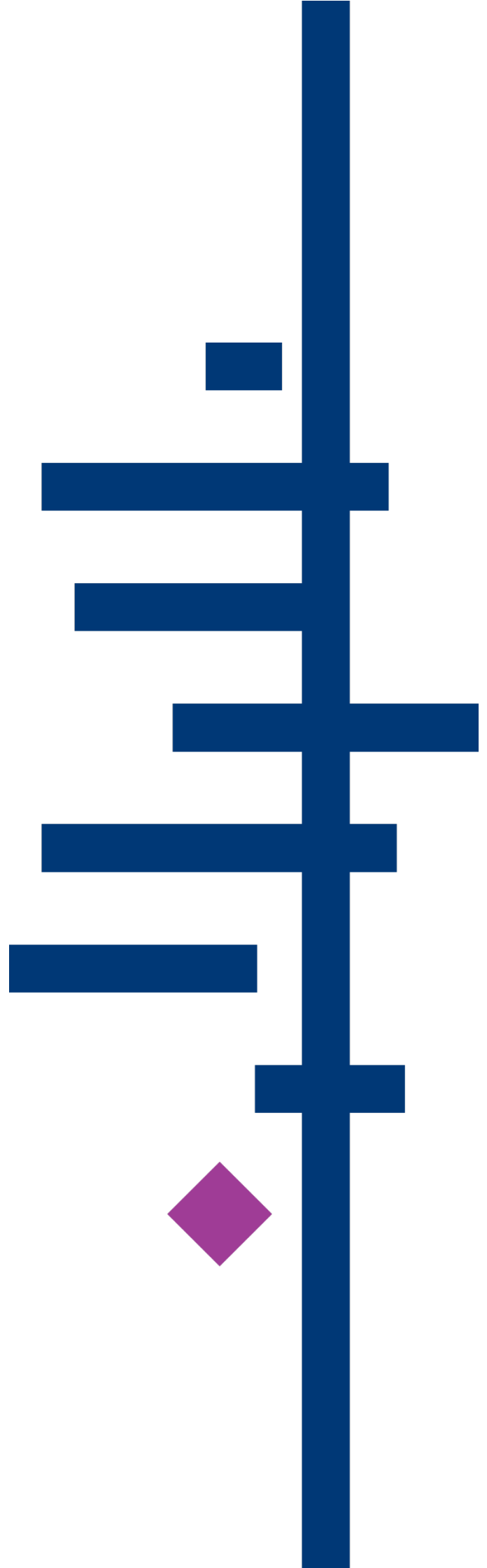




Results from the evaluation of the pilot living systematic reviews:

What works?

What could we improve?



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Key messages

Living systematic reviews appear to be both an acceptable and feasible approach to keeping high-quality evidence synthesis continually up to date. Challenges that need to be addressed include issues with the current publication processes and availability of resources to support living systematic reviews in the long term.

Executive Summary

Timely use of reliable research evidence is required for optimal health care, however, there is a persistent gap between research findings and healthcare practice. As a consequence, many patients are continuing to receive sub-optimal care. Living systematic reviews offer an approach to keep high-quality evidence synthesis continually up to date, so the most recent, relevant and reliable evidence can be used to inform policy and practice, resulting in improved quality of care and patient health outcomes. Since 2016, several Cochrane teams and others in the Living Evidence Network have been piloting living systematic reviews.

Ensuring these high-quality evidence syntheses are continually up to date requires some modifications to existing authoring and editorial processes, and poses a number of technical and publishing challenges. We aimed to explore the experiences of those conducting pilot living systematic reviews and to assess the feasibility and acceptability of this new approach in order to refine future living systematic review production models.

Across six pilot living systematic reviews (3 Cochrane; 3 non-Cochrane), we interviewed 27 participants (authors, editors, information specialists and peer reviewers) up to three times and tracked living systematic review progress with monthly surveys. The pilot period ran between September 2017 and August 2018.

Participants described overwhelming enthusiasm for involvement in the living systematic reviews pilot. They highlighted the importance of a motivated, efficient team to manage the monthly requirements of a living systematic review; the value of using machine learning and citizen science approaches to screening to manage workflow and reduce time commitment; the on-going, continuous commitment required of a living systematic review and the translation of this process into a reliable, efficient, streamlined operation; and the potential for time and effort savings in the long run.

Participants highlighted challenges with the current publication processes and the lack of resources to support living systematic reviews in the long term. They also raised concerns about the on-going workload.

The results of this evaluation will inform discussions about further implementation of living systematic reviews within Cochrane. The findings may also be used by others interested in the production of living systematic reviews.

1. Overview - living systematic reviews

Living systematic reviews are systematic reviews that are continually updated, incorporating new, relevant data as it becomes available. Utilising machine learning, citizen scientists and online platforms to reduce workload, and new author and editorial workflows, living systematic reviews are becoming a reality.

By retaining methodological rigour while staying on top of new evidence, living systematic reviews break the historical trade-off between review quality and currency. Living systematic reviews offer a new approach to review updating, and present exciting new opportunities for living guidelines and living recommendations.

Living systematic reviews differ from traditional systematic reviews in several ways that have important implications for review methods and processes, affecting authors, editors and publishers. Living systematic review approaches are being piloted internationally, with Cochrane at the forefront of method development and publishing approaches.

1.1 Purpose

This report presents the findings of the evaluation of the living systematic review pilots. The study aimed to assess the feasibility and effectiveness of living systematic reviews and explored how people are currently conducting living systematic reviews, the facilitators and challenges, opportunities for improvement and factors to consider for scale up.

The findings from this study will be used in discussions with the Cochrane community, key decision makers and people more broadly concerned with living systematic reviews to identify and develop priorities for scale-up.

2. Who did we hear from?

Six living systematic review teams were included in this evaluation study. The authors used purposive sampling to recruit review teams who were known to be conducting (or proposing to conduct) a living systematic review at the commencement of the pilot period. Online surveys and semi-structured qualitative interviews with key members involved with the living systematic review pilots explored their experiences with living systematic reviews.

