**KTDRR and Campbell Collaboration Research Evidence Training:**

**Management/Analysis Tools for Reviews – EPPI-Reviewer**

*Presenter: James Thomas*

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JOANN STARKS: Hello and welcome to today's webcast brought to you by the Center on Knowledge Translation for Disability & Rehabilitation Research or KTDRR at American Institutes for Research, in coordination with the Campbell Collaboration. The Center on KTDRR is funded by the National Institute on Disability, Independent Living, and Rehabilitation Research, known as NIDILRR in the US Department of Health and Human Services, Administration for Community Living. The Campbell Collaboration is an international organization that promotes positive change through the production and use of systematic reviews and other evidence synthesis for evidence‑based policy and practice. The Center on KTDRR partners with Campbell's Disability Coordinating Group to help increase the number of Campbell reviews in the disability field.

I am Joann Starks with the Austin office of American Institutes for Research, or AIR, and I will be the moderator today. I want to thank my colleagues, Shoshana Rabinovsky and Ariana Hammersmith for helping with the logistics. The KTDRR Center and the Campbell Collaboration are working together to offer a 5‑part training course that focuses on high‑quality methods for synthesis of evidence, including the procedures and methods for conducting systematic reviews as well as software, tools and strategies for analyzing and reporting data.

Today we will learn about several software tools for managing and analyzing data in systematic reviews. Dr. Thomas is a Professor of Social Research & Policy at the EPPI-Centre, at the University College, London. He has written extensively on research synthesis, including methods for combining qualitative and quantitative research in reviews, and leads the development of EPPI-Reviewer, a software which manages data through all stages of a systematic review.

JAMES THOMAS: Hello. Good afternoon, or good evening, or good morning, depending on where you are. Thank you very much for the invitation to come and talk about EPPI-Reviewer today. I'm going to go straight in, and here's the outline of what I'm planning to talk about.

I'm going to give you a very brief history of EPPI-Reviewer, just so that you've got some context in terms of where it's come from. And then I'm going to talk about the design principles and the structure of EPPI-Reviewer-- and that's where I'm going to focus quite a lot of time-- give you an overview of the functionality, though we can't go to everything in detail, and then talk about the future a little bit.

So, just to give you some context, EPPI-Reviewer has been around a while. It was created in '93 as a small desktop database. And then, when the EPPI-Centre was founded, in the mid '90s, it became a multiuser database. As the EPPI-Centre's work grew, it became an online platform for support systematic reviews and became known as EPPI-Reviewer around 2000.

Now, I'm giving you this history because EPPI-Reviewer is very much tied to the development of reviewing, of history, and also the EPPI-Centre's reviewing model in particular. So, the way that we do reviews, we tend to do reviews which have multiple different components and methods and answer a range of different questions in a range of different disciplines. And so EPPI-Reviewer's really been designed to support those kinds of reviews and the breadth of reviewing activity that we've been involved in over the years.

It seems a while ago now, but in 2008 version 4 was launched. And, at the time, it had these new, machine-learning, text-mining technologies in its. 2015, it became one of Cochrane's author-support tools-- along with Covidence, which you'll hear about soon. And, in particular, our role is to support some of the more complex Cochrane reviews.

In 2018, we launched a version with NICE. There's a version called version 5 which is available internally within NICE. They're not outside NICE, at the moment. And also, last year, we were happy to work with the Campbell Collaboration on some mapping visualizations which you must have seen around. And I'll show you in this presentation, too.

Finally, I'm about to draw your attention to EPPI-Reviewer-Web, which is still being worked on. The name's not quite finalized yet. But what we're doing with EPPI-Reviewer-Web is working through the functionality available in version 4 and putting it into a web browser. At the moment, some of you may know that you need to use the Silverlight browser plugin for EPPI-Reviewer 4. And we're changing that, as we go forward.

So, in terms of the design principles, what sort of lies behind the way that we develop EPPI-Reviewer? And there are some core principles that we apply. First and foremost, as you might expect, is flexibility. We have to support a wide range of different review and study types and different uses of the software.

So, we don't assume any particular review workflow. What we're doing is developing tools and making available tools which will support a wide range of different reviews and people doing different reviews in different situations. The development is very much driven by user need, both internally and externally. So, if you've got any particular needs, do get in touch, because that's what drives what we do and drives the priorities, in terms of our to-do list.

One of the important components of doing reviews, for us, is mapping research activity. We use that with almost all of our own reviews that we do. And we find that particularly useful, in terms of taking stock as we're going through the review and also conversations with review stakeholders-- in our case, quite a lot with policymakers. So, we can take informed decisions about where the evidence is situated, as we go through the review, in order to decide what we should focus our priorities on. The other design principle that's quite important to us is completeness. We found, when we've used lots of different tools in the past, that it was challenging, keeping track of data.

So, we like to be able to have one place where we keep all our review data throughout the entire lifecycle of the review.

