Final report: metrics to inform priority setting in Cochrane Oral Health

1. Introduction

To begin the prioritization project, an initial scoping exercise has been undertaken, looking at usage of existing Cochrane Oral Health reviews between 2014 and 2018, taking into account metrics in five areas. 2014 was the date of conclusion of Cochrane Oral Health's previous prioritization exercise, and so data was collected from this point onwards. A complete list of all Cochrane Oral Health reviews was retrieved from Cochrane's information system. This was imported into Excel, and data for each of the five areas was inputted.

The five areas considered were:

1. The number of times the full text of the review was downloaded from 2014 to 2017 (full text downloads);
2. The number of times the review was cited in another paper according to Thomson Reuters (Web of Science citations);
3. The number of times the review was cited in another paper according to Google Scholar (Google Scholar citations);
4. The Altmetric score of the review;
5. The number of times the review has been cited in a guideline (guideline citations).

2. Methods

2.1. Full text downloads

The full text of Cochrane Oral Health's reviews is available online for download in PDF format via *The Cochrane Library*. Cochrane currently operates a "green and gold" access programme. Reviews are embargoed for 12 months (green access) unless the reviewers pay a fee to make the review open access (gold access). In addition, in certain countries all reviews are accessible free of charge to all citizens via a countrywide site licence. People may also have access through subscription-based individual or institutional licences (Cochrane Library, 2017). Wiley, the publishers of *The Cochrane Library*, make available the statistics for the number of full text downloads to Cochrane review groups in an annual report. This was analysed for this research.

2.2. Web of Science citations (Thomson Reuters)

The impact of research is traditionally measured by the impact factor. This is a way of judging the importance of a particular journal in its field (Garfield, 2005). Impact factor is calculated by

dividing the number of times a journal's articles have been cited by the number of articles that the journal has published in a given year (Clarivate Analytics, 2017). The numerator in this equation is calculated using data from Thomson Reuters's ISI Web of Science's Journal Citation Reports database. This citation data was collected from the Web of Science database in February 2019, for all of Cochrane Oral Health's published reviews.

2.3. Google Scholar citations

Research by Mongeon and Paul-Hus (2016) has shown that the citation data obtained through Web of Science may not show the whole picture when it comes to citations in biomedical research. They compared coverage of biomedical journals in Web of Science to the periodicals directory maintained by Ulrich, and found that only 28% of journals in the field are indexed in Web of Science. An alternative source of citation metrics was sought for this study, to compare to the citation data provided by Wiley from Web of Science.

Google Scholar is a search engine rather than a database, which searches the scholarly literature including full text articles. It is designed to be as comprehensive as possible (De Groote and Raszewski, 2012). Harzing and van der Wal (2008) report that impact data for individual scholars is generally higher in Google Scholar than in Web of Science, often substantially so. They indicate that several factors account for this. These include the reliance on Web of Science indexed journals to provide cited articles, limited coverage of non-English language sources and issues with non-ISI Web of Science indexed journals. In many cases, these citations are included but only for the first author (Harzing and van der Wal, 2008). They conclude that Google Scholar also has limitations in that it does not perform well for older articles and includes non-scholarly citations. However, it provides a robust alternative to Web of Science.

Google Scholar allows researchers to create an alert, in which an email is sent every time a particular scholarly work is cited. These alerts have been set up for all Cochrane Oral Health reviews, and the number of citations for each review has been collected by the group since 2014.

2.4. Altmetric score

Altmetrics have emerged since 2010 as a new way of considering the impact of research, an alternative to the traditional impact factor (Kolahi and Khazaei , 2016). Articles are tracked using their DOI number and the number of times an article is mentioned in the following places is counted:

1. Policy documents
2. News sources
3. Blogs
4. Online reference managers (such as Mendeley)
5. Post-publication peer review forums
6. Social media (Twitter, Facebook, Weibo, Google+, Pinterest and Reddit)
7. Other resources, such as Wikipedia and You Tube.

(Kolahi and Khazaei , 2016)

An aggregated score is then produced and assigned to an article. This score acts as an indicator of the online attention an article has received. It is weighted, with (for example) a mention in a

news article gaining 8 more points than a mention on Twitter (Altmetric Support, 2016). Costas *et al* (2014) found a weak but positive correlation between traditional impact factor and Altmetric score, and argue that the Altmetric score represents a complementary way to analyse the impact of an article.

Altmetric scores for all Cochrane Oral Health reviews are available online via *The Cochrane Library*. These scores were retrieved and documented in January 2017.