The pilot Cochrane living systematic reviews included:

1. Anti-coagulation in people with cancer (3 interrelated reviews)
2. Fruit and vegetable consumption in children
3. Delayed antibiotics for respiratory infection

Non-Cochrane living systematic review pilots included:

1. Zika virus and adverse neurological outcomes (F1000Research and PLOS Medicine)
2. Adherence to guidelines in traumatic brain injury (Journal of Neurotrauma)
3. Epidemiology of traumatic brain injury (Journal of Neurotrauma)

2.1 Interviews

Up to three semi-structured interviews were conducted with each of the key team members involved with the living systematic review (LSR) pilots between September 2017 and August 2018. A total of 27 participants were interviewed including Lead/Senior Authors (n = 8), Information Specialists (n = 3), editors responsible for managing the review production and publication process (Managing Editors, n = 3) and coordinating the review production for clinical areas within Cochrane (Coordinating Editors, n = 3), Peer Reviewers (n = 2), other editorial team members involved in the LSR pilots (n = 6), the project lead for Cochrane Crowd (n = 1) and the coordinator of the pilot living systematic reviews (n = 1).

The interviews explored participants' experiences of conducting/contributing to living systematic reviews and the barriers, facilitators, challenges and advantages of LSR processes. Interviews were conducted via online meeting software or by phone, and audio-recorded. Detailed notes were taken during the interviews. Interviews were conducted by Tanya Millard, Tari Turner or Annie Synnot all of whom worked on the living systematic review pilot program within Cochrane and have extensive experience in qualitative interviewing.

2.2 Surveys

Surveys were distributed each month from October 2017 to July 2018 and captured time spent on key living systematic review tasks, the numbers of citations screened, and reflections on the pilot review process. Surveys commenced after each pilot team published their baseline living systematic review. Twelve people completed online monthly surveys (minimum of one representative from each included review). Respondents described themselves as Senior/Lead Authors (6), Information Specialists (3) and Managing Editors (3). The study was approved by the Monash University Human Research Ethics Committee. See Appendix 1 describing the research methods.

3. About the reviews

Table 1. Key characteristics of the living systematic review pilot teams, processes and publication models

Review topic ¹	Anti-coagulation in people with cancer (3 related LSRs)	Fruit and vegetable consumption in children	Delayed antibiotics for respiratory infections	Zika virus and adverse neurological outcomes	Adherence to guidelines in traumatic brain injury	Epidemiology of traumatic brain injury
No. of authors maintaining LSR ²	4	2	2	4	2	4
Search or other support	Information specialist to develop and run searches; ongoing LSR methods expert support			Librarian to develop searches only	Information specialist to develop and review searches only; ongoing LSR methods expert support	
Direct funding for personnel	Yes (Part-time RA for authors)	Yes (Part-time RA for authors, stipend for editorial group)	No	Yes (Three funded positions [various roles] for authors)	Yes (Authors funded as part of broader work program, plus specific part-time LSR methods expert)	
Journal/Editorial Group; Publisher	Cochrane Gynaecological, Neuro-Oncology and Orphan Cancers; Cochrane	Cochrane Heart; Cochrane	Cochrane Acute Respiratory Infections; Cochrane	F1000Research; F1000	Journal of Neurotrauma; Mary Ann Liebert, Inc.	
Search frequency	Monthly ³			Daily or monthly ⁴	Three-monthly ⁵	
Technological enablers ⁶	Machine classifier and crowd-sourcing to identify RCTs ⁷		Nil	Automation and machine learning algorithms to identify RCTs, with some data output automation ⁸	Nil	
Communicating review status to reader	Monthly statement to reader about review status (i.e. search date, new studies found, update plans) published in the 'What's New' section of the review, via an article amendment			Daily updates (search date, new studies found) via study website ⁹	3-6 monthly updates, describing results of new evidence found, available as supplementary material in online version of article	

Review topic ¹	Anti-coagulation in people with cancer (3 related LSRs)	Fruit and vegetable consumption in children	Delayed antibiotics for respiratory infections	Zika virus and adverse neurological outcomes	Adherence to guidelines in traumatic brain injury	Epidemiology of traumatic brain injury
Editorial and peer review of status updates	No formal editorial review; no peer review			No formal editorial review; no peer review	Editorial review and copy-editing; no peer review	
Process for integration of new evidence (citation/DOI status)	Full re-publication of review, with new citation and DOI ¹⁰			New version of the review published, with linked citation and DOI (intended) ¹¹	Full re-publication of review, or short commentary article, with a new citation and DOI (intended) ¹¹	
Editorial and peer review of new versions/publications	Standard editorial and peer review processes apply (may qualify for 'selective' peer review per Cochrane policy); same peer reviewers approached			Standard editorial and peer review processes apply; same peer reviewers approached (intended) ¹¹	Not confirmed (likely standard editorial and peer review processes apply) (intended) ¹¹	
Trigger for integration of new evidence	When new evidence identified that changes review conclusions (intended) ¹¹	Every 4 months (irrespective of impact of new evidence)	When new evidence identified (irrespective of its impact) (intended) ¹¹	Every 6 months (irrespective of impact of new evidence) (intended) ¹¹	When new evidence identified that changes review conclusions, but no more frequently than yearly (intended) ¹¹	

Footnotes

¹Each team produced one LSR unless otherwise stated.

²Meaning authors who contributed to the ongoing review tasks associated with maintaining the LSR (this may or may not have included the entire author team who contributed to the 'baseline' review).

³Electronic databases +/- clinical trials registries all searched monthly, with remaining non-database sources, such as journal hand searching, websites and conference proceedings searched every 6 months.

⁴Daily searches for PubMed, Embase and LILACS databases, with monthly searches for all other sources.

⁵All sources (including non-database sources) searched at this frequency.

⁶'Technological enablers' refers to both computer technology and more efficient models of human contribution to increase the efficiency and sustainability of the systematic review enterprise (adapted from Thomas 2017 J Clin Epi 91:31-37).

⁷More detail to be provided about the Crowd/Classifier process in the manuscript.

⁸Searches in some databases (PubMed, Embase and LILACS) are automated. De-duplication of citations is automated. Machine learning algorithm suggests a decision for inclusion based on title and abstract. All existing predefined tables and figures can be updated by running a script that re-renders these tables and figures.

⁹Study website is the Zika Open Access Project, available at: <https://zika.ispm.unibe.ch/home>.

¹⁰This process was implemented in one Cochrane Review only (Fruit and vegetable consumption in children). It was the intended process to be used in the remaining Cochrane Reviews but they did not reach the trigger for integration of new evidence, so their reviews were not re-published during the pilot period.

