# Decline of case reports in pathology and their renewal in the digital age: an analysis of publication trends over four decades

Luca Cima ,[1] Francesca Pagliuca,[2] Evelin Torresani,[1] Antonio Polonia ,[3] Catarina Eloy,[3] Venkatesh Dhanasekeran,[4] Rifat Mannan,[5] Silvia Gamba Torrez,[6] Nicola Mirabassi,[1] Angelo Cassisa,[7] Andrea Palicelli,[8] Mattia Barbareschi[1,9]

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/jcp-2022-208626).

For numbered affiliations see end of article.

**Correspondence to**
Dr Luca Cima, Department of Laboratory Medicine, Unit of Surgical Pathology, Ospedale Santa Chiara di Trento, APSS, Trento, 38122, Italy; lucacima85@gmail.com

Received 10 October 2022
Accepted 2 December 2022
Published Online First 16 December 2022

## ABSTRACT

**Aims** We investigated the trend in case reports (CRs) publication in a sample of pathology journals. Furthermore, we proposed an alternative publishing route through new digital communication platforms, represented by the 'social media case report'.

**Methods** 28 pathology journals were selected from SCImago database and searched in PubMed to identify the number of published CRs. Four reference decades (1981–2020) were selected. The 5-year impact factor (IF) was retrieved from the Academic Accelerator database.

**Results** CRs increased during the first three decades (6752, 8698 and 11148, respectively; mean values: 355, 27.3%; 334, 26.4%; 398, 28.8%) as the number of CR-publishing journals (19, 26 and 28, respectively). In the last decade, CRs significantly decreased (9341; mean 334, 23.6%) without variation in the number of CR-publishing journals (28). Half of the journals reduced CRs (from −1.1% to −37.9%; mean decreasing percentage −14.7%), especially if active since the first decade (11/14, 79%); the other half increased CRs (from +0.5% to +34.2%; mean increasing percentage +11.8%), with 8/14 (57%) starting publishing in the first decade. The 5-year IF ranged from 0.504 to 5.722. Most of the journals with IF ≥2 (10/14, 71%) reduced the CRs number, while 71% of journals with IF <2 increased CRs publication (especially journals with IF <1, +15.1%).

**Conclusions** CRs publication decreased during the last decade, especially for journals which are older or have higher IF. Social media CRs may represent a valid alternative and by using standardised templates to enter all relevant data may be organised in digital databases and/or transformed in traditional CRs.

## INTRODUCTION

Pathology is both a medical specialty and an investigative scientific discipline, devoted to understand the essential nature of human diseases.[1] The routine practice of pathologists is filled with straightforward diagnoses of common entities, nevertheless, extraordinarily unusual cases that deserve to be discussed and recorded are frequently encountered.[1]

Case reports (CRs), brief articles that describe unique aspects of a medical case, play a significant role in scientific literature and medical education.[2 3] They represent one of the first opportunities for young pathologists to approach scientific writing and literature search, compare differential diagnoses and review related cases. Occasionally, they have been pivotal in describing important achievements in diagnostics, such as new histopathological or molecular entities. In other contexts, they have brought to light unusual prognostic data or allowed the identification of non-canonical predictive biomarkers.

The 2013 CARE (CAse REports) Guidelines provide a framework for writing CRs in an accurate and transparent way that can be adapted to include specialty-specific information.[4]

A well-written CR, using the CARE Checklist, should provide enough details on a specific case to have a relevant impact on pathologists' diagnostic practice. Nonetheless, the traditional CR publication format has several limitations on scientific grounds. In general, CRs are relatively low in the evidence hierarchy, due to various factors including lack of generalisation, impossibility to establish cause-and-effect relationships, risk of overinterpretation and publication biases.[5]

Moreover, since they describe uncommon entities, they are rarely cited.[6] Thus, pathology journals have become very restrictive in accepting CRs because are considered the lowest level of evidence in the evidence-based medicine pyramid.

The aims of this article are to analyse the publication trend of CRs in a sample of pathology journals and to discuss how publication rates have changed over four decades. Moreover, we want to describe an alternative publishing route through social media, represented by the 'social media case report' (SMCR), highlighting its pros and cons over the traditional publication format and identifying strategies to estimate its scientific value.

