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ARTICLE

How has the dental literature evolved over time? Analyzing 20 years of journal self-citation rates and impact factors

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ABSTRACT

Objective: As journal impact factors (IFs) can be artificially inflated by excessive journal self-citation practices, research quality evaluation based solely on IF ranking may be manipulated and, therefore, ethically challenged. This study aimed to analyze the longitudinal development of journal self-citation rates (SCRs) and IFs in dental literature and to determine possible confounders.

Methods: Twenty-eight journals with scope within general dentistry and (sub)specialties listed in 1997–2016 Journal of Citation Reports® were scrutinized. The following information was retrieved: publication year, total number of citations, number of self-citations, IF, corrected IF, and SCR.

Results: Endodontic journals had the highest SCR (median = 35.3, IQR = 21.6–47.5), journals related to periodontics had the lowest (median = 14.7, IQR = 8.9–25.5). Periodontics had the highest IF (median = 2.1, IQR= 1.7–2.8) and general dentistry had the lowest (median = 0.9, IQR = 0.7–1.2). SCR significantly decreased over time ($p < .0001$) by 1 unit per year. Additionally, 1 unit increase in corrected IF resulted in 15.2 units decrease in SCR. IFs significantly increased 0.06 units per year ($p < .000$).

Conclusions: Overall, favourable changes in citation metrics have been observed for dental journals during the 20-year observation period. SCR significantly decreased per observation year whereas IFs significantly increased, indicating a healthy publishing environment in the dental literature. SCR was regulated both by time and corrected IF.

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Dentistry; bibliometrics; impact factor; self-citation

Introduction

Citing or documenting information sources in scientific writing aims to acknowledge earlier work. It enables the reader to examine the validity of the referenced material and the strength of the author's claims [1]. Citation counts and other citation-based metrics have long been used in measuring the impact of scholarly work [2,3].

The journal Impact Factor (IF) [4,5] calculated by dividing the number of current year citations to the number of publications in that journal in the preceding 2 years represents nowadays the most popular journal metric. The assumption that a journal's IF reflects the quality of articles or authors published in the journal has led to inappropriate application of IF in the evaluation of the academic performance of researchers, groups or institutions [6,7].

The increasing misuse of IFs has arguably changed the submission behaviour of researchers towards journals with maximum impact as well as editorial policies [8,9]. Editors carried away by 'the IF game' implement strategies that boost the IF of their journals, and among others, encourage authors to cite articles published in the same journal approving by this means journal self-citations [9]. Persistently high journal self-citation rates (SCR) can severely distort the perceived importance of journals and journal IF rankings. A steep increase in pervasive journal self-citation malpractices has been observed for the period 2004–2015 in the fields of Sciences and Social Sciences in the Web of Science database [10].

The available evidence on the potential influence of journal self-citation on IF in medicine is rather inconclusive with contradictory results published across specialties [11–18]. Regarding the dental literature, a recent 3-year observational study found that SCR was not significantly associated to the IF of dental journals [19]. Dental subspecialty journals contained significantly more self-citations than general dental journals in 2015 [19]. However, more solid conclusions can be drawn by bibliometric studies with longer time windows. Therefore, the present study aimed to determine the evolution of SCR and IFs of journals dedicated to general dentistry and dental (sub)-specialties over a 20-year period and identify possible confounders.

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Supplemental data for this article can be accessed here.

Materials and methods

Data collection

The Journal of Citation Reports® (JCR) issued by Clarivate Analytics (formerly by Thomson Reuters), which provides cited and citing journal statistics from 1997 until the present time, has been accessed through an institutional Web of Science subscription (https://www.webofknowledge.com). The 1997–2016 JCR-lists grouped under the subject category 'Dentistry, Oral Surgery & Medicine' were reviewed for general dentistry journal titles published by national dental associations and dental (sub)specialty journals i.e. journals defining their scope within oral and maxillofacial surgery, oral implantology, orthodontics, periodontics, endodontics and prosthodontics. To facilitate data-processing, groups of 4 journals with the longest continuous presence in JCR were considered for each field. In total, JCR data of 28 journals were collected (Supplementary Table 1).