¹¹'Intended' refers to the fact that this was the agreed process and/or trigger for integrating new evidence but that it was not undertaken during the pilot period

Abbreviations: DOI = Digital Object Identifier, LSR = living systematic review, RA = research assistant, RCT = randomised controlled trial.

4. Results

4.1 Progress during the pilot

Table 2. Review progress and workload implications during the pilot period (i.e. until August 2018)

Review topic ¹	Anti-coagulation in people with cancer (3 related LSRs) ²	Fruit and vegetable consumption in children	Delayed antibiotics for respiratory infections	Zika virus and adverse neurological outcomes	Adherence to guidelines in traumatic brain injury	Epidemiology of traumatic brain injury
Date 'baseline' review published	LSR 1 ³ : September 2017 LSR 2 ⁴ : December 2017 LSR 3 ⁵ : June 2018	September 2017	September 2017	February 2018	October 2015	November 2015
No. of studies in 'baseline' publication	LSR 1 ³ : 19 LSR 2 ⁴ : 7 LSR 3 ⁵ : 16	50	11	101	22	66
No. of new studies found since 'baseline' publication ⁶	5 ⁷	13	0	96	14	18
No. of status updates since baseline review	Monthly updates LSR 1 ³ : 10 LSR 2 ⁴ : 7 LSR 3 ⁵ : 1	10	10	0	4	3
No. of times review re-published	0 ⁷	2 (January and May 2018)	0	0	0	0

Footnotes

¹Each team produced one LSR unless otherwise stated.

²These three LSRs were part of a suite of LSRs that used a single search.

³Refers to the first in the suite of LSRs published: [Parenteral anticoagulation in ambulatory patients with cancer.](#)

⁴Refers to the second in the suite of LSRs published: [Oral anticoagulation in people with cancer who have no therapeutic or prophylactic indication for anticoagulation.](#)

⁵Refers to the third in the suite of LSRs published: [Anticoagulation for the long-term treatment of venous thromboembolism in people with cancer.](#)

⁶Includes new (not ongoing) studies that were screened and found to meet the inclusion criteria for the review until the end of the pilot period.

⁷Data presented for all three reviews (as appropriate, given they transitioned into living mode at different times during the pilot period) given the same search fed into all reviews and they were managed by the same author and editorial teams.

Abbreviations: No. = number, mins = minutes

The number of citations screened per month varied widely between the reviews, from 3 to 300 citations screened per month. The amount of time spent per month by the author team on each review also, predictably, varied widely, from 5 minutes to 32 hours, depending on both the screening workload, and whether the review was being updated and republished that month. There was no clear pattern in how this time was spent on different tasks in the review process.

For Cochrane LSRs, the time spent per month by Managing Editors varied over a smaller range, from 0 minutes to 3.5 hours, with larger workload associated with LSRs that were being republished. Similarly the time spent by Information Specialists varied from 30 minutes to 6 hours per month.

4.2 Highlights of what people said about the process/experience

Overall, participants described their overwhelming enthusiasm for contributing to a living systematic review. Respondents eloquently described their motivations and experiences, highlighting the challenges, efficiencies, and opportunities for improvement. They described the importance of refining the methods and optimising the processes to support the feasibility of living systematic reviews in the long term.

Participants also described their varying approaches to review production and highlighted the vital importance of an experienced, committed, enthusiastic team to manage the monthly requirements of an LSR. Participants spoke about the benefits obtained through the use of machine learning and citizen science approaches to manage the monthly workflow and reduce time commitment, while also highlighting the shortcomings of these approaches and opportunities for improvement. They described the ongoing commitment required to conduct an LSR and the evolution of this process into a reliable, streamlined operation. Participants also discussed the potential for LSRs to result in time and effort savings over time.

The participants highlighted several sustained challenges which need to be addressed in order to support the feasibility and acceptability of LSRs. Challenges included:

- Managing the ongoing workload and rigid requirements with limited resources;
- Issues with search and screening; and
- The current publication processes.

In light of these experiences, participants highlighted several factors to consider for the scale up of living systematic reviews including:

- Improving clarity of roles, processes and expectations;
- Providing resources and other incentives to increase motivation for undertaking and sustaining an LSR;
- Better integration and knowledge of technology to reduce human investment;
- Having specific criteria about the appropriateness of a review to become an LSR;
- Improving publication processes; and
- Further refinement and additional development of machine learning / technologies / citizen science to improve efficiency.

4.2.1 Motivations (Team motivation for undertaking living systematic reviews)

Participants described many reasons for undertaking a living systematic review. All identified the novel appeal of LSRs and the notion of reduced workload and increased efficiency as a source of motivation. Many were interested in the methods for systematic reviews and were interested to explore how the process could be conducted more efficiently. The idea that the SR process could potentially be more efficient in the longer term, rather than updating traditional SR's, was appealing.

“For me, LSR’s are an interesting, novel concept. I am intrigued about the notion that it might reduce workloads compared to standard reviews” (Information specialist).

For all participants, the overwhelming appeal of undertaking a living systematic review was increasing the reliability of reviews – ensuring they are maintained as current and based on the most recent research which can better be used to inform decision making, policy and practice.

“Keeping the review up to date and relevant for people using it is very appealing” (Cochrane author).

“Enthusiasm (for LSRs) has been driven by everyone’s commitment to evidence based medicine. There is no solution to systematic reviews going out of date. The volume of evidence of work, potential of LSRs and overwhelming need for this to happen” (LSR coordinator).

Participants frequently mentioned the high profile of LSRs as a motivating factor. Publicity and recognition for authors along with the increased number of research outputs for the author team were key motivators in undertaking an LSR. Participants described their excitement at being involved in piloting LSRs and having the opportunity to contribute to process refinement.

“It is a very interesting area and a great learning opportunity. It is also an opportunity to influence how they [LSR’s] are being done” (Cochrane author).

4.2.2 Initial expectations

Many of the participants began the process of conducting/contributing to an LSR with a sense of uncertainty, particularly around the impact on their workload. Authors were largely hopeful, yet sceptical, that LSRs may prove more time efficient than traditional review updates. They identified that the increased frequency of tasks would likely increase their workload, however, believed that the increased frequency could potentially make LSRs more manageable in the long run, compared with the arduous and highly time intensive task of updating a traditional systematic review. Participants expected that the LSR process would be a learning curve and present some ‘teething issues’ as the process evolves and is streamlined. A few participants described apprehension about engaging with the new technologies.