## MATERIALS AND METHODS

We performed an advanced search in the PubMed database, setting the name of specific journals as Medical Subject Headings terms and selecting four reference decades as 'publication date' (first: 1981–1990; second: 1991–2000; third: 2001–2010; fourth: 2011–2020) and 'CR' as 'article type'. The list of journals included in the analysis was extracted from https://www.scimagojr.com. For their ranking, we selected the 5-year impact factor (IF), defined as the average number of times articles from a journal published in the past 5 years have been cited in the journal citation reports. The 5-year IF values related to the 2017–2021 time



**To cite:** Cima L, Pagliuca F, Torresani E, *et al*. *J Clin Pathol* 2023;**76**:76–81.

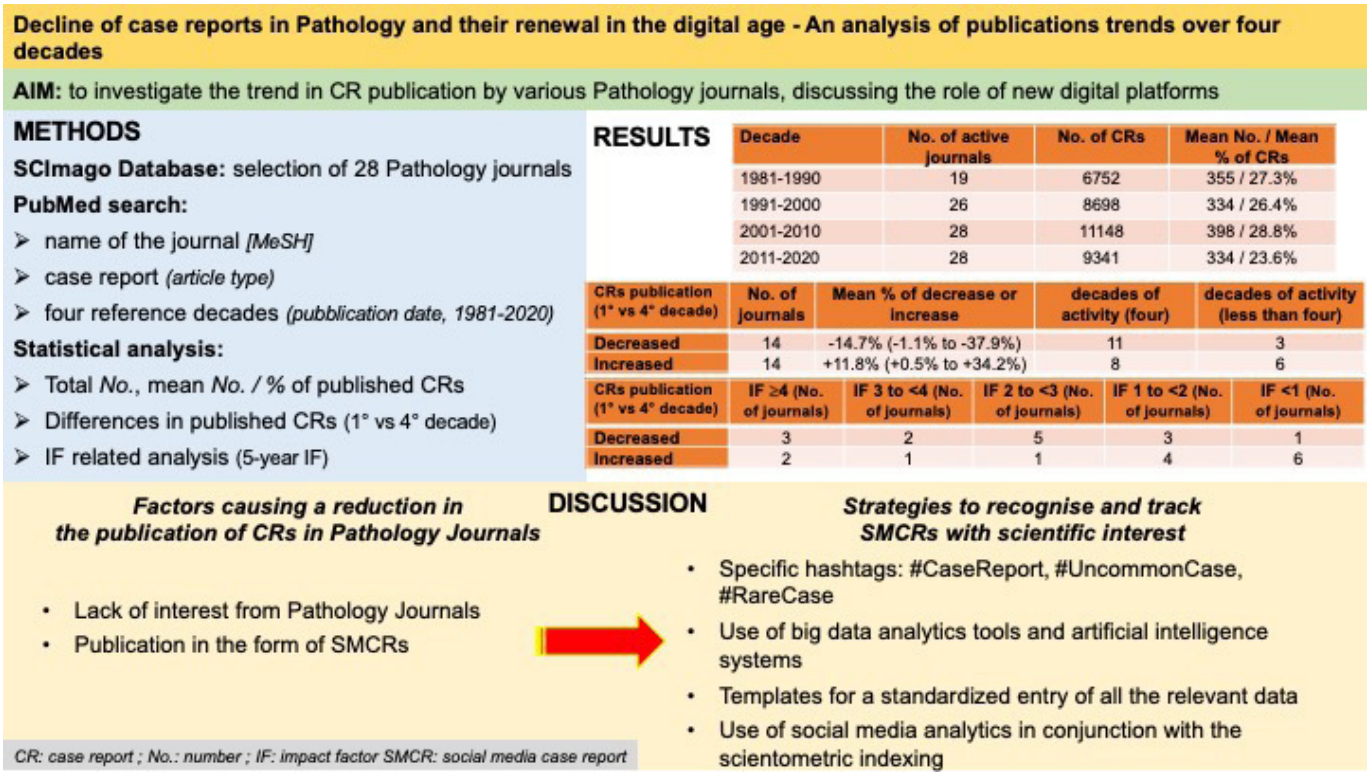


**Figure 1** Graphical abstract.

period were obtained automatically from https://academic-accelerator.com. The digital archives available on the official websites of the selected journals were used for the CRs not indexed on PubMed. All data were collected within August 2022. The list of selected journals consists essentially of English language anatomic pathology/cytopathology journals. To limit our sample size, we excluded from our analysis the following categories of pathology journals: those related to surgical pathology subspecialties; forensic histopathology journals; molecular pathology journals; clinical pathology/laboratory journals; journals related to mechanisms of disease pathogenesis; journals publishing in non-English language or which started publishing in English language after 2010; journals whose publication began after 2010; journals with an IF lower than 0.5; journals publishing only CRs/reviews.