The following information was retrieved by the second author from the JCR for each of the abovementioned journals: year, total number of citations to years used in IF calculation (TC), number of self-citations to years used in IF calculation (SC), IF, IF without self-citations (corrected IF), and SCR (number of self-citations divided by the total number of citing articles × 100).

Statistical analysis

Statistical analysis was performed with IBM SPSS Statistics 23 (SPSS, Chicago, IL, USA). Citation metrics were presented as means (sd) and medians (Q1–Q3, min–max).

Linear mixed models (co-variance structure: autoregressive first order) were used to evaluate the longitudinal associations between journal scope and taking into account a three-level structure of data: repeated measures were clustered within journals and journals were clustered within journal scope. In addition to crude analyses, analyses were performed adjusting for corrected IF. If main effects were significant, interaction effects were explored to reveal possible effect modifications. A similar analysis was performed between journal scope and IF. The normality of the residuals was checked by means of histograms and Q–Q plots. For all analyses, a two-tailed significance level of $p < .05$ was considered statistically significant.

Results

Journal metrics per journal scope are presented in Table 1. The highest and the lowest SCR (median = 35.3, IQR = 21.6, 7.5) were observed in journals with scope within endodontics (median = 35.3, IQR = 21.6, 47.5) and periodontics (median = 14.7, IQR = 8.9, 25.5), respectively. Periodontics was assigned the highest IF (median = 2.1, IQR = 1.7, 2.8) (Table 1 and Figure 1), while the lowest IF was assigned to general dentistry (median = 0.9, IQR = 0.7, 1.2). Periodontics and implantology shared the highest corrected IFs, i.e. 1.8 (IQR = 1.3, 2.4) and 1.6 (IQR = 1.1, 2.3), respectively.

Table 1. Descriptive statistics of the 20-year observation period per journal scope.

				IQR			
	Mean	SD	Median	Q1	Q3	Min	Max
Endodontics							
Self-citation rate (%)	32.7	17.9	35.3	21.6	47.5	0.0	67.4
Self-citations (*n*)	245.3	330.5	123.0	27.0	204.5	0.0	1077.0
Total citations (*n*)	569.9	627.3	320.0	76.0	780.5	22.0	2025.0
Impact Factor	1.7	1.0	1.3	0.8	2.8	0.5	3.4
Corrected Impact Factor	1.0	0.6	0.9	0.5	1.5	0.3	2.5
Prosthodontics							
Self-citation rate (%)	24.5	13.2	21.8	12.2	34.8	5.2	50.0
Self-citations (*n*)	72.7	75.7	45.0	21.3	104.3	11.0	420.0
Total citations (*n*)	266.5	165.8	249.0	174.8	330.5	34.0	1125.0
Impact Factor	1.1	0.4	1.1	0.8	1.4	0.5	2.1
Corrected Impact Factor	0.9	0.3	0.9	0.5	1.1	0.3	1.4
Orthodontics							
Self-citation rate (%)	24.2	11.4	22.6	16.5	30.2	3.4	51.8
Self-citations (*n*)	66.8	57.7	56.0	19.3	98.0	3.0	222.0
Total citations (*n*)	259.8	192.3	218.5	91.3	359.0	44.0	821.0
Impact Factor	1.0	0.4	1.0	0.7	1.3	0.4	1.8
Corrected Impact Factor	0.8	0.4	0.8	0.5	1.1	0.3	1.6
OMFS							
Self-citation rate (%)	21.1	11.1	19.1	13.6	25.4	7.2	64.0
Self-citations (*n*)	100.7	115.1	65.0	24.0	133.0	9.0	640.0
Total citations (*n*)	459.2	381.3	354.0	137.8	650.3	40.0	1451.0
Impact Factor	1.2	0.5	1.1	0.8	1.5	0.4	2.9
Corrected Impact Factor	0.9	0.3	0.9	0.6	1.1	0.3	1.7
General Dentistry							
Self-citation rate (%)	21.0	11.8	18.6	13.9	29.1	0.0	53.8
Self-citations (*n*)	43.7	36.5	43.0	7.0	75.0	0.0	133.0
Total citations (*n*)	191.9	145.6	201.0	41.0	286.0	16.0	551.0
Impact Factor	1.0	0.5	0.9	0.7	1.2	0.3	2.2
Corrected Impact Factor	0.8	0.4	0.7	0.5	1.0	0.2	1.9
Implantology							
Self-citation rate (%)	19.6	8.6	19.4	13.8	25.3	1.5	39.7
Self-citations (*n*)	89.5	76.1	69.5	44.5	90.8	4.0	336.0
Total citations (*n*)	483.1	387.5	345.5	225.0	639.3	98.0	1719.0
Impact Factor	2.1	0.8	1.9	1.5	2.8	1.0	4.2
Corrected Impact Factor	1.8	0.8	1.6	1.1	2.3	0.8	3.6
Periodontics							
Self-citation rate (%)	17.4	9.5	14.7	8.9	25.5	1.9	40.5
Self-citations (*n*)	126.6	138.5	47.5	25.5	204.0	2.0	894.0
Total citations (*n*)	550.0	376.5	443.5	225.8	860.3	19.9	1314.0
Impact Factor	2.3	0.9	2.1	1.7	2.8	0.8	4.9
Corrected Impact Factor	1.9	0.8	1.8	1.3	2.4	0.6	4.5