“The feeling at the beginning was kind of half daunting and slightly overwhelming but also feeling very supported by the strategic group who was running the project” (Cochrane author).

“I’m a bit worried going forward. I have some vague notions about the process but I don’t feel certain about how it’s going to play out or the impact workwise” (Information specialist).

“The authors will have smaller sets of results to screen rather than having a huge overwhelming set of results and finding time once a year or 2 to work through rather than topping it up incrementally. It might actually be a bit more efficient for them. For me, it is a little more time consuming because I have to do a search each month but because it will be a smaller number of results, hopefully it will be quicker in terms of importing and exporting etc” (Information specialist).

4.2.3 Reality – overall experience

Overall, participants were highly enthusiastic and largely positive about their experiences in the pilot living systematic reviews. They reported feeling well supported throughout the process and largely felt that the process itself was “quickly demystified” and “not as difficult as originally predicted”. They described their contribution to a living systematic review as a fantastic learning opportunity and an interesting academic experience, many discussing opportunities for new collaborations that arose as a direct result of their involvement.

“I felt very involved in contributing to the paperwork and the practical logistics of how a LSR should be done and what it would look like. It’s been very exciting” (Information specialist).

“Everyone has been highly enthusiastic, willing to experiment and prioritise. They have been overwhelmingly responsive and proactive” (LSR coordinator).

Participants noted that the response from the community to LSRs has been overwhelmingly positive, with “high levels of interest and excitement, and a sense of novelty about living systematic reviews”. Overwhelmingly, the main concerns expressed by participants at the end of the pilot period surrounded managing the ongoing workload and refining publication methods/processes.

In terms of impacts of the LSR on the separate stages of systematic reviews, the main area highlighted was the search stage. Data analysis and integration appeared to only be impacted by the increased workload due to the increased frequency of the tasks. The impact to the search stage is detailed throughout this document.

4.2.4 Benefits

When talking about benefits of living systematic reviews, common themes included the rapid identification and translation of research evidence; the benefits to Cochrane directly; the continual, live process; and the improved accountability and commitment to the review.

Participants highlighted the appeal of up to date evidence. They discussed living systematic reviews as resulting in the rapid identification of new evidence and the ability of this evidence to inform future decision-making, guideline development and clinical practice. The live, dynamic nature of living systematic reviews was seen as a significant benefit. Living systematic review teams are constantly reviewing the latest body of research evidence and integrating the evidence as it is made available. This evidence can be used to inform guideline development and clinical practice in a live, dynamic manner.

“The evidence base for our topic was very small... There is now a large amount of information to inform practice, many of which have been integrated highlighting the live ability of research” (Cochrane author).

“It has been very interesting to see the evidence base change over a short period of time” (Cochrane author).

In the LSR where no new trials were identified during the pilot period, the authors found the process to be very low maintenance. Although no new studies were identified, it was good to say with confidence that there is nothing new.

The benefit of living systematic reviews specifically for Cochrane were also discussed by the participants involved in the Cochrane LSRs. Participants highlighted Cochrane’s prominent role in the rapid response to a changing evidence base, and the need to ensure Cochrane reviews are informative and up to date. Many emphasised a need for Cochrane to lead the way or ‘stay ahead of the game’ with regards to living evidence changes.

“We (Cochrane) can be more reactive. When new information is available, a group can respond and update review; reducing the lag and improving the responsiveness of Cochrane reviews. Overcoming the criticism that we are too slow” (Cochrane coordinating editor).

“The concept is really interesting and such a good idea. It seems helpful for Cochrane more broadly to keep pace with the literature and ensure they are making appropriate developments to make their content useful for decision-makers” (Cochrane managing editor).

Living systematic review processes ensure that the author team is up to date on the newest evidence, integrating the evidence into their reviews, and tweaking the conclusions and citations constantly. For many, this continual, live process resulted in author teams feeling “on top of the curve”. The authors get to see the picture developing over time rather than a large amount of evidence delivered and processed at the end of an update.

“There are typical shifting milestones, this is more steady and predictable. You are forced to keep up to date despite other tasks” (Cochrane author).

The benefit of having one team responsible for a living systematic review and this responsibility being documented with very strict timelines was believed to result in improved responsibility/accountability and commitment to the review. The strict timeline meant that people needed to prioritise the review over other tasks and adhere to the timeframes. While some considered this a benefit – it was also seen as a significant challenge (and further described in challenges section).

4.2.5 Enablers/facilitators

In discussing the enablers or facilitators in the living systematic review processes, participants identified the importance of team enthusiasm and commitment; and input from Cochrane’s living systematic review team and the Living Evidence Network.

The living systematic review process heavily relies on the ongoing commitment of the author team, editorial team and publishing team, and their immediate capacity and skills. High levels of organisation, motivation and team commitment were identified as requirements for living systematic reviews, needing to ensure that the work process is clear so everyone knows exactly what they have to do, and the timeframe for completion.

“It is a complex moving process which requires strong attention to detail, a high level of communication and a coordinated management approach” (Cochrane author).

Participants described the enthusiasm and support they received from everyone involved (from authors to the editorial team and publishing members), as being key facilitators and essential to the success of the living systematic reviews. Team responsiveness and communication were seen as vital to keep on track and adhere to tight deadlines. The high level of enthusiasm and commitment facilitated the constant communication between the team members and with the editorial teams which was seen to be vital to the conduct of LSRs and key to their efficiency.

“Everyone has been highly enthusiastic, willing to experiment and prioritise. They have been overwhelmingly responsive and proactive” (LSR coordinator).

“I felt very supported by the strategic group who was running the project. There was always someone to ask a question and someone with an answer and if not, an answer was quickly forthcoming” (Cochrane author).

The input from Cochrane’s living systematic review team was repeatedly highlighted as a significant enabler to the success of the Cochrane reviews. Participants described feeling

supported through the process and the benefits in being involved in discussions with a wider team concerned with living systematic reviews. The role of the living systematic review coordinator in linking everyone, clarifying processes and resolving issues was highly valued and many participants expressed the need for this support to continue in the future.

“The living systematic review team were constantly providing support, encouragement, pushing, motivating and keeping everyone moving. My question is to what extent that will be able to be there in the future?” (Cochrane author).

