. These results are in line with findings in bibliometric studies in other areas. Likewise, the most productive institutions belonged to the same geographic areas.

In multi-authored documents, Italy and USA and UK were the countries that collaborated the most. The high rate of international collaboration between the Americas and Europe demonstrates the need to find shared solutions to the same problems between countries with similar health systems.

This bibliometric analysis was performed using the WOS database. The search strategy was as comprehensive as possible, and the data was thoroughly analysed. However, the results may differ according to other databases (e.g. Scopus) or by including different search terms. Given the importance of the topic and the current trend of increasing number of COVID-19 publications, the quantitative results provided by this analysis are bound to inevitably change in the coming months.

CONCLUSIONS

The COVID-19 pandemic has significantly impacted the Urology literature over the past two years. A significant reduction in peer review time might raise concern regarding the quality of peer review processes, and it certainly reflects the exceptional features

of the pandemic. Urology researchers have investigated on topics related to the impact of COVID-19 at different levels and within different domains. Restrictive measures taken by governments to reduce the spread of infection had a strong impact on several aspects of urological practice, including mental stress and anxiety of patients and healthcare professionals. A coerced deferral of diagnosis and treatment of several urological emergencies and uro-oncological cases represented the most challenging task from a clinical

standpoint. USA, Italy and UK published the highest number of COVID-19 related articles, mirroring the geographic dissemination of the virus over different time frames. Trends in literature are likely to change over time as researchers remain motivated to understand how the virus affects the urological community and clinical practice.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

References

- Wallis CJD, Catto JWF, et al. The Impact of the COVID-19 Pandemic on Genitourinary Cancer Care: Re-envisioning the Future. *Eur Urol.* 2020; 78: 731-742.
- Campi R, Amparore D, Capitanio U, et al. Assessing the Burden of Nondeferrable Major Uro-oncologic Surgery to Guide Prioritisation Strategies During the COVID-19 Pandemic: Insights from Three Italian High-volume Referral Centres. *Eur Urol.* 2020; 78: 11-15.
- Puliatti S, Eissa A, Eissa R, et al. COVID-19 and urology: a comprehensive review of the literature. *BJU Int.* 2020; 125: E7-E14.
- Aria M, Cuccurullo C. bibliometrix: An R-tool for comprehensive science mapping analysis. *J Informetr.* 2017; 11: 959-975.
- Chan VWS, Chiu PKF, Yee CH, Yuan Y, Ng CF, Teoh JYC. A systematic review on COVID-19: urological manifestations, viral RNA detection and special considerations in urological conditions. *World J Urol.* 2021; 39: 3127-313.
- Khalili MA, Leisegang K, Majzoub A, et al. Male fertility and the COVID-19 pandemic: Systematic review of the literature. *World J Mens Health.* 2020; 38: 1-15.
- Kashi AH, de la Rosette J, Amini E, Abdi H, Fallahkarkan M, Vaezjalali M. Urinary viral shedding of COVID-19 and its clinical associations: A systematic review and meta-analysis of observational studies. *Urol J.* 2020; 16: 1-28.
- Yang M, Chen S, Huang B, et al. Pathological Findings in the Testes of COVID-19 Patients: Clinical Implications. *Eur Urol Focus.* 2020; 6: 1124-1129.
- Kadihasanoglu M, Aktas S, Yardimci E, Aral H, Kadioglu A. SARS-CoV-2 Pneumonia Affects Male Reproductive Hormone Levels: A Prospective, Cohort Study. *J Sex Med.* 2021; 18: 256-264.
- Bahmad HF, Abou-Kheir W. Crosstalk between COVID-19 and prostate cancer. *Prostate Cancer Prostatic Dis.* 2020; 23: 561-563.
- Gallegos H, Rojas PA, Sepúlveda F, Zúñiga Á, San Francisco IF. Protective role of intravesical BCG in COVID-19 severity. *BMC Urol.* 2021; 21: 50.
- Mostafa T. Could Oral Phosphodiesterase 5 Inhibitors Have a Potential Adjuvant Role in Combating COVID-19 Infection? *Sex Med Rev.* 2021; 9: 15-22.
- Lv W, Wu M, Ren Y, et al. Coronavirus Disease 2019: Coronaviruses and Kidney Injury. *J Urol.* 2020; 204: 918-925.
- Zhang H, Chen Y, Yuan Q, et al. Identification of Kidney Transplant Recipients with Coronavirus Disease 2019. *Eur Urol.* 2020; 77: 742-747.
- Zhu L, Gong N, Liu B, et al. Coronavirus Disease 2019 Pneumonia in Immunosuppressed Renal Transplant Recipients: A Summary of 10 Confirmed Cases in Wuhan, China. *Eur Urol.* 2020; 77: 748-754.
- Teoh JYC, Ong WLK, Gonzalez-Padilla D, et al. A Global Survey on the Impact of COVID-19 on Urological Services. *Eur Urol.* 2020; 78: 265-275.
- Motterle G, Morlacco A, Iafrate M, et al. The impact of COVID-19 pandemic on urological emergencies: a single-center experience. *World J Urol.* 2020; 39: 1985-1989.
- Amparore D, Campi R, Checcucci E, et al. Forecasting the Future of Urology Practice: A Comprehensive Review of the Recommendations by International and European Associations on Priority Procedures During the COVID-19 Pandemic. *Eur Urol Focus.* 2020; 6: 1032-1048.
- Ficarra V, Novara G, Abrate A, et al. Urology practice during the COVID-19 pandemic. *Minerva Uro Nefrol.* 2020; 72: 369-375.
- Branche B, Carbonara U, Crocerozza F, Autorino R, Hampton LJ. Robotic urological surgery in the time of COVID-19: Challenges and solutions. *Urol Pract.* 2020; 7: 547-553.
- Quarto G, Grimaldi G, Castaldo L, et al. Avoiding disruption of timely surgical management of genitourinary cancers during the early phase of the COVID-19 pandemic. *BJU Int.* 2020; 126: 425-427.
- Ribal MJ, Cornford P, Briganti A, et al. European Association of Urology Guidelines Office Rapid Reaction Group: An Organisation-wide Collaborative Effort to Adapt the European Association of Urology Guidelines Recommendations to the Coronavirus Disease 2019 Era. *Eur Urol.* 2020; 78: 21-28.
- Minervini A, Di Maida F, Mari A, et al. Perioperative outcomes of patients undergoing urological elective surgery during the COVID-19 pandemic: a national overview across 28 Italian institutions. *Cent European J Urol.* 2021; 74: 259-268.
- Heijkoop B, Galiabovitch E, York N, Webb D. Consensus of multiple national guidelines: agreed strategies for initial stone management during COVID-19. *World J Urol.* 2021; 39: 3161-3174.
- Fentes DP, Baltar CF, Otero JN, Gil RD, Sampedro FG. The SCQ-SCORE: Initial validation of a new scoring system for elective stone surgery prioritization in the COVID-19 era. *Cent European J Urol.* 2021; 74: 81-88.