Random intercept was modelled in the linear mixed models analysis but the model could not converge. SCR significantly decreased over time ($p < .0001$) by 1 unit per year (Table 2 and Figure 2). The reduction over time was different for the different scopes. Additionally, 1 unit increase in corrected IF resulted in 15.2 units decrease in SCR (at time = 0). Although the introduction of time as an interaction term did not yield statistically significant regression coefficients, it significantly improved the model as revealed by the −2loglikelihood ratio test. Based on the regression coefficients, the predicted SCR for e.g. 2000 (time = 3) were 20.6 for periodontics and 32.9 for endodontics.

Overall, IFs significantly increased 0.06 units per year ($p < .000$) (Table 3). Periodontics, endodontics and implantology showed the highest IF (Table 3 and Figure 3).

Discussion

The present study revealed that SCR medians in dental journals ranged from 14.7% to 35.3% exceeding the reported rates in medical fields like ophthalmology, dermatology and

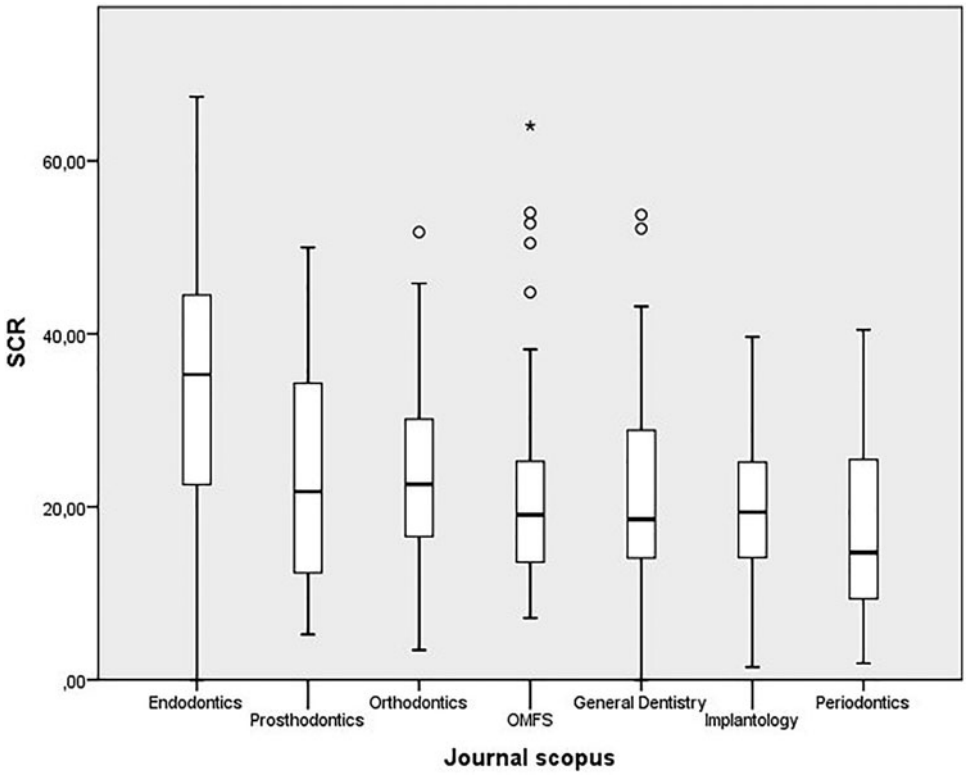

Figure 1. Box-plots showing median SCR and 25 and 75 percentile per journal scope during 1997–2016 (journal scope categories are ordered from the one with the highest to the one with the lowest SCR). SCR: self-citation rate; OMFS: oral and maxillofacial surgery.