Participants also emphasised the role of the Living Evidence Network in providing additional support, learning opportunities and opportunities to work with people with different skills in living systematic reviews and thus, facilitating knowledge exchange and professional development. The large number of people involved in the Network was seen to give access to increased expertise and increase overall benefit to all of the pilot LSR teams.

“The involvement of experts built the legitimacy of LSR and increased the feasibility of the model” (Information specialist).

“It’s fantastic to feel part of a wider group. The emails, suggest fest etc were great. We felt very well supported” (Cochrane author).

“It has been a good experience working with people with different skills in LSR’s and the opportunity for knowledge exchange” (Information specialist).

4.2.6 Efficiencies

In describing factors which increased efficiency, the most common themes included the repetitive nature of the process; team responsiveness; automation in searching; and having an information specialist.

The potential for overall time and effort saving for researchers was mentioned. Participants expressed that as the pilot progressed, the whole process became more streamlined, that the repetitive nature and increased familiarity with the processes increased their efficiency. Keeping constantly aware of the review was seen as a key factor contributing to the efficiency of living systematic reviews.

“Having your head in a body of literature every month can only mean increased efficiency” (Cochrane author).

Constant communication between the teams themselves and with the editorial unit was mentioned as vital to the conduct of living systematic reviews and key to their efficiency. The high level of support and responsiveness provided by individual team members and Annie at Cochrane (living systematic review coordinator) meant that immediate questions were answered thus preventing delays in the process.

“We have worked with a really good author team, very active and engaged and that has been the key to success” (Information specialist).

“Efficient team is key to feasibility. Need speed of communication to make crucial decisions and progress. Big communication gaps cannot occur” (Information specialist).

“Consistent correspondence with the author team has made the process feel more connected, more alive” (Cochrane managing editor).

Despite initial challenges and some remaining areas for improvement, Cochrane Review Groups identified the search phase as the easiest or most efficient component of the LSR process, particularly the aspects which are automated or technologically assisted. Information Specialists described the benefit of saving searches in databases and setting up automatic alerts to receive the monthly searches. New and supporting technologies including Cochrane Crowd, Covidence and CRS web were all seen as increasing efficiency of the living systematic reviews. The ongoing challenges with the integration and use of these technologies were also discussed along with suggestions for improvements (presented below).

“We need to develop skills and faith in the use of these technologies (including CRS Web). This may present further time saving” (Cochrane author).

“I feel that we have used the machine aspects well and in addition to Cochrane Crowd to reduce both the burden and magnitude of time spent on screening records” (Cochrane author).

“A major strength is that I can run and collate the results myself and check them against previous results sent to ensure the authors work load is kept as small as possible” (Information specialist).

The involvement of an Information Specialist as seen in the Cochrane groups may be key to the search efficiency as the non-Cochrane groups all identified ongoing issues with screening or a large burden on authors as a result of screening tasks (see explanation in Challenges).

“It is a lot of ongoing work. I’m constantly juggling my time. Managing a high number of citations and a high number of irrelevant hits. Resulting in the update becoming slightly bigger each time” (non – Cochrane author).

“We need someone to double screen the citations. Searching the databases takes a lot of time” (non – Cochrane author).

“A major enabler is being delivered the search results. And our search specialist updating the review each month” (Cochrane author).

“The major enabler is having someone run the search and send me a ready made endnote library” (Cochrane author).

4.2.7 Challenges

In discussing their experiences, several challenges of the living systematic review process were highlighted. Themes included the ongoing workload; issues with search and screening; and editorial/publication issues.

The ongoing workload

The ongoing workload was perceived as requiring a large investment and ensuring immediate availability of capacity was considered to be a significant and sustained challenge, particularly for members of the author team. Participants discussed a variety of tasks as contributing to the workload including tracking ongoing studies, locating full text articles, chasing trial authors for data, issues with screening and data management, updating PRISMA and results tables, and the

publication process. Many of the team members described feeling stressed and, at times, frustrated with the challenge of keeping up. They questioned ongoing author capacity and motivation to perform all of these tasks in the long term, particularly in the absence of additional funding.

“Updating the manuscript 3-4monthly requires a large capacity over a short period of time. In the long term this may become an increasing challenge especially without funding to support sustainability” (Cochrane author).

“Author teams need to have the review in the front of their consciousness all the time – this won’t work for all author groups. For example, [I suggested to one of the groups] they might like to pilot an LSR “it’ll be fun!,” but they were put off by the idea of having to keep the review in their consciousness... It was unexpected that author teams were lukewarm to the idea” (Cochrane managing editor).

“We are concerned about the human capacity to maintain the review(s). We need to do continual updates as opposed to updating every three years. The availability of people familiar with the review and the process is important” (Cochrane author).

“Without extra resources, this level of engagement and investment is probably unsustainable” (Cochrane author).

Many participants described the process as feeling very rigid and not providing a lot of leeway. Authors described the constantly revolving process as “time consuming” and, at times, cumbersome.

“The process required multicomponent, ongoing tasks. At times we were conducting our monthly search, plus addressing comments, plus integrating new findings all at the same time. This was way more complicated than expected” (Cochrane author).

“The complexity of having a manuscript updated and continuing with monthly screening is a challenge. Contacting authors can result in delays. There are multiple concurrent aspects of the review updating at once - this is tricky but required” (Cochrane author).

“There are many documents to update and screen on a monthly basis. Even if eligible studies are not identified the PRISMA still needs to be updated” (Cochrane author).

“It is a job that never ends. It is interesting but I have other deliverables also” (Cochrane author).

“There is not a lot of flexibility in the approach - What happens if leave is taken by key member?” (Information specialist).

Largely, workload issues experienced by participants outside of the author teams were as a result of the increased frequency of publications and issues where the method needs further refinement rather than the burden of work.

Editorial team challenges

Managing Editors described having a very experienced author team as making the process very efficient. They had the manual to follow and largely found limited changes required to their standard editorial processes. They described the couple of weeks leading into the first

publication as intensive as it was the first time they were publishing a living systematic review and the small changes to the review required multiple checks to ensure they were correct.

“Initially, the publication timing, keeping up with the speed of everything caused a lot of frustration within the team. Now there is an increased workload but it is not necessarily more cumbersome. The nature of the monthly work is different and feels more manageable” (Cochrane managing editor).

