Brazilian Journal of Physical Therapy 26 (2022) 100392

Brazilian Journal of Physical Therapy

https://www.journals.elsevier.com/brazilian-journal-of-physical-therapy

ORIGINAL RESEARCH

The Physiotherapy Evidence Database (PEDro) has better free full-text access than PubMed: An observational study

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Received 18 March 2021; received in revised form 22 December 2021; accepted 10 January 2022
Available online 31 January 2022

KEYWORDS
Access to information;
Databases, Bibliographic;
Evidence-based practice;
Physical therapists

Abstract
Background: Access to full-text articles is an essential element of evidence-based practice.
Objective: Estimate the percentage of articles in the Physiotherapy Evidence Database (PEDro) that have free full-text access and compare free access between PEDro and PubMed. Secondary objectives for access via PEDro: determine if publication year and geographic location impact on free access; determine if adding a link to a portable document format (PDF) locator website would improve free access; and evaluate the association between article characteristics and free access.
Methods: This observational study used a random sample of 200 articles published in 2000–2019 and indexed in PEDro. Data collectors in Australia, Brazil, Nepal, and Spain attempted to access free full text for each article via PEDro. One data collector attempted to access free full text via PubMed. One data collector attempted to access full text via a PDF locator (http://www.pdfsearchengine.net/). The percentage (95% confidence interval [CI]) of articles with free full-text access from PEDro, PubMed, and the PDF locator website were calculated. Logistic regression was used to evaluate the association between free full-text access and article characteristics.

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https://doi.org/10.1016/j.bjpt.2022.100392

Results: Free full text could be accessed via PEDro for 51% of the articles (95% CI: 44, 58). PEDro had 4% higher free access than PubMed (95% CI: 1, 7). Access via PEDro did not vary systematically with time, geographic location, or article characteristics. Access improved by 9% (95% CI: 6, 14) by adding a PDF locator website.
Conclusions: PEDro is a good source of free full-text articles for physical therapists and other rehabilitation professionals. Evidence resources, professional organisations, employers, researchers, and research agencies could all help to increase access to free full text.

Introduction

Rehabilitation professionals use an evidence-based practice approach to treatment.[1] An essential element in this approach is to acquire full-text copies of research articles that answer clinical questions. Rehabilitation professionals read the full-text articles to appraise the quality and applicability of the research before applying the results in practice. Therefore, access to full-text articles is crucial for all rehabilitation professionals to take an evidence-based practice approach to patient care.

Cost may be a barrier to acquiring full-text copies of research articles for individuals and for the libraries of many institutions globally. The content of some journals can only be accessed with a subscription or payment per article ('toll access'). It has been estimated that access to 78% of medical research was restricted to toll access in 2009.[2] This restriction is a type of research waste[3] because a large amount of clinical research cannot be accessed to inform practice. A survey of surgeons in the United States, Ghana, Peru, and Thailand revealed that access to subscription journals was poorest in Peru (54% lacked access) followed by Ghana (42%) and Thailand (32%).[4,5] Even established institutions in high-income economies, like Harvard University,[6] are experiencing difficulty.

Journal publishers are now facing a backlash from research institutions in European countries over subscription costs.[7] Some research funding agencies are instituting public access policies that require investigators to make the results of their funded research freely available. For example, the National Institutes of Health in the United States,[8] the World Health Organization,[9] and the European Research Council[10] all mandate publication in freely available full-text articles. While it is difficult to make causal inferences about the impact of these policies, research is being increasingly published in open-access journals.[8] Other factors that may have contributed to this shift include progressive policies of some journals[11-13] and the perceived open-access citation advantage.[14,15]

Shifting from toll access to open access for full-text articles increases their usage. This is illustrated well by a trial where subscription-only journals published by the American Physiological Society were randomized to either remain toll access or to become open access.[16] The articles in journals assigned to open access had 89% more html full-text downloads and 42% more portable document format (PDF) downloads compared to articles in toll access journals.

Open access for the physical therapy profession could be evaluated using the Physiotherapy Evidence Database (PEDro; pedro.org.au) and PubMed (pubmed.ncbi.nlm.nih.gov). PEDro is a free resource that indexes articles reporting the results of randomized trials, systematic reviews, and practice guidelines evaluating the effects of physical therapy interventions.[17] It has equal or better coverage of this research than any other database (including PubMed).[18,19] PubMed is a free resource that indexes articles relevant to biomedicine and life sciences that use any research method.[20] PEDro and PubMed include links to full text, but the percentage of articles with links to free full text is not known.