Table 2. Longitudinal association of SCR per journal scope with corrected IF.

Estimates of fixed effects[a]					
				95% Confidence interval	
Parameter	Estimate	Std. error	Sig.	Lower bound	Upper bound
Intercept[c]	35.00	4.1	0.000	26.9	43.2
Orthodontics	0.80	5.7	0.886	−10.5	12.1
OMFS	−2.5	5.3	0.644	−13.1	8.1
Periodontics	5.9	5.8	0.308	−5.5	17.3
Endodontics	15.2	5.8	0.011	3.6	26.7
Prosthodontics	14.5	6.6	0.030	1.4	27.5
Implantology	15.8	7.5	0.039	0.8	30.7
General Dentistry	0[b]	0	.	.	.
Corrected IF	−15.2	2.7	0.000	−20.6	−9.9
Time	−1.0	0.3	0.000	−1.5	−0.4
Corrected IF * Time	0.7	0.2	0.000	0.3	1.1
Introducing Journal scope and time interaction[d]					
Orthodontics * Time	0.2	0.3	0.490	−0.4	0.9
OMFS* Time	0.4	0.3	0.167	−0.2	1.0
Periodontics * Time	−0.0	0.49	0.937	−0.7	0.7
Endodontics* Time	−0.4	0.3	0.264	−1.1	0.3
Prosthodontics * Time	−0.8	0.4	0.052	−1.6	0.0
Implantology * Time	−0.7	0.5	0.146	−1.8	0.3
General Dentistry * Time	0[b]	0	.	.	.

Corrected IF: IF without self-citations; OMFS: oral & maxillofacial surgery
[a]Dependent variable: self-citation rate.
[b]This parameter is set to zero because it is redundant.
[c]Intercept corresponds to the mean self-citation rate of journals in general dentistry in 1997 (Time = 0).
[d]Introduction of interaction terms was intended to reveal effect modifications.

otolaryngology, i.e. 11.9%, 11.7% and 10.5%, respectively [12,15,16]. However, the current findings fall within the median SCR values observed in the anaesthesiology literature, namely 4–57% [11]. When comparing similar bibliometric studies, caution should be paid to variables such as number of journals, length of the observation period and journal availability per scientific area that might have affected the results. Confining the observation time window or searching a few journals, for example, may result in underestimating or overestimating of SCR base on small sample variation. In particular, the limited journal variation in (sub)-specialties tends to increase the likelihood of self-citations [16]. To date, studies have examined a rather small fraction of journal titles covered by JCR [11,12] and/or merely up to 2 publication years [12,15,16].

SCR, mainly in endodontic journals, and less in orthodontic and prosthodontic journals, crossed 'the critical threshold of 20%', which has been labelled by Thomson Reuters as high and suspect of abuse [20]. Several legitimate explanations may apply to a high SCR including novelty and specialization of the topic that make the given journal a unique publication venue [21] or the target publication behaviour of the authors. As an author may prefer to submit his/her manuscript to a journal that has previously published relevant work, citations are likely to derive from publications in the same journal [15]. However, more than half scholars in Economics, Sociology, Psychology and Business, strategically add journal-specific citations before submission [22]. In theory, a high self-citing frequency may be due to a lower level of citation by the literature as a whole, and not necessarily to excessive or exclusive self-citing by the journals. In this way, a slight change in the number of self-citations in journals with low numbers of total citations can have a profound impact on SCR [21].