For each journal, the following data were collected: number of published CRs and total number of published articles. Stratification per decades and IF categories was carried out. A descriptive statistical analysis of the collected data was performed, summarising continuous variables by ranges and mean values and categorical variables by frequencies and percentages. For each decade, we focused on the total number of published CRs, the mean number/percentage of published CRs related to the number of active journals, and percentages of CRs on the total number of published articles for each journal. We also compared the first and last decade results, analysing the differences in percentages of published CRs (expressed as maximum, minimum and overall mean percentage increase or decrease) for each IF category or specific journal.

The main methods are summarised in the graphical abstract (figure 1).

## RESULTS

Twenty-eight journals were considered in our analysis. Eighteen of them covered all the four decades under consideration, having started their activity before 1990. Seven journals covered three decades, having begun publishing from 1991 to 2000 or having their articles available on PubMed since that decade, while three journals covered only the last two decades (2001–2010, 2011–2020).

During the first three decades, the absolute number of published CRs increased (n=6752 vs n=8698 vs n=11 148) together with the number of publishing journals (n=19 vs n=26 vs n=28). The mean number and mean percentages of published CRs were not much different in the first two decades, with a slight increase during the third one (n=355, 27.3% vs n=334, 26.4% vs n=398, 28.8%). In the last decade, a significant decrease in publication of CRs occurred (absolute number n=9341, mean number n=334, mean percentage=23.6%) with no variation in the number of publishing journals (n=28).

The 5-year highest IF was represented by American Journal of Surgical Pathology: 5.722. The 5-year lowest IF was represented by Indian Journal of Pathology and Microbiology: 0.504.

The latter also published the highest number of CRs (n=2753), its activity covered all the four decades. The journal which published the smallest number of CRs was Advances in Anatomic Pathology (n=59), which was founded at the end of the third decade.

Further details for each journal are shown in online supplemental data.

Considering the first decade of activity as a starting point and the last decade as an arrival point, half of the journals (14/28, 50%) showed a reduction in the percentage of published CRs (decreased group, d-CR) and the other half a growth (increased group, i-CR). Most of the d-CR journals have been active since the first decade (11/14, 79%), while the remaining were founded or were available on PubMed/official website of the journal in the second decade (3/14, 21%).

On the contrary, slightly more than half (8/14, 57%) of the i-CR journals have been active since the first decade, while the

**Table 1** Percentage decreases (left) and increases (right) in published case reports for each Journal between the first and last decade of activity in the reference period

| | | | |
|---|---|---|---|
| Archives of Pathology and Laboratory Medicine | **−37.9%** | Indian Journal of Pathology and Microbiology | +34.2% |
| Acta Cytologica | **−25.7%** | International Journal of Surgical Pathology | **+31.7%** |
| American Journal of Surgical Pathology | **−24.9%** | Diagnostic Pathology | **+23.7%** |
| Histopathology | **−23.9%** | Pathologica | **+21.3%** |
| Human Pathology | **−17.3%** | Diagnostic Cytopathology | **+12.2%** |
| American Journal of Clinical Pathology | **−17.3%** | Cytojournal | **+12.1%** |
| Modern Pathology | **−16%** | Cytopathology | **+ 9.1%** |
| Annals of Diagnostic Pathology | **−15.7%** | Romanian Journal of Morphology and Embriology | **+6.5%** |
| Histology and Histopathology | **−8.8%** | Advances in Anatomic Pathology | **+ 5.4%** |
| Pathology and Oncology Research | **−8.7%** | Pathology | **+ 5.3%** |
| Pathology Research and Practice | **−4%** | Applied Immunohistochemistry & Molecular Morphology | **+1%** |
| Virchows Archiv | **−3.2%** | Polish Journal of Pathology | **+1%** |
| Journal of Clinical Pathology | **−1.6%** | Acta Pathologica Japonica/Pathology International | **+0.7%** |
| Journal of Cytology | **−1.1%** | APMIS | **+0.5%** |
| Mean value of percentage decrease | **−14.7%** | Mean value of percentage increase | **+11.8%** |

other journals started publishing or were available on PubMed/official website of the journal during the second (4/14, 29%) or third decade (2/14, 14%).

Comparing the first and last decades (table 1), the mean increasing percentage for i-CR journals was +11.8%, while the mean decreasing percentage for d-CR journals was −14.7%. The greatest percentage increase occurred for Indian Journal of Pathology and Microbiology (+34.2%; n=170 vs n=1131 published CRs) while APMIS showed the lowest increase (+0.5%; n=31 vs n=86). The highest percentage decrease was reported for Archive of Pathology and Laboratory Medicine (−37.9%; n=1107 vs n=119) while the smallest decrease occurred for Journal of Cytology (−1.1%; n=53 vs n=245).