Securing peer-reviewers was identified as an ongoing challenge and editors emphasised the need to set up peer review in advance in order to prevent delays. The peer review process was reliant on the reviewers adhering to the strict timelines for the living systematic review. Challenges within Archie were also identified, specifically with getting the text right and the technicalities of amendment and frequency. Overall, the editorial process was largely considered “similar to other publications but expedited all round”. Managing Editors reiterated the need for additional resources (namely funding) to support the sustainability of living systematic reviews from an editorial perspective.

“The turnaround time is also difficult (it’s hard enough when you get 2-4 weeks with other manuscripts) and it is already more time-consuming because it is a Cochrane Review” (Peer reviewer).

“I like the idea of repeat peer reviewing the same manuscript. Over time, you would become more familiar with the topic and you would get to see how if the peer review you are providing is helpful and how that might be changing the manuscript. So it would be nice to get that feedback. Sometimes being a peer reviewer feels mean for the sake of being mean, and this way it’s like you are more associated with the LSR and taking some responsibility for it” (Peer reviewer).

From a copy editing perspective challenges included substantially increased workload and insufficient resources to support this. The need for advanced communication about the arrival of a review for copy editing within the tight timeframes designated by the living systematic review process was emphasised. Dangers of inconsistency were highlighted, with the potential for contributing members to a living systematic review rushing the process to adhere to deadlines. As with other editorial tasks, the time required for copy editing was substantially reduced for each subsequent version.

The main challenge highlighted with screening living systematic reviews prior to publication was understanding the flow of work within Archie. Screening time for a living systematic review was seen to be on par with standard Cochrane reviews and having the potential to become more efficient if the same ‘screener’ is looking at the review multiple times (given the review will be familiar, and they will be able to just go directly to anything that has changed since the last published update). Use of the triage tool for screening was seen as a key facilitator to this. A ‘compare version’ assisted the screening member to identify what had changed within the version and also what the authors may have omitted to change. Concern was raised that in reviews where the evidence base changes considerably from update to update, a more intensive process for the screening would be required.

Looking forward, editorial team members questioned whether the workload is ‘doable’ and manageable if LSRs are scaled up.

“There is incrementally less screening needed over time. And maybe don’t need as much peer review over time – the burden is lighter than expected. Diminishing return is matched by diminishing workload” (Cochrane senior editor).

Challenges with search and screening

For information specialists, the need to refine the process to ensure efficiency was paramount. They described the development of the living systematic review search strategy and process as initially intensive to set up, however, once correctly in place, the search was viewed as an “efficient, reliable, predictable process”. This was echoed throughout the interviews, with many of the participants describing the search as the easiest and most efficient part of the living systematic review process.

While the search itself was viewed as easy and efficient, the search specialists described a considerable increase to their workload due to the increased frequency of searches.

“The search for a traditional systematic review update takes between 1 to 5 days and then you are done for two years. With living systematic reviews you receive constant emails with new citations over the month (which you need to organise) and then you need a morning of work to process the citations and pull them all together for the authors” (Information specialist).

“It feels very rigid. There is the constant receipt of monthly alerts and the need to plan for them. There is not a lot of leeway” (Information specialist).

The search specialists described significant challenges learning how best to manage and organise the constant flow of alerts. Each team used different search strategies to locate the most current evidence. For some of the participants, machine learning and citizen science approaches (RCT classifier and Cochrane Crowd) were used effectively to reduce the burden and magnitude of time spent screening records. There were a few technical issues experienced in the set up (central alerts; CRS web; classifier; managing discrepancies in Crowd assessments), however, these were largely resolved and not considered to be an ongoing issue once the technology was in place to support the process. Participants indicated that these technologies needed further refinement to ensure reliability and conveyed the need to develop their skills and trust in use of these technologies.

Participants highlighted the potential of these technologies to result in further time saving.

For some, the technologies they initially used did not meet all of their needs or work out as planned, resulting in the teams reverting to manual completion of the tasks. The information specialist in one of the pilot groups decided against using technology to assist screening due to the small result set. They believed that the tasks were not big enough for automation to make a difference and would have resulted in double handling.

“Manual management of search data was much easier” (Information Specialist).

“Using existing technology only saves 10-15% of effort. We need an algorithm for different study designs” (Non-Cochrane author).

The non-Cochrane teams did not use information specialists and therefore, search was the responsibility of the author team and a significant contributor to the burdensome workload. One author (non-Cochrane) discussed experimenting with technology to alleviate the workload

issue however their review included study designs other than RCT's meaning that search algorithms did not work efficiently/effectively. Those who weren't using Covidence or RevMan were interested in exploring these technologies to potentially increase efficiency. The authors of non-Cochrane living systematic review pilots reported feeling that they currently don't have the resources, technology or tools to manage the frequent searches and minimise the workload. The need for further refinement of existing technologies and the development on new innovative tools was emphasised.

"We had issues with hits via automatic database searches. Screening automation causing issues and a large number of citations to screen" (Non-Cochrane author).

"We attempted to alleviate (the high workload) with technology however it remained a challenge. Diverse data (including more than RCTs) meant that the search algorithms did not work so well" (Non-Cochrane author).

Publication Issues

Cochrane review teams identified substantial issues with the publication process. The development and implementation of improvements to the publication interface was delayed which meant that it was not clearly obvious which reviews were living systematic reviews, when the review had been updated and what this involved. Members of the author teams all described their disappointment and frustration with this delay. The need to clearly highlight on the Cochrane Library and within the review (and updates) what is new, what has been found and what has been included was emphasised.

Frustration was also expressed with the current process of republishing reviews triggering a new DOI and the impact this has from an academic perspective - negatively affecting citation counts and impact factor. One of the pilot teams were identifying a high number of new studies and wanting to publish the updates frequently. Several versions of the review were published in a small amount of time with "not much difference between versions ... this feels like a lot of work for a diminishing return."

"It was really difficult to go into the workflow in Archie and work out what happened when, and where the review is currently up to because of all the amendments being published every month, in addition to the other tasks for re-publication of full updates" (Editorial team member).

Issues with the publication processes were also flagged by the non-Cochrane participants. They faced delays due to needing institutional clearance and 'classical publication issues' including copyright issues with authors which were largely outside of their control. As a consequence of these delays, one LSR pilot team reduced their update frequency from monthly to every three months.