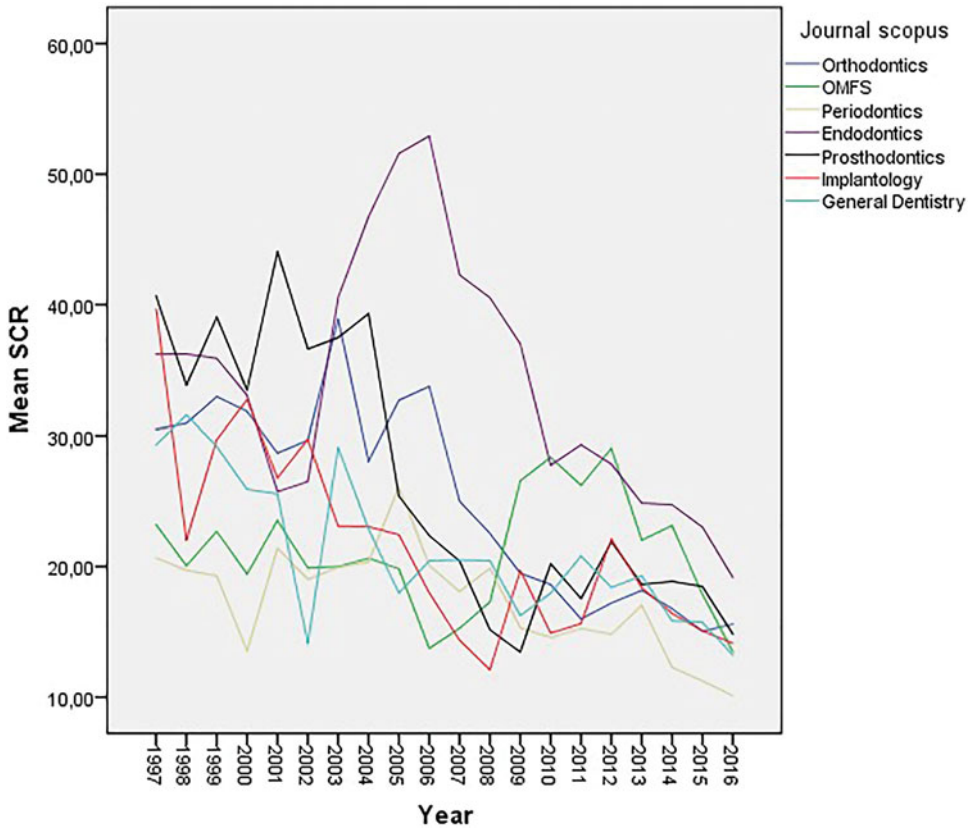

Figure 2. Self-citation rate per journal scope within time.

Table 3. Longitudinal association of IF per journal scope.

Estimates of fixed effects[a]				95% Confidence interval	
Parameter	Estimate	Std. error	Sig.	Lower bound	Upper bound
Intercept[c]	0.38	0.16	0.023	0.05	0.71
Orthodontics	0.03	0.22	0.902	−0.43	0.48
OMFS	0.22	0.22	0.316	−0.22	0.67
Periodontics	1.45	0.22	0.000	0.10	1.90
Endodontics	0.68	0.24	0.007	0.20	1.16
Prosthodontics	0.03	0.24	0.907	−0.45	0.50
Implantology	1.11	0.23	0.000	0.65	1.58
General Dentistry	0[b]	0	.	.	.
TIME	0.06	0.00	0.000	0.05	0.07

OMFS: oral & maxillofacial surgery
[a]Dependent variable: Impact Factor.
[b]This parameter is set to zero because it is redundant.
[c]Intercept corresponds to the mean IF of journals dealing with scope within general dentistry in 1997 (Time = 0).

Implantology and periodontics were the only subspecialties showing over the 20-year observation period a significant decrease in SCR and at the same time a significant increase in IF. Hypothetically, the extensive acceptance of dental implants in the last decades together with the wide scope of periodontics may account for the continuous IF increase of the journals related to these fields. Interdisciplinary and international citations, as showed by new research, have contributed to rise of IF of prestigious dental journals including Periodontology 2000 [23]. Interestingly, IFs of dental journals significantly increased per observation year, while SCR significantly decreased indicating favourable patterns in the bibliometric evolution of the dental literature. These findings are in line with the trends demonstrated by the total of the dental journals ranked by 2013–2016 JCR [19]. More specifically, increase of corrected IF by 1 unit was associated with an almost 15%-decrease of SCR, which is consistent with the significantly higher prevalence of self-citation in low-corrected IF dermatology journals [15].