An analysis of access to full text must recognize where the user is as free access may depend on geographic location. The World Health Organization's Hinari Programme facilitates access to biomedical research (~16,000 journals) for countries with low- to middle-income economies.[21] In contrast, firewalls in countries like China may restrict access.[22]

The primary objectives of this study were to: (1) estimate the percentage of articles indexed in PEDro that have free full-text access from at least one of the links provided in the PEDro resource; and (2) compare free access between PEDro and PubMed. Secondary objectives were to determine if free full-text access via PEDro: (1) is better for more-recently published articles; (2) is dependent on geographic location (Australia, Brazil, Nepal, or Spain); (3) could be expanded by adding a link to a PDF locator website; and, (4) is associated with article characteristics.

Methods

Source of articles

PEDro was used as the source of articles because it is the preeminent global evidence resource for physical therapy and other rehabilitation professions.[17,23] Because there has been rapid growth in the number of trials, reviews, and guidelines in physical therapy since 2000,[24] this study focused on articles published in 2000–2019. The sample was divided into 5-year subperiods: 2000–2004, 2005–2009, 2010–2014, 2015–2019. We used the random number function in Microsoft Excel to randomly sample articles indexed in PEDro that were published in 2000–2019 and were not in-process.

The details downloaded from PEDro for each selected article were: citation; article identification numbers (PEDro Article Identification number, PubMed Identification number (PMID), PubMed Central Identification number (PMCID), Digital Object Identifier (DOI)); publication year; publication language; method; area of practice; and trial quality. Publication year was converted to article age by subtracting it from 2019. Publication language was dichotomized as '1' for

English and '0' for all other languages. Method was dummy coded as '1' for trials, '2' for reviews, and '3' for guidelines. Area of practice was coded as '1' for 'yes' and '0' for 'no' for 10 subdiscipline codes: cardiothoracics; continence and women's health; ergonomics and occupational health; gerontology; musculoskeletal; neurology; oncology; orthopaedics; paediatrics; sports. Trial quality was quantified using the total PEDro score (range 0–10; higher scores indicate better trial quality). Publication year, publication language, method, area of practice, and trial quality were used in the analyses for secondary objectives 1 (ie, if free full-text access via PEDro is better for more-recently published articles) and 4 (ie, if free full-text access via PEDro is associated with article characteristics).

Sample size

200 articles were required to provide a 95% confidence interval (CI) for the overall estimates of prevalence that is no wider than 13.75% (ie, a margin of error of ± 6.9%). The method used to calculate this sample size is the Wilson score method without continuity correction.[25] The number of articles sampled from each 5-year subperiod was the same proportion as the articles in PEDro published in 2000–2019 for that subperiod.

Data collection

Data collection was undertaken using a pilot-tested Excel spreadsheet. All data collection occurred in the same 24 hours using computers that were not connected to the intranet of an institution (eg, university, hospital). This was to ensure that automatic proxy settings were not used to access full text via institutional subscriptions.

For primary objective 1 (ie, estimating the percentage of articles indexed in PEDro that have free full-text access) and secondary objective 2 (ie, if free full-text access via PEDro is dependent on geographic location), data collectors in four countries (Australia, Brazil, Nepal, Spain) accessed the PEDro Detailed Search Results page for each article. This page includes up to four links to full text: PMCID, DOI, PMID, and journal website. Starting at the top of the list, the data collector attempted to access free full text for each article. Accessing free full text was defined as viewing the full article in either PDF or on a webpage. The data collectors stopped as soon as one link provided access to free full text; they did not test every link. If successful, they recorded the link used and moved to the next article. If unsuccessful, they recorded a 'no' and moved to the next article. The data collectors double-checked their coding of access to full text for those articles where there was not 100% agreement.

For primary objective 2 (ie, compare free access between PEDro and PubMed), one data collector (in Spain) attempted to access free full text for each article via PubMed. If there was more than one link, they accessed each of the available links starting from the top link until they were successful. If successful, they recorded the link used (PMCID, other repository, journal website, DOI) and moved to the next article. If unsuccessful, they recorded a 'no' and moved to the next article.