Journals were divided in five groups according to their IF (<1, n=7; 1 to <2, n=7; 2 to <3, n=6; 3 to <4, n=3; ≥4, n=5) (table 2). From the first to the last decades, we observed a reduction in publication of CRs by the majority of journals with IF 2 to<3 (5/6, 83%), IF 3 to<4 (2/3, 67%) and IF≥4 (3/5, 60%). The overall mean decreasing percentage was greater the higher was the IF category (−4.2%, −8.86%, −13.54%). Conversely, most journals with IF ranging from 1 to <2 (4/7, 57%) or with IF<1 (6/7, 86%) showed an increased number of published CRs. While in the former group, the overall mean value was decreasing (−3.9%), that of journals with IF <1 was confirmed to increase (+15.1%).

**Table 2** Percentage decreases and increases and overall mean percentage differences in published case reports for impact factor categories between the first and last decade of activity in the reference period

| | IF ≥4 | IF 3 to <4 | IF 2 to <3 | IF 1 to <2 | IF<1 |
|---|---|---|---|---|---|
| d-CR % | American Journal of Surgical Pathology **−24.5%**<br>Modern Pathology **−16%**<br>Archives of Pathology and Laboratory Medicine **−37.9%** | Histopathology **−23.9%**<br>Virchows Archiv **−3.2%** | Human Pathology **−17.3%**<br>Pathology Research and Practice **−4%**<br>Pathology and Oncology Research **−8.7%**<br>Journal of Clinical Pathology **−1.6%**<br>American Journal of Clinical Pathology **−17.3%** | Histology and Histopathology **−8.8%**<br>Annals of Diagnostic Pathology **−15.7%**<br>Acta Cytologica **−25.8%** | Journal of Cytology **−1.1%** |
| i-CR % | Pathology **+ 5.3%**<br>Advances in Anatomic Pathology **+ 5.4%** | APMIS **+0.5%** | Diagnostic Pathology **+23.7%** | Acta Pathologica Japonica / Pathology International+**0,7%**<br>Applied Immunohistochemisty & Molecular Morphology **+1%**<br>Cytopathology **+9.1%**<br>Diagnostic Cytopathology **+12.2%** | Polish Journal of Pathology+**1%**<br>Romanian Journal of Morphology and Embriology **+6.5%**<br>International Journal of Surgical Pathology **+31.7%**<br>Cytojournal **+12.1%**<br>Pathologica **+21.3%**<br>Indian Journal of Pathology and Microbiology **+34.2%** |
| oam-CR % | **−13.54** | **−8.86%** | **−4.2%** | **−3.9%** | **+15.1%** |

CR, case report; d, decreased; i, increased; IF, impact factor; oam, overall mean.

The main results are summarised in the graphical abstract (figure 1).

## DISCUSSION

In this study, we demonstrated that the publication rate of CRs on a sample of selected pathology journals has significantly decreased over the last four decades, from 1981 to 2020. Furthermore, clustering the journals in five groups on the basis of their IF, only the group with the lowest IF (<1) showed an increase in the overall percentage of published CRs between the first and the last decade. All the other groups showed a reduction: the higher the IF, the greater the decrease.

Several factors contribute to the significant decline in the publication of CRs in Pathology journals. Among these, two are predominant: lack of interest from pathology journals and publication in the form of SMCRs.

First point: Pathology journals prefer other types of articles such as editorials, case series, narrative and systematic reviews as CRs could be less frequently cited. To be considered appealing, CRs should definitely add some new information or be enriched with an up-to-date systematic review of the literature about the discussed topic, which require longer time and greater efforts. Due to the frequent lack of the aforementioned features, the interest about CRs in pathology is limited to fairly unique cases and rare cases, including new entities, cases concerning non-canonical expression of known immunohistochemical/molecular markers, or cases suggesting new potentially diagnostic, prognostic and/or predictive biomarkers. Moreover, the policy of an increasing number of journals to reject CRs may discourage pathologists to publish CRs.

Second point: the growing trend of sharing interesting Pathology cases on social media (Twitter, Facebook) or on websites fully dedicated to pathology could be identified as a second factor, actually being both a cause and a consequence of traditional CR decline.