2.5. Guidelines citations

Fostering links with groups who develop guidelines in health care is a key component of Cochrane's *Strategy to 2020* (Cochrane, 2015). A number of Cochrane Oral Health reviews have been cited in clinical guidelines, and this data provides an indicator of the review's practical utility, and it's potential to change practice. The citation results from Web of Science and Google Scholar were combined with data provided by information specialists at the UK Cochrane Centre to identify those reviews which had been sought after by guideline development groups.

The data collected for all of these metrics was collated in an Excel spreadsheet. As some of the reviews were published during the period 2014-2018, a mean score for the four years 2014, 2015, 2016 and 2017 was calculated for two of the metrics: Google Scholar citations and full-text downloads, to give an average yearly score. For Web of Science citation data, a yearly average score was also calculated, but across the lifespan of the review, rather than over the four years. This was because it was not possible to get year-by-year citation data from Web of Science.

3. Results

By January 2019, Cochrane Oral Health had 162 published reviews. A top ten of reviews for each of the metrics was produced.

3.1 Full text downloads

The most downloaded Cochrane Oral Health review was *Oral hygiene care for critically ill patients to prevent ventilator associated pneumonia*, with an average of 8,116 downloads per year. This review was by far the most popular, with the next most popular being *Powered versus manual toothbrushing for oral health*. Of all of the reviews in the top ten, only three (*Oral hygiene care for critically ill patients to prevent ventilator associated pneumonia, Chlorhexidine mouthrinse as an adjunctive treatment for gingival health*, and *Interventions for preventing oral mucositis for patients with cancer receiving treatment*) did not cover the topic of caries prevention or treatment in some way.

Cochrane Oral Health most downloaded reviews, 2014-2017 (yearly average)

Cochrane Oral Health Review	Downloads
Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia	8116
Powered versus manual toothbrushing for oral health	5842
Water fluoridation for the prevention of dental caries	5542
Pit and fissure sealants for preventing dental decay in the permanent teeth	4553
Fluoride varnishes for preventing dental caries in children and adolescents	4044
Chlorhexidine mouthrinse as an adjunctive treatment for gingival health	3585
Xylitol-containing products for preventing dental caries in children and adults	3237
Interventions for preventing oral mucositis for patients with cancer receiving treatment	3126
Operative caries management in adults and children	3001
Direct composite resin fillings versus amalgam fillings for permanent or adult posterior teeth	2964

3.2 Web of Science citations

The majority of Cochrane Oral Health reviews had received less than 10 citations in the years 2014-2018, according to the data calculated using the journals indexed by Web of Science. 60 out of 162 had received an average of five citations or less over the four year period. The most cited review was *Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents*. Three of the ten most cited were on the topic of dental implants, and *Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia* and *Chlorhexidine mouthrinse as an adjunctive treatment for gingival health*. The other four were about the treatment or prevention of dental caries.

Cochrane Oral Health most cited reviews according to Web of Science data, 2014-2018 (yearly average)

Cochrane Oral Health Review	Citations
Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents	32
Interventions for replacing missing teeth: augmentation procedures of the maxillary sinus	31
Water fluoridation for the prevention of dental caries	28
Pit and fissure sealants for preventing dental decay in the permanent teeth	26
Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia	24
Interventions for replacing missing teeth: antibiotics at dental implant placement to prevent complications	21
Chlorhexidine mouthrinse as an adjunctive treatment for gingival health	20
Interventions for replacing missing teeth: different types of dental implants	18
Fluoride varnishes for preventing dental caries in children and adolescents	17
Interventions for preventing oral mucositis for patients with cancer receiving treatment	17

3.3 Google Scholar citations

The number of citations received by Cochrane Oral Health reviews on Google Scholar was greater than those reported by Web of Science. 89 out of 162 received a yearly average of 5 citations or less compared with 60 out of 162 on Web of Science during the period 2014-2018. The reviews cited most according to this data were again mainly concerned with the prevention or treatment of dental caries, however two of the dental implant reviews were also highly cited.