With that in mind, the tool needs to be analytical as well, in that we need to do our analysis within the tool. Sometimes we have to export data-- for example, into R, if we're doing some more complex analysis. But on the whole, what we're trying to do is do the analysis within the platform itself.

Currency-- we like to keep the tool up to date, in terms review methods, technologies-- which I'm going to talk about in a little while. Also, scalability. Sometimes we have very, very large reviews. I think the largest review we've had was around 2 million records. So, we have tools both that can support and cope with reviews that are that large, but also they enable users to cope with reviews that are that large. So, we've got some data-mining tools and some automated tools which help people to get their heads around such large amounts of literature.

And the final design principle is it's the not-for-profits. It's based in a university department, so we have to cover some of our costs, so there's licensing fees that are available on the website for you to look at. But any surplus is invested for new development. And, on the whole, what we find is that we just about cover our costs, thanks to a little bit of income plus the grants that we bring in.

So, as I mentioned, we've got three flavors of EPPI-Reviewer, at the moment. Version 4 has been around for about 10 years, now, and it's the most complete in functionality. The drawback with it is, it doesn't work on mobile devices. And that's why we've been looking at new versions.

The last couple of years, we've been working with NICE, around its needs, to support NICE reviews. And then also EPPI-Reviewer-Web accesses the same database as version 4. And that's quite important to us. There's no real migration concern or data movement. You can use both version 4 and the version web on the same review, and you'll see exactly the same data, because it's using the same database at the back end. The critical thing about the web version is it works within all modern web browsers, and it's currently a subset of EPPI-Reviewer 4, and we're rapidly adding features as we go forward.

The EPPI-Reviewers are all connected at the back end, in different ways. Version 4 and the web use the same portal for accounts and user management, as well. And there's a whole load of machine learning, which I'm going to talk about as we move on. This rather complicated picture I've put up just to highlights that EPPI-Reviewer's really made up of two broad components. The first is the data stores and the services which operate at the back. They're kind of invisible to users, but they're what makes EPPI-Reviewer tick. And there's lots of different ways in which those data services and data stores are used, and they're used by the front-end applications. And I'm going to talk about them in detail and, in particular, talking about EPPI-Reviewer-- so, the software for systematic reviews.

Taking you through some of the features that are available in an EPPI-Reviewer. It's a multiuser platform, available on the web, so lots of people can use it at once. And it has tools to support discrepancy reports and that kind of thing, so that we can see whether or not reviewers are doing their data extraction, for example, in the same way.

There's a whole load of tools which help us to manage duplicates. We've got new duplicate-track algorithm on its way, actually. And also, full document management, uploading and viewing PDF files. And then the heart of the system really is coding tools, the tools that we use to classify the research when we're doing systematic reviews-- so, being able to create and edit coding tools, to be able to select from a range of different coding tools which other people have created, and to be able then to reuse coding tools across reviews, across organizations, et cetera.

The heart of the system is applying the classifications to items. So, we've got tools to manage the processes of that but also see how we're doing in terms of progress, in terms of screening. One of the things that makes screening quite efficient is term highlighting, so people like that particular function. And we've also got priority screening, which uses machine learning to make this screening process more efficient.

Obviously, we've got tools for risk of bias assessment, data extraction. We extract numeric outcome data, and we have tools which handle large numbers of studies at once-- so, bulk assignments and removal of codes. And one of the things which we find particularly useful is the integration of PDF files within the program-- so, being able to view the PDF from within the program itself. That means that we can actually interact with the PDF and associate text with particular decisions. And I've got some illustration of that coming up.

But that's one of the difficult challenges that we've faced, when putting this into a web browser, and we're just about there with it. So, I expect the next release will also support PDF file line-by-line coding.

As I mentioned, you might have guessed I'm quite keen on some of the new machine-learning tools that we've got and are putting into progress at the moment. So, we've got tools which enable us to cluster studies automatically. We've got study type classifiers-- so, randomized trials, systematic reviews, and economic evaluations we can classify automatically. And we've also got some build-your-own classifiers. So, if we've got data, or uses for that data, they can build their own classifiers and then use those to classify unseen studies.

As I mentioned, reviews can be quite large, so we've got tools which help us to search and combine searches there are quite complicated and sophisticated tools for that, and also a whole load of reporting tools-- frequency and crosstab reports. Configurable reports. I've got an example of that for you.

Meta-analysis, meta-regression. Network meta-analysis is also possible, for those who like to do network meta-analysis. And I know that's becoming increasingly popular. The ability to do grade assessments. And we're working on PRISMA diagrams, too.

So, just some screenshots, just to give you a little bit of flavor of what it's looking like. And this is the new web user interface, so that those of you who haven't seen it can have a little look to see what it says. We've kept some of the design quite similar to version 4, but we're also trying to make it more user-friendly and keep some tools or make some tools available so that people can see where they are in the review at any particular point in time.