New digital tools such as open access social media platforms have promptly acquired prominence as a fundamental method for the delivery of a cost-free and easily accessible medical education. Twitter and Facebook host a rich and constantly growing medical community pursuing a democratisation of the medical dialogue including doctors in academic medicine and private practice, non-medical academics, students, residents, patients and patients advocates.[7]

Pathologists are no exception: a great number of single-user accounts and groups dedicated to Surgical and Clinical Pathology and to Cytopathology can be found on Twitter and Facebook, where many educators share cases in a rapid and interactive way and discuss them with a global audience. Some of these accounts and groups are chaired by eminent pathologists, while others are not moderated. Both general and subspecialty-specific hashtags have been created on Twitter allowing tweets on any topic to be grouped together and easily retrieved.[8] In other words, hashtags act as 'box of data' and help single pathologist users with an internet connection and social media accounts to find cases in any area of interest.

Cases are published on social media either as static or as whole slide images (WSI), the latter consisting in high-resolution digital replicas of a slide.[9] The use of WSI and static images enhance some core skills, such as feature identification, differential diagnosis, annotation, photography description and presentation.[10]

The rich debates around specific cases are often transformed in a sort of literature review which has many similarities with the 'discussion section' of traditional CRs. As a result, social media, together with WSI repositories like PathPresenter and Kiko, offer an extraordinary opportunity for publishing interesting cases in a non-traditional format: the SMCR.

There are currently around 8000 pathologists and pathology-related accounts on Twitter according to two online lists managed by Dr Jerad Gardner.[11 12] An even greater number of pathologists are likely registered on Facebook. The professional use of social media is characterised by an excessive amount of information and it is very difficult to quantify the number of SMCRs of potential interest for the traditional scientific literature. However, the hashtags trends related to the different Pathology subspecialties on platforms such as Symplur (https://www.symplur.com) reveal that SMCRs are numerous, in the range of hundreds every week.

We demonstrated a reduction in the publication of traditional CRs in pathology journals, but the introduction of the SMCR concept theoretically allows us to assume that the total number of CRs (traditional CRs+SMCRs) is constantly growing. The emerging problem is the lack of standardised schemes for the publication of SMCRs, now including highly variable formats according to the posting user's taste, the expected target or the leading trends (eg, quiz case is a very popular format). Also, the structure of a SMCR is deeply influenced by the characteristics of the selected social media, such as the limit of characters and images per single tweet. Furthermore, many uncommon or rare cases published as SMCR, with potential interest for the traditional scientific literature, are not detected nor tracked. Instead, collecting SMCRs and including them into case series together with traditional reports could allow more detailed clinicopathological, immunohistochemical and molecular studies.

Four main strategies could be applied to identify and track SMCRs with scientific value.

First, at least one of the following hashtags could be added to the post/tweet in order to facilitate the search in the social media archives: #CaseReport, #UncommonCase, #RareCase.

The second idea is to provide a template for a quick entry of all the relevant data relating to an interesting SMCR, such as the one proposed in box 1. Each subspecialty may have a specific checklist and all the checklists could be collected on a dedicated online platform that may also allow the upload of supplementary images and WSIs. The collected templates could be used to set

**Box 1 Suggested template for a standardised publication of social media case reports related to neoplastic diseases**

Personal information (age, sex).
Clinical presentation.
Medical/surgical history.
Family history.
History of cancer (synchronous/metachronous).
Laboratory findings.
Imaging.
Type of specimen.
Maximum dimension of the tumour (if multifocal, of each nodule).
Macroscopy.
Microscopy.
Immunohistochemical findings.
Molecular findings.
Management (surgical, medical, radiation).
Follow-up.
Discussion.

up quickly a case series or to transform the specific SMCR into a traditional journal-based CR.

The third proposal is the use of big data analytics (BDA) tools to catalogue the SMCRs. Given the large number of pathologists who tweet and/or post cases, SMCRs can be considered as 'big data', which are difficult to analyse and manage with human abilities alone or with traditional softwares or hardwares.[13 14] Through the use of BDA tools, SMCRs could be catalogued with artificial intelligence algorithms, distinguishing instructive cases from, uncommon and rare ones, with the last two categories more closely aligned to the current standards of the traditional scientific CRs. Moreover, BDA tools would allow for a qualitative/quantitative evaluation of SMCRs based on the quality of information, quality of images, the presence of citations from the literature, the degree of involvement in the discussion and other parameters. Some authors have already proposed a particular type of automated annotation analysis for clinical CRs, defined as 'metadata extraction approach'; it consists in extracting text and numerical values from a large collection of published CRs to standardise the description of the discussed specific biomedical concepts.[15 16] The BDA tools and metadata extraction approach would allow the development of SMCR databases which may be published in special online sections of Pathology journals or dedicated websites. Large web-based SMCR databases could also encourage collaborative studies on rare entities and could promote an 'aggregative approach to their analysis, paving the way for systematic reviews of CRs.