For secondary objective 3 (ie, if free full-text access via PEDro could be expanded by adding a link to a PDF locator website), one data collector (in Australia) attempted to access full text via a PDF locator (http://www.pdfsearchengine.net/). They recorded the success of this strategy as 'no' or 'yes'. The search results in the PDF locator are ranked for relevance using a built-in algorithm. We considered links in the first two pages of the search results because pilot testing indicated that, if available, links to free full text appeared in this section of the search results.

Analysis

For primary objective 1 (ie, estimating the percentage of articles indexed in PEDro that have free full-text access), the percentage of articles indexed in PEDro that had free full-text access from any of the geographic locations was calculated. The 95% CI was computed using the PEDro Confidence Interval Calculator.[26]

To compare free full-text access via PEDro and PubMed (primary objective 2), the percentage (95% CI) were calculated for the articles that have free full-text access using PEDro and/or PubMed. A McNemar test was performed using SPSS version 26 and the MYMCNEMAR macro[27] to compare these percentages.

To determine if free full-text access via PEDro is better for more-recently published articles (secondary objective 1), the percentage (CI) of articles indexed in PEDro that have free full-text access from any of the geographic locations were calculated for four 5-year subperiods: 2000–2004, 2005–2009, 2010–2014, 2015–2019.

To determine if free full-text access via PEDro is dependent on geographic location (secondary objective 2), the percentage (95% CI) of articles indexed in PEDro that had free full-text access were calculated for each country (Australia, Brazil, Nepal, Spain).

To determine if access to free full text in PEDro could be expanded by adding a link to a PDF locator website (secondary objective 3), the percentage (95% CI) overall access to full text (ie, access via PEDro or PDF locator) plus the difference between access via PEDro only and overall access were calculated.

Logistic regression analyses were undertaken using SPSS version 26 to evaluate the association between article characteristics and access to free full text using PEDro (secondary objective 4). Two predictive models were examined because a measure of quality was only available for trials – the first included all articles and the second included trials only. The dependent variable for both models was access to free full text from any of the geographic locations (coded as '1' for 'yes' and '0' for 'no'). The independent variables for the first model were article age, publication language, and area of practice. The independent variables for the second model were article age, language, area of practice, and trial quality. Article age was calculated by subtracting the publication year from 2019. The percentage of correct predictions and variables in the predictive equations were reported for each model.

Results

Sample of articles

In the 2 March 2020 update of PEDro, 46,285 articles were indexed, of which 39,028 were published in 2000–2019 and

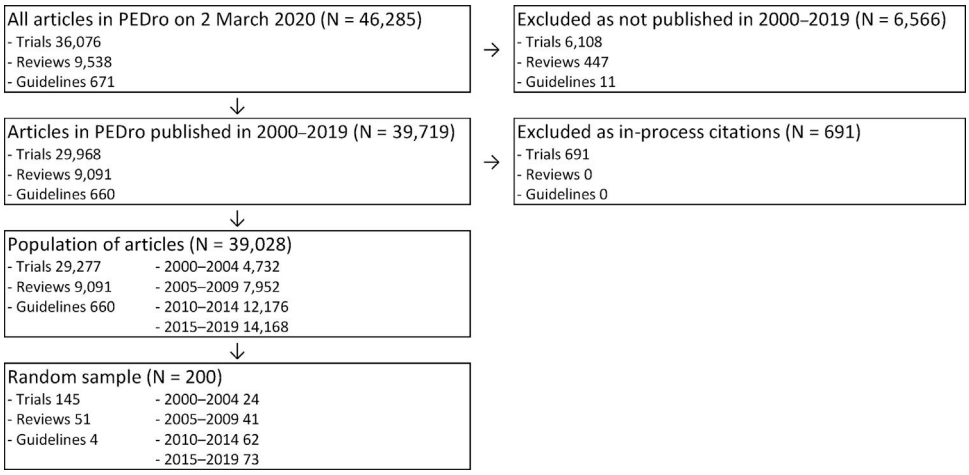

Fig. 1 Flow of trials through the study.

had complete indexing: 4,732 (12%) in 2000–2004; 7,952 (21%) in 2005–2009; 12,176 (31%) in 2010–2014; 14,168 (36%) in 2015–2019. A random sample of 24 articles published in 2000–2004, 41 from 2005–2009, 62 from 2010–2014, and 73 from 2015–2019 were selected for this study. The flow of articles through the study is summarized in Fig. 1.

