## **EDITORIAL**

## "Reference rot": does it matter?

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Every thesis and scientific article contains a list of references listing sources that the author used to develop the study question and to discuss the results. In medical scientific articles this list of references mostly contains citations of other scientific articles or sometime chapters from books. There are strict rules regarding how to cite, with the aim of allowing the reader to access and verify this information unambiguously.

In recent years, it has become common practice to cite information from the internet as well. The authors give a link (URL—Uniform Resource Locator) to a specific webpage with the information the author wants to cite. The reader clicks on the http address and is taken to the webpage containing the information. However, the question is whether the link has the same value as the citation of a specific article?

One hint that something may be amiss is that authors usually also provide the date when the link was used and the information accessed. Indeed, the concern that the information behind the link may no longer be what the author wanted to cite is well founded for two reasons.

First, the URL may no longer be valid and the reader receives an error message. The owner may have shut down the link or the server may no longer respond to requests. This phenomenon is referred to as "link rot". Second, although the link is still operative the contents may have been moved to another location or another website, sometimes called a term that needs no further explanation [1]. One may ask: where is the problem? We reviewed the 231

"content drift". In both instances the reader can no longer

access the information in the list of references, making the

citation useless. This fact is called graphically "reference rot",

articles published in the IUJ in 2013 and found that 63 papers contained URLs in the list of references, with an average of 1.7 links per article. Checking these links in February 2015 we found that 27.3 %—more than a quarter—could no longer be accessed after 13-25 months. With the passing of time the number of broken links can only increase.

What can be done? The use of URLs in lists of references will not go away. Sometimes, past information from the internet can be retrieved from an archiving service, such as archive.org. This internet archive automatically stores billions of pages with a particular date. It calls itself the Wayback Machine, "a non-profit library of millions of free books, movies, software, music, and more" [2]. It depends on crawlers, automated computer programs that search websites. This is more of a hit-and-miss initiative and for academics and scholars something more solid is needed.

This is where the perma.cc link comes in. It helps authors, editors and publishers to archive web pages and protects the work from "link rot". Perma generates a unique URL-a "perma link"—that directs readers to the cited reference, even if the original information has moved away [3]. At present perma is still in beta, but one could foresee a day where journals will require authors to use such a service and a unique URL for their citation in all references.

The problem is particularly acute in legal articles where the reasoning often depends on previous court decisions, which have to be available verbatim. If a reader cannot access the information the whole article may become useless. A recent



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article in the Harvard Law Review [4] explains the problem and also demonstrates how perma links can be used in a list of references. Instead of giving a date when the URL was accessed—which can often become irrelevant—the authors add a permalink after the URL (archived at http://perma.cc/). When a reader clicks on the perma link he/she sees the reference even if the website has changed in the meantime and in exactly the same format and with the same content that the author used for the article.

The URLs in lists of references make it very easy for readers to access the information. Readers do not have to go through library websites or active subscriptions to journals. But readers also expect to find the information when they open a URL. More will have to be done to ensure that URLs are what they must be in a list of references—unambiguous identifiers of information that is actually available.

## References

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