Finally, the fourth strategy is an analytical scientific tracking procedure similar to that performed for scientific journals. Traditionally, the scientific value of our journals is measured through the IF which is a scientometric index. Social media platforms provide various tools to measure the global impact of a given SMCR, such as shares, likes, retweets/reposts, direct interactions with the tweets or the posts, number of views. Therefore, SMCRs could be tracked by social media analytics and their scientific value could be ranked with specific metric systems.

Once a case has been tweeted or posted, the entire Pathology community on social media is able to provide immediate feedback. As highlighted by Oltulu *et al*. SMCRs undergo a community-based, redundant and continuous peer-review process.[17] It could be defined as a public peer-review process, sharing some features with the editorial checks and peer-review procedures performed by the scientific journals. The main strength of the public peer-review process is that tweets and posts must withstand ongoing, real-time commentaries and critiques by anyone interested in participating rather than merely passing peer-review once, as occurs with journal-based publications.[18]

The result is a comprehensive and long-lasting review process as opposed to the traditional journal review process, which is limited both in terms of time (occurs only once) and in the number of people involved (usually one or two). Other advantages of SMCRs are represented by the possibility to attach WSI also through QR codes, the multidevice accessibility and the easiest sharability.

On the other hand, the lack of reporting guidelines, the dissemination to an unsuitable audience with the risk of incomplete anonymisation, the lack of a literature review and above all the absence of a methodical peer-review and an official expert scrutiny to guarantee the appropriateness of the contents still constitute considerable disadvantages. However, given the strong contribution of SMCRs to knowledge dissemination in pathology and the opportunity of measuring their impact with tailored indices, their scientific value should be officially recognised. SMCRs could be tracked by social media analytics and they could be ranked with specific metric systems.

The SMCRs with the greatest impact in terms of social media analytics could be flagged as 'suitable' for scientific literature and could then be edited, rewritten and submitted to a traditional scientific journal along with the comments that have already been raised. Thus, the SMCR could act as a sort of preprint and the editors of the journals would supervise not only the manuscript but also the attached discussion that the SMCR raised on social media.

The main topics of the discussion are summarised in figure 1 (graphical abstract).

## CONCLUSION

In this article, we highlighted how most of our journals have reduced the number of published CRs over the span of the last four decades. Conversely, SMCRs have exponentially increased, allowing an immediate, free and worldwide diffusion of knowledge. They may represent a new frontier in education and a part of the 'third revolution' in pathology, which has in digital pathology, artificial intelligence and computational pathology its cornerstones regarding diagnostic pathology, and follows the first and second revolutions represented by immunohistochemistry and molecular biology, respectively, also related to diagnostic pathology.[19]

Despite these potentials, SMCRs lack standardisation in their reporting, are not tracked properly and are not stored in dedicated databases. In our article, we suggested four different strategies to select those SMCRs that could have scientific value and could be published in pathology journals or in the form of free online 'SMCR databases'. To this purpose, the use BDA tools to simultaneously analyse numerous data, even very complex ones, could be of great help. The 'SMCR databases' could serve as a basis for systematic reviews of CRs that would definitely improve the practice of Evidence-Based Medicine in Pathology.

**Author affiliations**
[1]Department of Laboratory Medicine, Unit of Surgical Pathology, Ospedale Santa Chiara di Trento, APSS, Trento, Italy
[2]Department of Mental and Physical Health and Preventive Medicine, Pathology Unit, University of Campania 'Luigi Vanvitelli', Naples, Italy
[3]Department of Pathology, Ipatimup - Institute of Molecular Pathology and Immunology, University of Porto, Porto, Portugal
[4]Department of Histopathology, PGIMER, Chandigarh, Punjab and Haryana, India
[5]Department of Pathology, City of Hope National Medical Center, Duarte, California, USA
[6]Department of Pathology, Cruces University Hospital, Barakaldo, Spain
[7]Department of Oncology, Section of Pathology, San Giovanni di Dio Hospital, USL Centro Toscana, Florence, Italy
[8]Unit of Pathology, Azienda USL-IRCSS di Reggio Emilia, Reggio Emilia, Italy
[9]CISMED, Centro Interdipartimentale di Science Mediche, University of Trento, Trento, Italy

**Handling editor** Vikram Deshpande.

**Twitter** Luca Cima @atman_ci, Silvia Gamba Torrez @Silvia95056273 and Angelo Cassisa @http://twitter.com/AngeloCassisa

**Acknowledgements** The study was partially supported by the Italian Ministry of Health-Ricerca Corrente Annual Program 2023. We thank also all the Colleagues of the Unit of Surgical Pathology of the Ospedale Santa Chiara di Trento for their support.