"A major barrier in speed for the sexual transmission review was the time spent at clearance at different US institutions" (Non-Cochrane author).

"By the time the update gets to the reviewers, it is already dated" (Non-Cochrane author).

A lack of clarity around authorship

Several members of the teams discussed authorship issues as a complexity in living systematic review production. They described grappling with a large authorship team on the original review

but the ongoing requirements of a living systematic review only requiring a smaller team due to the smaller, nuanced changes. The opportunity for contribution is further restricted by the speed of the updates. This led the author teams to question when people should come off the author list and requesting more guidance around this issue.

“LSRs maintain a smaller team due to low the volume of high frequency, rigid work” (Cochrane author).

4.2.8 Opportunities for improvement and scale up

In discussing opportunities for improvement and scale up, key themes included the need for additional guidance; changes to current publishing processes; the refinement and development of technology to reduce workload; the need for resources and support; establishing policies and procedures; and encouraging/facilitating knowledge translation.

Guidance

Many of the challenges with the current LSR processes raised by participants indicate the need for further clarity about the responsibilities of different contributors to LSRs and the LSR methods and processes. Participants suggested the need for guidance on:

- Eligibility/criteria for reviews to become living systematic reviews;
- When and how LSRs cease to be living, and what happens then;
- Evolving authorship;
- Automation/tech tools available;
- Submission processes and editorial policies;
- Peer review - how to approach reviewing an LSR;
- Screening - what exactly needs screening and when is most useful/appropriate;
- Methods for publication.

“Feasibility may be limited by others’ fear of the unknown. People seem sceptical about time consuming tasks. We need to demystify the process and continue to provide support” (Cochrane senior editor).

Overwhelmingly, the most frequently mentioned consideration with regards to scale up was the need for guidance about the appropriateness/prioritisation/selection of a review to become an LSR. Participants emphasised the need to select/prioritise reviews based on feasibility and impact and suggested “cherry picking” topic areas for LSRs. One participant suggested concentrating on reviews that are listed as a priority for review groups. The potential for “targeted living reviews” was also mentioned. Largely, participants indicated that LSRs should focus on areas that have a large number of emerging trials or a constantly changing evidence base.

“We need very specific criteria about appropriateness of a review to become an LSR. They are appropriate when the evidence base is uncertain and health decisions based on the findings have important outcomes” (Cochrane author).

“We need to prioritise reviews based on feasibility and impact. If the field is moving quickly and there are highly engaged authors in well supported groups...” (Cochrane author).

“We need to prioritise the right questions, and not be led by researcher enthusiasm. Perhaps we could tie to Network priorities” (Cochrane senior editor).

“Look at the topics – seek clinical experts’ advice on need for living mode” (Information specialist).

Several participants highlighted LSRs as being particularly useful for disease outbreak and suggested that guidance or a protocol for conducting an LSR in this circumstance could be beneficial.

“They are highly applicable for disease outbreak. The evidence and questions need to be highly relevant to the current context. Tease out the bits which are specific to this outbreak and target the review accordingly” (Non-Cochrane author)

Considering the capacity, skill and motivation of the author team in the selection of reviews to become LSRs was also emphasised.

“LSRs require a large amount of author capacity and commitment which may limit feasibility. LSR teams should be from a well-known Cochrane group with high amount of LSR expertise” (Cochrane managing editor).

Publishing

Many of the challenges with current publishing processes raised by participants highlighted the need for better communication/promotion of LSRs. Among Cochrane participants, the implementation of the Update Classification System (UCS) was identified as the highest priority moving forward and key to improving motivation among author teams.

“They need to fix new Cochrane library as it is holding up bringing the living components to full effect. It is difficult to fully assess feasibility/effectiveness until this is up and running” (Information specialist).

Participants described the need to have a clear versioning system for updates including those that don't have major changes. They highlighted the need to ensure all updates, irrespective of size, are clearly described within the review and suggested that a standardised way for readers to refer to previous updates is required. Standardised text for use in the LSR manuscripts regarding updates was suggested as potentially useful for author teams and the editorial process while improving the readability of the reviews.

“Potentially using template text would result in less hands on monthly support” (Cochrane managing editor).

“The way in which we describe the various updates in the review itself could be improved, as it is starting to get confusing to follow for the reader” (Cochrane screening team member).

“If new evidence is added but there is no change, should we still have the updated version online? Maybe different versions of the same DOI would work? The reader needs to be able to see different versions but in an easier / more user friendly way. The latest version should appear first (rather than the first version)” (Cochrane author).

When asked about opportunities for improvement/scale up, ensuring living systematic reviews are both prominent and distinct from other reviews within the Cochrane library was emphasised by many.

“How to demonstrate what new things have been found and what makes it ‘living’. So identifying which studies are new, if included or not, and where. Or if they are waiting for updating. We need to clearly highlight what is new, what’s been found and what was included” (Information specialist).

Participants also made suggestions for new publication options. Ideas included protocols for updates; and frequent, interim updates for the components of primary interest to policy makers and users, namely effect sizes and meta-analysis, with text changes happening later. This would reduce time to publish and produce *“rapid access to key information slightly earlier.”* The need for consistency between publishers about the publication process was also suggested:

“It would be helpful to have consistency between publishers about the publication model and peer review process for LSRs. With F1000Research it’s easy given our existing model, but it’s not easy for many other publishers. Related to this, if a new team takes over an LSR, do they have to publish it with the same journal? Or can they go to a different one? If we are making use of meta-data and tools like Crossref properly, we could maybe do this. But it requires discussion and agreement across the publishing community” (Non-Cochrane author).

Technology

In discussing opportunities for improvement and scale up, many participants highlighted the need for better integration of technology to reduce human investment.

“Many authors report they don’t have the resources/tech/tools to manage the frequent searches. They need solutions to offer authors” (Non-Cochrane editorial team member).

Further refinement of existing technologies and the development of new innovative tools to manage the frequent searches, reduce workload and reduce human error were emphasised. Participants highlighted that further testing and refinement of citizen science and technologies is also needed to ensure reliability. Specific opportunities for improvement included:

- Expanding citizen science opportunities (e.g. tasking Cochrane Crowd to screen other study designs; screen PICO statement eligibility criteria; conduct risk of bias assessment; and data extraction; and extra systems within Crowd allowing authors to see screening progress in a ‘live’ way);
- Technologies/systems to auto populate data (particularly the results tables) or conduct risk of bias assessment and data extraction; and
- Improving the existing technologies for search and screening to facilitate a more seamless workflow (e.g. facilitating the aggregation of search automatic alerts, transitioning them into the reference management system and then de-duplicating).