The majority of articles were published in English and were trials. Musculoskeletal and cardiothoracics were the most frequent areas of practice. The average total PEDro score was 5.3 points out of 10. Descriptive characteristics of the included articles are in Table 1. Individual article data are in the publicly available data file.[28]

Estimate of free full-text access via PEDro (primary objective 1)

Free full text could be accessed via PEDro from at least one country for 102 articles (51%, 95% CI: 44, 58). The DOI link provided access to the most articles, see Table 2.

Comparison of free full-text access via PEDro and PubMed (primary objective 2)

Free full text could be accessed for 94 articles via PubMed (47%, 95% CI: 40, 54), see Table 3. Access to free full text is slightly higher using PEDro compared to PubMed, with PEDro

Table 1 Description of the sample of trials included in the study.

	Entire Sample *N* = 200	2000–2004 *n* = 24	2005–2009 *n* = 41	2010–2014 *n* = 62	2015–2019 *n* = 73
Language					
English	189	24	36	57	72
Other	11	0	5	5	1
Area of practice*					
Cardiothoracics	35	5	10	6	14
Continence and Women's health	21	3	5	5	8
Ergonomics and Occupational health	3	1	1	1	0
Gerontology	33	6	6	9	12
Musculoskeletal	49	5	8	17	19
Neurology	34	2	5	14	13
Oncology	8	1	1	2	4
Orthopaedics	10	1	3	2	4
Paediatrics	17	1	5	5	6
Sports	13	1	4	2	6
Other	21	2	4	6	9
Study method					
Trials	145	18	33	47	47
Reviews	51	5	8	14	24
Guidelines	4	1	0	1	2
Total PEDro score, mean ± SD	5.3 ± 1.4	5.3 ± 1.0	5.3 ± 1.4	5.2 ± 1.7	5.5 ± 1.3

* articles can be coded for more than 1 area of practice

Table 2 Links used to access free full text from four countries (N = 200).

Link	Any location	Australia	Brazil	Nepal	Spain
PubMed Central	38	37	37	37	38
DOI	48	48	48	48	48
PubMed	8	8	8	8	8
Publisher	8	8	8	8	7
No access	98	99	99	99	99

Table 3 Two-by-two contingency table comparing access to free full text via PEDro and PubMed (n = 200).

		Access to free full text via PubMed		
		No	Yes	Total
Access to free full text via PEDro	**No**	97	1	98
	Yes	9	93	102
	Total	106	94	200

having 4% better access (95% CI: 1, 7; McNemar test = 6.40, p = 0.01).

Is free full-text access via PEDro better for more-recently published articles (secondary objective 1)?

Although fluctuations were observed in the percentage of articles that could be accessed for free using PEDro, there was no consistent trend across publication subperiods and the CIs for all subperiods overlapped. There was access to: 13/24 articles in 2000—2004 (54%, 95% CI: 35, 72); 16/41 in 2005—2009 (39%, 95% CI: 26, 54); 30/62 in 2010—2014 (48%, 95% CI: 36, 61); 43/73 in 2015—2019 (59%, 95% CI: 47, 69).

Is free full-text access via PEDro dependent on geographic location (secondary objective 2)?

Geographic location did not appear to impact on access to free full text via PEDro, with each country having access to 101 of the 200 articles (51%, 95% CI: 44, 57). Access was identical for all but two articles. PEDro Article ID 55865[28] could be accessed via the publishers' website from Australia, Brazil, and Nepal, but not from Spain. PEDro Article ID 43643[28] could be accessed via PubMed Central from Spain, but not from Australia, Brazil, or Nepal.

Can free full-text access be expanded by adding a link to a PDF locator website (secondary objective 3)?

Of the 98 articles without free full-text access via PEDro, 18 could be accessed using a PDF locator website. Overall access to full text (ie, access via PEDro or PDF locator) was 60% (95% CI: 53, 67). Supplementing the current links on PEDro with a PDF locator website would increase access to full text by 9% (95% CI: 6, 14).