Cochrane Oral Health most cited reviews according to Google Scholar data, 2014-2018 (yearly average)

Cochrane Oral Health Review	Citations
Fluoride toothpastes for preventing dental caries in children and adolescents	47
Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents	43
Pit and fissure sealants for preventing dental decay in the permanent teeth	43
Interventions for replacing missing teeth: different times for loading dental implants	40
Fluoride varnishes for preventing dental caries in children and adolescents	40
Operative caries management in adults and children	35
Interventions for replacing missing teeth: augmentation procedures of the maxillary sinus	34
Interventions for preventing oral mucositis for patients with cancer receiving treatment	34
Powered versus manual toothbrushing for oral health	32
Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia	31

3.4 Altmetric score

The Cochrane review *Flossing for the management of periodontal diseases and dental caries in adults* had by far the most attention on social media. Prevention and treatment of caries and gum diseases were the most popular topics, featuring in 7 of the ten reviews with the highest Altmetric scores.

Cochrane Oral Health highest Altmetric scores as of January 2019

Cochrane Oral Health Review	Altmetric score
Flossing for the management of periodontal diseases and dental caries in adults	467
Powered versus manual toothbrushing for oral health	348
Water fluoridation for the prevention of dental caries	330
Triclosan/copolymer containing toothpastes for oral health	290
Surgical removal versus retention for the management of asymptomatic disease-free impacted wisdom teeth	238
Xylitol-containing products for preventing dental caries in children and adults	200
Fluoride mouthrinses for preventing dental caries in children and adolescents	148
Fluoride toothpastes for preventing dental caries in children and adolescents	143
Ibuprofen and/or paracetamol (acetaminophen) for pain relief after surgical removal of lower wisdom teeth	135
Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia	134

3.5 Guideline citations

The review *Fluoride toothpastes for preventing dental caries in children and adolescents* featured in seventeen guidelines over the period studied, and the other Cochrane Oral Health review on fluoride toothpastes was cited 16 times by guideline developers. Again, the prevention of dental caries was of significant interest, with seven of the ten most cited reviews measuring the effectiveness of various interventions.

Cochrane Oral Health reviews most cited in Guidelines, 2014-2018

Cochrane Oral Health Review	Guideline citations
Fluoride toothpastes for preventing dental caries in children and adolescents	17
Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents	16
Fluoride varnishes for preventing dental caries in children and adolescents	11
Antibiotics for the prophylaxis of bacterial endocarditis in dentistry	10
Interventions for preventing oral mucositis for patients with cancer receiving treatment	10
Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia	10
Pit and fissure sealants for preventing dental decay in the permanent teeth	10
Fluoride mouthrinses for preventing dental caries in children and adolescents	9
Pit and fissure sealants versus fluoride varnishes for preventing dental decay in the permanent teeth of children and adolescents	9
Flossing for the management of periodontal diseases and dental caries in adults	9

3.6 Aggregated top tens

As a final stage, a matrix was produced, to show which of the published reviews appeared in more than one of the top tens, to develop an overall picture of usage (see Table 6). Only one review appeared in all five top tens: *Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia. Fluoride varnishes for preventing dental caries in children and adolescents, Interventions for preventing oral mucositis for patients with cancer receiving treatment* and *Pit and fissure sealants for preventing dental decay in permanent teeth* appeared in four of the top tens.

A matrix showing which Cochrane Oral Health reviews appeared in which of the top ten results in the five metrics considered

	ALTMETRICS	GOOGLE SCHOLAR	WEB OF SCIENCE	DOWNLOADS	GUIDELINES	TOTAL
Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia	X	X	X	X	X	5
Fluoride varnishes for preventing dental caries in children and adolescents		X	X	X	X	4
Interventions for preventing oral mucositis for patients with cancer receiving treatment		X	X	X	X	4
Pit and fissure sealants for preventing dental decay in the permanent teeth		X	X	X	X	4
Fluoride toothpastes for preventing dental caries in children and adolescents	X	X			X	3
Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents		X	X		X	3
Powered versus manual toothbrushing for oral health	X	X		X		3
Water fluoridation for the prevention of dental caries	X		X	X		3
Chlorhexidine mouthrinse as an adjunctive treatment for gingival health			X	X		2
Flossing for the management of periodontal diseases and dental caries in adults	X				X	2
Fluoride mouthrinses for preventing dental caries in children and adolescents	X				X	2
Interventions for replacing missing teeth: augmentation procedures of the maxillary sinus		X	X			2
Interventions for replacing missing teeth: different times for loading dental implants		X	X			2
Operative caries management in adults and children		X		X		2
Xylitol-containing products for preventing dental caries in children and adults	X			X		2
Direct composite resin fillings versus amalgam fillings for permanent or adult posterior teeth				X		1
Ibuprofen and/or paracetamol (acetaminophen) for pain relief after surgical removal of lower wisdom teeth	X					1
Interventions for replacing missing teeth: different types of dental implants			X			1
Antibiotics for the prophylaxis of bacterial endocarditis in dentistry					X	1
Pit and fissure sealants versus fluoride varnishes for preventing dental decay in the permanent teeth of children and adolescents					X	1
Surgical removal versus retention for the management of asymptomatic disease-free impacted wisdom teeth	X					1
Triclosan/copolymer containing toothpastes for oral health	X					1