Several participants suggested that managing/monitoring a PRISMA flowchart could be improved. They suggested a “live” PRISMA flowchart, allowing the author team (and the reader) to see monthly searches in a live way, and how it grows and categorises. A suggested improvement to RevMan was to insert data in the analysis section and then have it all be linked and automatically updated.

Resources and support

When discussing the continuation and scale up of LSRs, almost all participants indicated that feasibility is highly dependent on the addition/continuation of funding and resources and the provision of ongoing support. Participants highlighted the increased workload required of an LSR for the author and editorial teams (particularly copy editing) and suggested that LSRs are not sustainable without additional funding.

“Living systematic reviews are more costly than standard reviews in terms of resources needed. Additional funding and resources are needed to support long-term feasibility” (Information specialist).

Participants emphasised the need to motivate author teams and to incentivise LSRs. Additional funding, addressing authorship challenges and providing access to ongoing support were identified as significant incentives to conducting an LSR and key to their feasibility and efficiency. In terms of support, participants discussed the need for the continuation of an LSR coordinator type role to oversee the process and provide assistance when required.

“[We need someone to] facilitate communication within the implementation science community doing LSRs. Linking in with others doing LSRs making it explicit for groups going forward from here” (Cochrane managing editor).

Other suggestions were for a team of experts supporting LSR groups or an LSR team to be built into each Cochrane Review Group to *“update data and have clinical experts check it; something like the BMJ Clinical Evidence model where they send you all the evidence. This is really powerful, rapid fire turnaround, really useful, but requires resource” (Cochrane coordinating editor).*

The need for implementations policies supporting the roll out of LSRs more broadly within Cochrane was also noted.

Knowledge translation

Several participants expressed the need for the promotion of LSRs as an important factor to consider in terms of scale up. They highlighted the need for promotion to both users of LSRs and funding groups.

“How do we raise awareness and support uptake and use of LSRs? How do we get these reviews used?” (Cochrane editor).

“We need more education/awareness with funding groups and other important people about LSRs” (Cochrane author).

“We need to be able to demonstrate externally that a LSR is really changing and updating living guidelines and resulting in changing conclusions” (Cochrane managing editor).

Conclusions – Where to from here?

On the basis of the preliminary evaluation of the living systematic review pilots, living systematic reviews appear to be both an acceptable and feasible approach to keeping high-quality evidence synthesis continually up to date.

There are challenges that need to be addressed for living systematic reviews to be sustainable and have maximum value, these include issues with the current publication processes and approaches to providing resources to support living systematic reviews in the long term.

Appendix 1. Description of methods

A mixed methods approach was undertaken, drawing on both quantitative and qualitative methods. Ethics approval was provided by the Monash University Human Research Ethics Committee (project number 8006).

Survey

Objective	To capture the time taken by members of each LSR team on monthly key LSR tasks and activities and key learnings throughout the pilot period.
Participants	Participants included authors, search specialists and managing editors from the included LSR pilot studies.
Participant Recruitment	Participants were invited to complete the survey via email. The investigator team directly contacted individuals known to be undertaking LSR's / who expressed interest in conducting an LSR.
Consent	Participation was voluntary and consent was obtained via email.
Data Collection	Data were collected using an online survey tool (Qualtrix). Both quantitative and qualitative data were collected. Surveys were sent each month to capture that month's tasks/activities and time taken for LSR activities. A reminder was sent after one week if participants had not yet completed the survey. The survey was developed by Tanya Millard in consultation with the other authors and pilot-tested before use.
Data Items	Data were collected on: <ul style="list-style-type: none"> • Time spent on key living systematic review tasks. • The number of citations screened per month. • Reflections on the pilot review process.
Data Analysis	Quantitative data were analysed using simple descriptive statistics. Qualitative (free text) data were merged and analysed with the interview data.
Data Use	Data will be used to refine LSR processes and to inform future production models. Data will also be used to develop publications for journals, Cochrane meetings and academic/industry conferences.

Interviews

Objective	To explore participants' experiences of conducting/contributing to living systematic reviews and the barriers, facilitators, challenges and advantages of LSR processes.
Participants	Participants were key people involved in the pilot LSR's including authors, information specialists, managing editors and coordinating editors, peer reviewers, other editorial team members, the project lead for Cochrane Crowd, and the coordinator of the Cochrane pilot living systematic reviews.
Participant Recruitment	Participants were invited to participate via email. The investigator team directly contacted individuals known to be undertaking LSR's / who expressed interest in conducting an LSR.
Consent	Participation was voluntary and consent was obtained via email.
Data Collection	<p>Up to three semi-structured interviews were conducted with each participant.</p> <p>Interviews were conducted via online meeting software (Zoom) or by phone, and audio-recorded.</p> <p>Interview questions were loosely based on a predetermined interview schedule, with questions varied to suit the interviewee's roles and experience.</p> <p>The interview schedule was developed by TM in consultation with the other authors.</p> <p>Detailed notes were taken during the interviews.</p> <p>Interviews were conducted by TM, TT or AS all of whom work on the living systematic review pilot program within Cochrane and have extensive experience in qualitative interviewing.</p>
Data Items	<p>Data were collected on:</p> <ul style="list-style-type: none"> • Motivations and expectations of undertaking an LSR. • Experiences with conducting an LSR. • The differences between LSR and traditional systematic review processes. • Challenges, barriers, facilitators and enablers encountered in the process of conducting an LSR. • Advantages and disadvantages in conducting an LSR. • Opportunities for improvement to the LSR processes. • Scale up factors to consider.
Data Analysis	NVivo 12 was used to analyse qualitative data and to extract quotes. Interview notes were analysed using open coding to identify key concepts which were organised into emerging themes. Tanya Millard undertook the primary data analysis. TT and AS reviewed and collaborated on the conceptual development and refining of themes. A draft report of the analysis was provided to the LEN (which included interview respondents) for feedback. The data from the open ended questions in the surveys were combined with the interview data due to the similarity of themes.

Data Use

Data will be used to refine LSR processes and to inform future production models.

Data will also be used to develop publications for journals, Cochrane meetings and academic/industry conferences.