26. Laukhtina E, Sari Motlagh R, Mori K, et al. Oncologic impact of delaying radical prostatectomy in men with intermediate- and high-risk prostate cancer: a systematic review. *World J Urol.* 2021; 39: 4085-4099.
27. Fischer-Valuck BW, Michalski JM, Harton JG, et al. Management of Muscle-Invasive Bladder Cancer During a Pandemic: Impact of Treatment Delay on Survival Outcomes for Patients Treated With Definitive Concurrent Chemoradiotherapy. *Clin Genitourin Canc.* 2021; 19: 41-46.e1.
28. Pinar U, Anract J, Perrot O, et al. Preliminary assessment of patient and physician satisfaction with the use of teleconsultation in urology during the COVID-19 pandemic. *World J Urol.* 2020; 39: 1991-1996.
29. Boehm K, Ziewers S, Brandt MP, et al. Telemedicine Online Visits in Urology During the COVID-19 Pandemic - Potential, Risk Factors, and Patients' Perspective. *Eur Urol.* 2020; 78: 16-20.
30. Hameed BMZ, Shah M, Naik N, Reddy SJ, Somani BK. Use of ureteric stent related mobile phone application (UROSTENTZ App) in COVID-19 for improving patient communication and safety: a prospective pilot study from a university hospital. *Cent European J Urol.* 2021; 74: 51-56.
31. Feng YJ, Fan YJ, Su ZZ, et al. Correlation of Sexual Behavior Change, Family Function, and Male-Female Intimacy Among Adults Aged 18-44 Years During COVID-19 Epidemic. *Sex Med.* 2021; 9: 100301.
32. Chiancone F, Fabiano M, Fedelini M, Carrino M, Meccariello C, Fedelini P. Preliminary evidence of the impact of social distancing on psychological status and functional outcomes of patients who underwent robot-assisted radical prostatectomy. *Cent European J Urol.* 2020; 73: 265-268.
33. Apfelbeck M, Staehler M, Rodler S, et al. Does Pandemic Anxiety Affect Urology Health Care Workers? *Urol Int.* 2021; 105: 192-198.
34. de la Rosette J, Laguna P, Álvarez-Maestro M, et al. Cross-continental comparison of safety and protection measures amongst urologists during COVID-19. *Int J Urol.* 2020; 27: 981-989.
35. Porter J, Blau E, Gharagozloo F, et al. Society of Robotic Surgery review: recommendations regarding the risk of COVID-19 transmission during minimally invasive surgery. *BJU Int.* 2020; 126: 225-234.
36. Gravas S, Ahmad M, Hernández-Porras A, et al. Impact of COVID-19 on medical education: introducing homo digitalis. *World J Urol.* 2020; 39: 1997-2003.
37. Shah M, Hameed BMZ, Naik N, Rai BP, Bres-Niewada E, Somani BK. The history and evolution of 'webinars' and their role in urology: The modern way of training, education and communication. *Cent European J Urol.* 2021; 74: 128-130.
38. Teixeira BL, Cabral J, Mendes G, et al. How the COVID-19 pandemic changed urology residency - a nationwide survey from the Portuguese resident's perspective. *Cent European J Urol.* 2021; 74: 121-127.
39. Besançon L, Peiffer-Smadja N, Segalas C, et al. Open science saves lives: lessons from the COVID-19 pandemic. *BMC Med Res Methodol.* 2021; 21: 117.
40. Mavragani A. Tracking COVID-19 in Europe: Infodemiology Approach. *JMIR Public Heal Surveill.* 2020; 6: 18941. ■