Table 4 Logistic regression model for all articles (N = 200).

Variables in the Equation	B	SE	p-value	Exp(B)	95% CI Exp(B)
Age	-0.04	0.03	0.18	0.96	0.91, 1.02
Language	2.32	1.08	0.03	10.17	1.22, 84.65
Study method	-0.18	0.31	0.56	0.83	0.45, 1.53
Cardiothoracics	-0.18	0.44	0.67	0.83	0.35, 1.96
Continence and Women's health	-0.25	0.52	0.63	0.78	0.28, 2.16
Ergonomics and Occupational health	-0.81	1.27	0.53	0.45	0.04, 5.41
Gerontology	0.09	0.43	0.84	1.09	0.47, 2.52
Musculoskeletal	-0.05	0.41	0.91	0.96	0.43, 2.13
Neurology	-0.38	0.47	0.42	0.69	0.27, 1.73
Oncology	-1.33	0.89	0.14	0.27	0.05, 1.52
Orthopaedics	-0.91	0.71	0.20	0.40	0.10, 1.62
Paediatrics	0.12	0.55	0.83	1.12	0.39, 3.27
Sports	1.05	0.74	0.16	2.86	0.67, 12.24
Constant	-1.50	1.21	0.22	0.22	

Table 5 Logistic regression model for trials (n = 145).

Variables in the Equation	B	SE	p-value	Exp(B)	95% CI Exp(B)
Age	-0.02	0.04	0.63	0.98	0.92, 1.05
Language	2.17	1.11	0.05	8.75	0.99, 77.20
Cardiothoracics	-0.41	0.51	0.42	0.66	0.25, 1.79
Continence and Women's health	-0.39	0.65	0.55	0.68	0.19, 2.41
Ergonomics and Occupational health	-0.14	1.48	0.93	0.87	0.05, 15.79
Gerontology	-0.23	0.50	0.65	0.80	0.30, 2.14
Musculoskeletal	-0.10	0.49	0.84	0.91	0.35, 2.36
Neurology	-0.22	0.54	0.69	0.80	0.28, 2.32
Oncology	-1.24	1.29	0.34	0.29	0.02, 3.65
Orthopaedics	-0.75	0.87	0.39	0.47	0.09, 2.61
Paediatrics	-0.44	0.65	0.49	0.64	0.18, 2.29
Sports	0.97	0.76	0.20	2.64	0.60, 11.63
Total PEDro score	0.20	0.14	0.14	1.23	0.94, 1.60
Constant	-2.63	1.35	0.05	0.07	

Are article characteristics associated with being able to access to free full text (secondary objective 4)?

The predictive models produced by the logistic regression analyses were not much better than chance – predicting correct values 59% of the time for the model including all articles (Table 4) and 61% for the model focusing on trials (Table 5). The odds ratio (Exp(B)) was significant (ie, $p<0.05$ and 95% CI did not include 1.00) for only one variable (language) in the model involving all articles (Table 4) – free full text was more likely to be available via PEDro for articles published in English (odds ratio=10.17; 95% CI: 1.22, 84.62). However, even this lone significant result did not exclude the possibility of a negligible association with full-text access because the lower end of the CI indicated a trivial association.

Discussion

Free full text could be accessed via PEDro for half the sample of 200 articles (51%, 95%CI: 44, 58). PEDro had slightly higher free access than PubMed (4%, 95% CI: 1, 7). Dividing the sample into 5-year subperiods revealed that free full-text access is not higher among more-recently published articles. Access did not vary by geographic location. Eighteen extra articles could be accessed via a PDF locator website. Article characteristics were not related to free full-text access.

An important strength of our study was that it was an adequately powered random sample from the population of trials, reviews, and guidelines for an entire health discipline. Two aspects of data collection reduced the risk of errors. First, the Excel spreadsheet used for data acquisition was rigorously pilot tested. Second, we double checked all data where there was not 100% agreement between all data collectors.

While data regarding full-text access via PEDro were collected on four continents, the countries used may not be representative of global access to free full text and attempts at free full-text access via PubMed and a PDF locator website were from one country only (ie, Spain and Australia, respectively). Two of the countries were classified as high-income economies by the World Bank (Australia, Spain), one as an upper-middle-income (Brazil), and one as a low-income (Nepal) at the time of data collection.[29] Evaluation from additional countries would provide a more detailed global perspective.