Strengths and limitations of the study

To the best of our knowledge, this is the first study on the dental literature that analyzed journal citation data over an extended period of 20 years. Given citation is a dynamic and on-going phenomenon, coverage of a number of consecutive years is required to define comprehensively self-citation practice in the scientific literature [21]. The robust statistical model, in which a 3-level structure of data was applied, can be considered advantageous in the assessment of the variables of interest. Our study covered, however, approximately one-third of the journals listed in JCR. Had the whole range of the journals been reviewed, the inclusion of new journals would have complicated the analysis because of missing data. In this case, interpretation of data might have been compromised by initial fluctuations in the bibliographic variables of the journals with a short presence in JCR. Furthermore, our study sample and observation length outperform those described in previous studies [11,12,17].

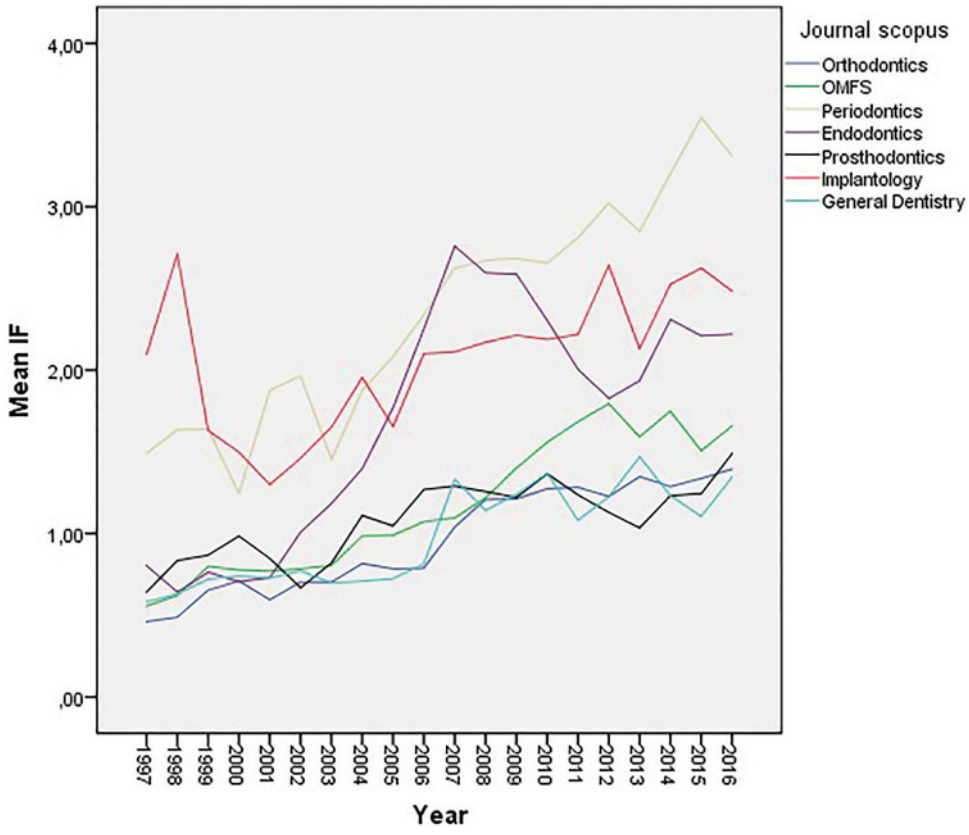

Figure 3. IF per journal scope within time.

Recommendations for future research

As authors are increasingly submitting their dental related manuscripts to highly ranked non-dental journals [24], a more holistic bibliometric approach should include longitudinal evaluation of the full list of journals indexed by multiple databases. Based on the domination of English in academic communication, with more than 90% of the articles in Natural Sciences being published in this language, this study focussed on English dental periodical publications [25]. Future studies should be conducted on the long-term comparison of citation metrics of English and non-English language publications in the dental literature.

Conclusions

This 20-year analysis showed a significant SCR decrease per observation year whereas IFs significantly increased, indicating a healthy publishing environment in the dental literature. Journal self-citation was influenced both by time and corrected IF.

Disclosure statement

No potential conflict of interest was reported by the authors.

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