**Contributors** LC, FP, ET, AP, CE, VD, RM, SGT, NM, AC, AP and MB: study design; data collection; data interpretation; manuscript preparation; literature search; review and approval of the final manuscript.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interests** None declared.

**Patient consent for publication** Not applicable.

**Provenance and peer review** Not commissioned; externally peer reviewed.



**ORCID iDs**
Luca Cima http://orcid.org/0000-0001-6960-744X
Antonio Polonia http://orcid.org/0000-0001-8312-1681

## REFERENCES

1 Crawford JM. Original research in pathology: judgment, or evidence-based medicine? *Lab Invest* 2007;87:104–14.
2 Cabán-Martinez AJ, Beltrán WFG. Advancing medicine one research note at a time: the educational value in clinical case reports. *BMC Res Notes* 2012;5:293.
3 Vandenbroucke JP. In defense of case reports and case series. *Ann Intern Med* 2001;134:330–4.
4 Riley DS, Barber MS, Kienle GS, *et al*. Care guidelines for case reports: explanation and elaboration document. *J Clin Epidemiol* 2017;89:218–35.
5 Albrecht J, Werth VP, Bigby M. The role of case reports in evidence-based practice, with suggestions for improving their reporting. *J Am Acad Dermatol* 2009;60:412–8.
6 Nissen T, Wynn R. The clinical case report: a review of its merits and limitations. *BMC Res Notes* 2014;7:264.
7 Cifu AS, Vandross AL, Prasad V. Case reports in the age of Twitter. *Am J Med* 2019;132:e725–6.
8 Mukhopadhyay S, Kanakis C, Golab K, *et al*. The network that never Sleeps. *Lab Med* 2021;52:e83–103.
9 Evans AJ, Salama ME, Henricks WH, *et al*. Implementation of whole slide imaging for clinical purposes: issues to consider from the perspective of early adopters. *Arch Pathol Lab Med* 2017;141:944–59.
10 Hassell LA, Absar SF, Chauhan C, *et al*. Pathology education powered by virtual and digital transformation. *Arch Pathol Lab Med* 2022. doi:10.5858/arpa.2021-0473-RA. [Epub ahead of print: 25 Jul 2022].
11 Twitter web site. Available: https://twitter.com/i/lists/108204968 [Accessed 30 Aug 2022].
12 Twitter web site. Available: https://twitter.com/i/lists/1058774358582329344 [Accessed 30 Aug 2022].
13 Ristevski B, Chen M. Big data analytics in medicine and healthcare. *J Integr Bioinform* 2018;15:20170030.
14 Borges do Nascimento IJ, Marcolino MS, Abdulazeem HM, *et al*. Impact of big data analytics on people's health: overview of systematic reviews and recommendations for future studies. *J Med Internet Res* 2021;23:e27275.
15 Caufield JH, Liem DA, Garlid AO, *et al*. A metadata extraction approach for clinical case reports to enable advanced understanding of biomedical concepts. *J Vis Exp* 2018;139:58392.
16 Caufield JH, Zhou Y, Garlid AO, *et al*. A reference set of curated biomedical data and metadata from clinical case reports. *Sci Data* 2018;5:180258.
17 Oltulu P, Mannan AASR, Gardner JM. Effective use of Twitter and Facebook in pathology practice. *Hum Pathol* 2018;73:128–43.
18 Crane GM, Gardner JM. Pathology image-sharing on social media: recommendations for protecting privacy while motivating education. *AMA J Ethics* 2016;18:817–25.
19 Salto-Tellez M, Maxwell P, Hamilton P. Artificial intelligence-the third revolution in pathology. *Histopathology* 2019;74:372–6.

**Supplementary Data:** Trends of case reports published by a sample of Pathology journals in four decades expressed in absolute values and percentages over the total number of articles.