We're also working quite hard on help. And I think probably what I might do, here, is just show you this live, because it is interactive. So, here's a review in the web interface. And there's a Help button at the top, here. And the help is context-sensitive, in that it changes depending on what screen you're on. And it's also quite visual. And you can see these little visualizations moving, here. So, they show you what happens when you click particular tools, particular buttons. And those help screens are available throughout the program, and we're adding to them as we go.

So, moving on from help, those of you who've seen it before will be very familiar with the flexible codes that you can apply to documents. And here's a list of the documents in this particular review. But we can also pull into the review a range of different tools. So, we've got various risk-of-bias-assessment tools, for example, quality-assessment checklists. And they can just be pulled straight into the review, for use across different reviews.

I mentioned reporting. Here's an example of one of the reports. We've got a row for each study. And you can see, here, we've got some classifications. So, this is around behavior change. So, there's problem-solving, for example. There's text which has been entered by the reviewer, to justify that code. But then also we've got the text that's come from the PDF file. So, whenever we assign a particular code or make a decision about something, we can also then transparently associate that with the text in the PDF file, for a nice, clean audit trail between the decisions and the judgments we make as reviewers to the files and the text where they've come from.

Here's a visualization of meta-analysis. I mentioned that we can do that. Thanks to Wolfgang Viechtbauer's very nice Metafor program in R, we call R at the back end. And so we're able to make use of that package. And also, machine learning. This is a graph of scores that have come from the RCT classifier. And it tells us how confident the classifier is, in terms of whether or not a given study is or isn't an RCT. And this is a typical shape for the distribution of scores that we see, very confident at the top end of the scores that these are RCTs, very confident at the bottom end that these aren't, and some stuff in the middle which would probably need manual review.

So that's it in terms of looking at the user interface. I'll just take you through a couple of other points about the connected services. If you're doing Cochrane or Campbell reviews, you can look in using your Archie ID, so you don't need a license or anything. You can do your reviews here. In terms of Campbell, we've also got the evidence mapping. So, again, what I'll do is I'll drag my browser up here, so we can see it in all its glory. So, this is one of the maps which has been produced using EPPI-Reviewer and the mapping visualization that we've been doing with Campbell. It's on homelessness, and we can see the distribution of research, in terms of the number of studies, the quality of the studies, in this case, and the systematic reviews available.

We can click in, and we can look in more detail at some of the studies. We've got some hyperlinks here, as well, so that we can go and read more if we want to. So, the data have been entered using EPPI-Reviewer, using those coding tools I showed you. And then they can be then visualized, using this mapping tool.

So, I mentioned automation. We're working with the Center for Behavior Change and IBM research on a large Welcome Trust-funded project which is doing a lot of automation. And we're building some data services and some prediction algorithms around behavior change. So, some of these tools will be useful for many different types of reviews. Extraction of structured data from tables in PDFs, for example, is very difficult to do, but we're needing to work on it for this project. And we're hoping that we're going to be able to benefit from that in EPPI-Reviewer.

So, in terms of the future, as you might have guessed by now, there's going to be more semi automation coming our way. One of the things that we're particularly excited about, at the moment, are the potentials that we see in terms of automating the updates for reviews-- so, living, systematic reviews, if you're familiar with those. And it's a key area of research and development for us, at the moment.

We're also interested in extracting study characteristics from study reports. And this is related to that human-behavior-change project I mentioned, but we think it'll be particularly useful in terms of just prospectively organizing the evidence base. So, before we actually get into doing a systematic review about something, if we can just manage to look after the research that's coming through the system a little bit better, then it will just make those reviews that bit more efficient, if we can get that running properly.

I mentioned the extraction of data from tables and graphs. We've done some preliminary work on that. There's nothing that's going to come imminently on that, because it's such a difficult problem, but that's an area of active research activity. Because, if we can crack that, then we really will be able to make the data extraction process much more efficient and much more accurate, as well, I'm hoping.

More support for mapping. Especially when we're thinking about large reviews, what we're wanting to do is use topic modeling and the like to be able to assist people to get into the subject matter of their reviews, to see what topics and what subject domains are being covered and what participants are in their studies. And, in order to do that, we're hoping that we're going to have some more interactive visualizations. So, we've got some active research work around that, at the moment.

So, if you've got any questions, I'd be very happy to answer them. There's our website address. I should probably also mention a couple of books. One is, the latest edition of the Cochrane handbook will be out fairly soon, so keep an eye out for that. And also, the EPPI-Centre book on conducting systematic reviews. So, if there are any questions, I'd be very happy to answer them.

JOANN STARKS: I want to thank our presenters for taking time to prepare and to introduce these software tools to help manage and analyze data for systematic reviews. We hope you will take a few minutes to give us some feedback about the webcast by filling out a brief evaluation—the link is listed in the slides. You only need to respond once, after you have viewed all 4 videos. I also want to thank the AIR staff and representatives from the Campbell Collaboration who helped with planning and logistics, and of course, we want to thank NIDILRR for their support to offer these webcasts and other events.