4. Discussion

The results so far give Cochrane Oral Health a snapshot of which reviews are most in demand, and which reviews are candidates for future updates. It seems clear that the challenges of preventing and treating dental caries remain popular topics with stakeholders; whether that is researchers who are citing reviews in their own works, or people who are discussing Cochrane reviews on social media or in news outlets. The prevention of dental caries also seems to be high on the agenda of clinical guideline developers in oral health.

There are some interesting differences in the types of reviews that are cited in the work of other researchers and those which people are most likely to be discussing on social media. The reviews on dental implants were not likely gain attention on social media, but they were highly cited by other researchers. The popular topics on social media were more around whether or not to floss, whether to use a powered toothbrush, what type of toothpaste to use and whether fluoride should be added to the water supply or not. This suggests that Cochrane Oral Health reviews are being used by different stakeholders for different purposes. More "technical" topics such as what type of dental implant to use and whether or not to augment the maxillary sinus before placing implant are sought after by other researchers and academics, but not so much by members of the public and the statistics on the full text downloads confirms this.

However, statistics of this nature should be interpreted with caution. For example, The Cochrane Library database where the Cochrane reviews are housed is not currently completely open access, there is a one-year embargo on free publication in some territories, and this may have an impact on the results. However, it should be said that one of the most downloaded reviews (Water fluoridation for the prevention of dental caries) was published during the period covered by the study and would have been subject to the embargo. This did not stop the full text of this review being downloaded an average of 5542 times per year. There is a possibility even so that the embargo has condensed this figure, along with other reviews published during the period under study that would have been subjected to the embargo.

One interesting aspect of this research is the considerable difference between the number of reviews with Web of Science citations versus the number of reviews with Google Scholar citations. Google Scholar casts its net very widely. Konkiel (2014) has outlined several reasons why Google Scholar citations may not be wholly reliable. Firstly, Google's definition the scholarly web is not rigorous, and items such as student handbooks and library guides could be pulled in as cites via Google's algorithm. Secondly, Konkiel argues that Google Scholar's lack of transparency around how the data is arrived at allows the system to be "gamed" to an extent, and she also found that Google was slow to issue corrections to errors. Conversely, the data collected via Thomson Reuters on Web of Science may be more limited to a narrower set of journals, however, there is some quality control in that attempts to "game" the system by inflating citations are more likely to be identified (Konkiel, 2014). However, both systems are flawed and neither gives a complete picture of the impact and usage of Cochrane reviews.

Altmetics is another system which may be open to "gaming" or manipulation of the data. As Holmberg (2014) has suggested, the line between "gaming" and legitimately promoting a piece of research is quite fine. Do the highest Altmetric scores of Cochrane Oral Health's reviews reflect legitimate online interest, or the amount of time and effort the Group has taken to promote them? Euan Adie (the founder of Altmetrics) has pointed out that there are some measures in place to guard against the more pernicious attempts to artificially inflate the online attention that an article may receive. For example, only data that is available for audit is included in an Altmetric score, and the blogs and news sources included are manually curated. Altmetric also use the data that they have collated to track unusual patterns of activity (Adie, 2013). As Altmetric scores are not yet part of the "official" impact factor for a journal or a paper, there may be less incentive to manipulate it, but this may change if the Altmetric score becomes a legitimized way of calculating impact.

A further reason for caution is that there may be a possible time lag between the publication of a Cochrane review, and the citations and attention scores starting to increase. Of the 22 reviews in the final matrix only four were brand new reviews, published in the period under study. The others were review updates, or reviews which were published prior to 2014. If the research was repeated in five years, it is possible that the matrix would look very different.

Conclusions

This examination of the metrics was a useful exercise to calculate the impact of current Cochrane Oral Health reviews. The data will inform the prioritisation process for updating reviews, however, the value of this data is limited. Although it gives a snapshot of which Cochrane Oral Health reviews are most in demand, this type of data does not identify evidence gaps, or give any indication of where new systematic review titles may be commissioned. Stakeholder involvement will be sought in the next steps, to confirm that these topics are the most important to consider for updates, and the next stages in the process will also examine the literature for areas of new developments in the evidence base.

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