We were surprised that access to free full text was not better from Nepal because Nepal qualifies for free access to journals under the Hinari Access to Research for Health Programme. We deliberately attempted to access full text using computers that were not connected to the intranet of an institution to simulate PEDro usage by physical therapists and other rehabilitation professionals who do not have institutional access. In contrast, the Hinari Access to Research for Health Programme is implemented at an institutional level, so rehabilitation professionals working in eligible countries need to be part of an institution to access journals via an institutional subscription to Hinari. Repeating this observational study using institutional access could quantify the differences in access to free full text by physical therapists and other rehabilitation professionals who work within an institution compared to those who work in private practice. Hinari providing access at a country level, rather than at an institutional level, would address this disparity. Alternatively, there may be scope for developing a partnership between PEDro and Hinari that allows for free access to articles indexed in PEDro for physical therapists in countries with low- to middle-income economies.

There was no association between article characteristics and free access to full text via PEDro. This is probably explained by full-text access usually being determined at the level of the journal or publisher, rather than at an article level. Perhaps investigating the association between free access to full text and journal characteristics would be worthwhile.

PEDro is a better source of free full-text articles than PubMed for physical therapists and other rehabilitation professionals wanting to use the results of research to inform their practice. From anywhere in the world, physical therapists with no institutional access to a medical library can

access free full text for about half the articles indexed in PEDro using the links provided in the PEDro Detailed Search Results page. This access to free full text, combined with features like coding for area of practice, ranking search results by the rigor of the research design and evaluating the methodological quality and completeness of reporting of trials, helps make PEDro an efficient and useful resource to support evidence-based practice. Individual physical therapists need to engage in life-long learning to develop their skills in using resources like PEDro to their fullest extent.[30] The developers of PEDro and other resources need to develop and promote the functionality that will support evidence-based practice. While the PEDro Search Help page includes a video on how to access full text,[31] the tutorial has one-quarter of the views of other tutorials, so perhaps more promotion is required. A future enhancement for PEDro could be to add a fifth link to full text that searches for the article using a PDF locator website. This strategy could increase the overall percentage of articles on PEDro with links to free access by about 9%, which could be tested by repeating this observational study after the addition has been made. Access to full-text articles is crucial for all rehabilitation professionals to take an evidence-based practice approach to patient care. Professional organisations that represent and businesses that employ rehabilitation professionals, including physical therapists, could facilitate access to high-quality clinical research by offering subscription access to important journals for their members or employees. Researchers could facilitate access to their articles by choosing to publish in open-access journals. Research agencies could mandate that the results of their funded projects be published in open-access journals.

Our estimates of access to free full text for 51% of articles via PEDro and 47% of articles via PubMed are remarkably similar to 47% for articles indexed in Scopus between 1996 and 2013 that could be downloaded for free in 2014[14] and 47% for users of Unpaywall in 2017.[15] In contrast, our data do not exhibit the consistent increase in free access to full text with time that was evident in the Scopus dataset.[14] Two reasons for this could be that some journals may have an embargo period for free full-text access and that some journals that have converted to an open-access model in the past decade also made their existing archives open access.[11,32] Sampling error may be another reason why our study did not identify better full-text access among more-recent publications. The study of Scopus evaluated access to 1.25 million articles across a large range of academic fields using automated web scraping technology.[14] While we could have increased our sample size to the entire population of articles indexed in PEDro if automation was used, we opted instead for using a manual search to simulate the experience of physical therapy clinicians and to avoid errors that may occur in large scale, automated analyses.

Conclusions

PEDro is a good source of free full-text articles for physical therapists and other rehabilitation professionals, with free full-text access being available for 51% of articles, and this access could be increased by 9% by adding a link to the PEDro Detailed Search Results page for a PDF locator website. This access is slightly (4%) higher via PEDro than via PubMed. Free full-text access via PEDro is not higher among more-recently published articles and did not vary based on geographic location. Article characteristics were not related to free full-text access.

Funding support

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of interest

Two of the authors (AMM, MRE) sit on the PEDro Steering Committee.

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