| | 5y IF | Founded in | 1981-1990 | 1991-2000 | 2001-2010 | 2011-2020 |
|---|---|---|---|---|---|---|
| American Journal of Surgical Pathology | 5.722 | 1977 | 416 *(35,3%)* | 631 *(32,3%)* | 439 *(18.5%)* | 227 *(10,4%)* |
| Modern Pathology | 5.647 | 1988 | 53 *(18%)* | 304 *(18%)* | 136 *(7%)* | 45 *(2%)* |
| Pathology | 4.715 | 1969 | 205 *(25,2%)* | 320 *(37,3%)* | 483 *(38%)* | 486 *(30,5%)* |
| Advances in Anatomic Pathology | 4.173 | 1994 | - | 2 *(2%)* | 28 *(8%)* | 29 *(7,4%)* |
| Archives of Pathology and Laboratory Medicine | 4.032 | 1926 | 1107 *(43,3%)* | 917 *(35,3%)* | 1323 *(41%)* | 119 *(5,4%)* |
| Histopathology | 3.872 | 1977 | 459 *(36,2%)* | 910 *(41,2%)* | 650 *(28%)* | 320 *(12,3%)* |
| Virchows Archiv | 3.259 | 1847 | 348 *(15,4%)* | 337 *(18,7%)* | 505 *(27,5%)* | 226 *(12,2%)* |
| APMIS | 3.098 | 1924 | 31 *(6.3%)* | 109 *(8%)* | 171 *(13,7%)* | 86 *(6,8%)* |
| Human Pathology | 2.932 | 1970 | 669 *(31%)* | 521 *(21%)* | 438 *(18,6%)* | 407 *(13,7%)* |
| Pathology – Research and Practice | 2.818 | 1978 | 224 *(21%)* | 384 *(30%)* | 448 *(39%)* | 415 *(17%)* |

| | IF | Founded in | 1981-1990 | 1991-2000 | 2001-2010 | 2011-2020 |
|---|---|---|---|---|---|---|
| Pathology Oncology Research | 2.702 | 1995 | - | 34 *(13,3%)* | 136 *(21,5%)* | 73 *(4,62%)* |
| Journal of Clinical Pathology | 2.662 | 1947 | 400 *(12,6%)* | 525 *(18%)* | 662 *(23,7%)* | 241 *(11%)* |
| Diagnostic Pathology | 2.390 | 2006 | - | - | 37 *(12%)* | 576 *(35,7%)* |
| American Journal of Clinical Pathology | 2.094 | 1931 | 827 *(25%)* | 394 *(14,3%)* | 171 *(7%)* | 157 *(7,7%)* |
| Histology and Histopathology | 1.993 | 1993 | 31 *(10,8%)* | 17 *(1,6%)* | 22 *(1,6%)* | 29 *(2%)* |
| Annals of Diagnostic Pathology | 1.933 | 1997 | - | 68 *(39%)* | 441 *(60%)* | 236 *(23,3%)* |
| Acta Cytologica | 1.868 | 1960 | 641 *(39,8%)* | 903 *(43,6%)* | 937 *(53,2%)* | 116 *(14%)* |
| Applied Immunohistochemistry & Molecular Morphology | 1.767 | 1992 | - | 5 *(10%)* | 75 *(10%)* | 131 *(11%)* |
| Acta Pathologica Japonica / Pathology International* | 1.749 | 1951 | 677 (47,5%) | 659 *(46,6%)* | 657 *(48,7%)* | 580 *(48,2%)* |
| Cytopathology | 1.360 | 1990 | 12 *(23,5%)* | 174 *(27,8%)* | 230 *(28,6%)* | 327 *(32,6%)* |
| Diagnostic Cytopathology | 1.268 | 1985 | 156 *(36,6%)* | 695 *(41%)* | 928 *(46%)* | 1102 *(48,8%)* |

| | IF | Founded in | 1981-1990 | 1991-2000 | 2001-2010 | 2011-2020 |
|---|---|---|---|---|---|---|
| Polish Journal of Pathology | 0.939 | 1994 | - | 62 *(24,2%)* | 81 *(23,3%)* | 146 *(25,2%)* |
| Romanian Journal of Morphology and Embriology | 0.932 | 1990 | 6 *(26%)* | 37 *(17,3%)* | 140 *(27,8%)* | 614 *(32,5%)* |
| International Journal of Surgical Pathology | 0.926 | 1993 | - | 22 *(33,8%)* | 469 *(53,5%)* | 1015 *(65,5%)* |
| Cytojournal | 0.920 | 2004 | - | - | 16 *(11.9%)* | 68 *(24%)* |
| Journal of Cytology** | 0.859 | 1984 | - | 53 *(38,1%)* | 182 *(41,7%)* | 245 *(37%)* |
| Pathologica | 0.702 | 1908 | 320 *(38,7%)* | 309 *(36,7%)* | 197 *(36,3%)* | 194 *(60%)* |
| Indian Journal of Pathology and Microbiology | 0.504 | 1958 | 170 *(26%)* | 306 *(36,4%)* | 1146 *(59,9%)* | 1131 *(60,2%)* |

*IF: Impact Factor*

* the journal changed its name from Acta Pathologica Japonica to Pathology International in 1994
** for Journal of Cytology case reports are available on PubMed from 2009 and on the official journal website from 1995; no data are available before 1995