


# NxGen evidence: Redesigning the Agency for Healthcare Research and Quality Effective Health Care website to promote engagement, interactivity, and usability of systematic reviews

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Evidence-based decision-making is predicated on the ability of users to find and comprehend results from systematic review. Evidence producers have an obligation to support evidence users in this process. The Agency for Healthcare Research and Quality (AHRQ) Evidence-based Practice Center (EPC) program—a producer of rigorous and comprehensive systematic reviews for two decades—has set a gold standard for reliability in health evidence reviews in the United States. It has recently begun a program of active support for evidence dissemination and uptake beyond mere publication of lengthy reports. This Brief Methods Note critiques the current paper-based format for systematic reviews and describes the development of a next generation (NxGen) AHRQ EPC Effective Health Care website. This redesigned platform will allow end-users of all types to find and share the evidence they need through data visualizations and other interactive displays. Several design principles guided the development of NxGen to make systematic review findings more accessible, customizable, adaptable, interactive, and shareable. NxGen will include visualizations for report results that are expressed as meta-analyses as well as those with narrative syntheses, through forest or bubble plots, respectively. Visual and interactive evidence heat maps are also planned. The NxGen version of the Effective Health Care website is planned to go live in the latter half of 2020 or early 2021.

## 1 | BACKGROUND

The imperative to hasten the uptake of systematic review evidence into personal and programmatic action requires little justification. It is axiomatic that better practice and better decisions result when guided by evidence, rather than custom, convenience, anecdote, or supposition. Very

generally, this equation for putting evidence into action has two halves—evidence producers and evidence consumers—with two distinct roles. At a minimum, evidence users should seek reliable, unbiased evidence and commit to an evidence-based approach. For their part, evidence producers should work to provide trustworthy evidence that is needed, accessible, and understandable

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for their end-users. In the ideal world, the relationship is symbiotic; these two halves of the equation become evidence partners, each engaging with and informing the work of the other.

The Agency for Healthcare Research and Quality (AHRQ) Evidence-based Practice Center (EPC) program—a producer of rigorous and comprehensive systematic reviews for two decades—has set a gold standard for reliability in health evidence reviews in the United States. And yet, AHRQ EPC reports can be hard to access and understand. To better fulfill its side of the producer-consumer equation, AHRQ has recently increased efforts to determine how to adapt systematic review methods to meet the needs and timelines of a broader audience of evidence consumers.<sup>1,2</sup> Simultaneously, the agency is also attempting to ensure at least a subset of its public data systems more closely conform to the FAIR Guiding Principles, which call for scientific data to be Findable, Accessible, Interoperable, and Reusable.<sup>3</sup>

This Brief Methods Note critiques the current method and describes the development of a next generation (NxGen) AHRQ EPC Effective Health Care website that allows end-users of all types to find the evidence they need through data visualizations and other interactive displays. To answer the needs of evidence consumers, this innovative web-based platform will allow the public to more rapidly find relevant evidence; to better understand it through visual displays; to drill down to finer-grained detail; and to easily share summaries, sections, reports, or visuals with colleagues.

## 2 | BEYOND PAPER

Most systematic reviews are presented in a paper-based format. Even when accessed through web pages, the electronically delivered PDFs remain, at base, flat files—two dimensional and linear. In the case of broad, comprehensive topics, these flat files can extend to many hundreds of pages. Length alone presents a substantial barrier to use, violating the principles of findability and accessibility. When users are able to find a report whose title indicates that it may provide evidence of interest, they can be daunted by the sheer volume of material and locating the piece or set of data that may meet their needs.

NxGen reimagines evidence report presentation. It provides engaging interactive summaries, modern and visually appealing graphics to present effects at-a-glance, and interactive drill downs that allow for tailoring the format and level of detail. Clinicians, policymakers, and systematic reviewers have been engaged formally and informally throughout the NxGen development process to identify key

### What is already known?

- Reports on the results of meta-analysis and other systematic review techniques can be lengthy and difficult for readers to process.
- Length and complexity remain as barriers to the use of evidence in practice and decision-making.

### What is new?

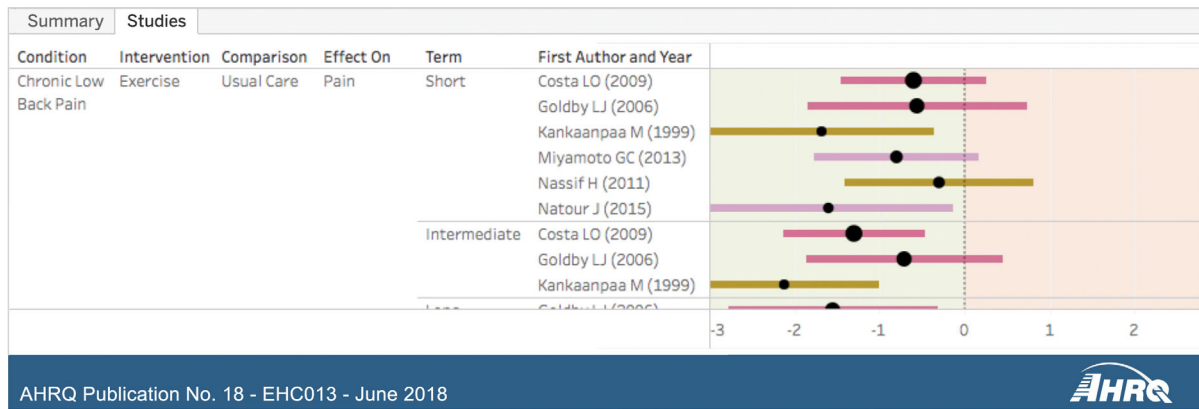
- The Agency for Healthcare Research and Quality has planned a dynamic web-based framework to provide visual and interactive display of report findings from its Evidence-based Practice Center Program.
- The new architecture is designed to meet an array of information needs, from high-level summary to fine-grained detail, with direct connections between these two views.

### Potential impact

- The template approach can be replicated by, and the decision points in the development process can serve as a model for, others needing a platform to convey systematic review data and findings to an audience of evidence consumers.

features and needs not met by paper-based reports for inclusion in the site. Layered atop tabular presentations of report findings are data visualizations—currently forest and bubble plots—to provide visual comparative displays of statistical (forest plots are used when meta-analysis is possible) or qualitative (bubble plots are employed with narrative synthesis) findings (Figures 1 and 2). These visual displays are provided for summary data as well as specific study-level data. Ultimately, the end-user can drill down to individual study publications (Figure 3).

In a program that provides systematic review on a scope as broad and deep as the range of topics within the purview of AHRQ EPCs, merely creating a one-off data visualization presentation for a single report can be intellectually and resource demanding. Creating an approach to cover all evidence products—from 50-page rapid reviews to 1300-page full comparative effectiveness reviews—presents special challenges.



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## NON-DRUG TREATMENTS for CHRONIC PAIN

- [Structured Abstract](#)
- [Visual Dashboard](#)
- [Tailored Evidence Summary](#)
- [Full EPC Report 15.2 MB](#)

### SUMMARY OF FINDINGS (SOF) TABLES

[Tailored SOF Report](#)

Intervention	Term <sup>†</sup>	Studies	Subjects	Finding	SOE*
[-] Back Pain					
<b>Exercise [-]</b>		6 Studies	553	visual data	
Exercise	Short	6 Studies	553	Slight improvement	●●○
Exercise	Intermediate	3 Studies	332	Moderate improvement	●○○
Exercise	Long	1 Study	124	Moderate improvement	●○○

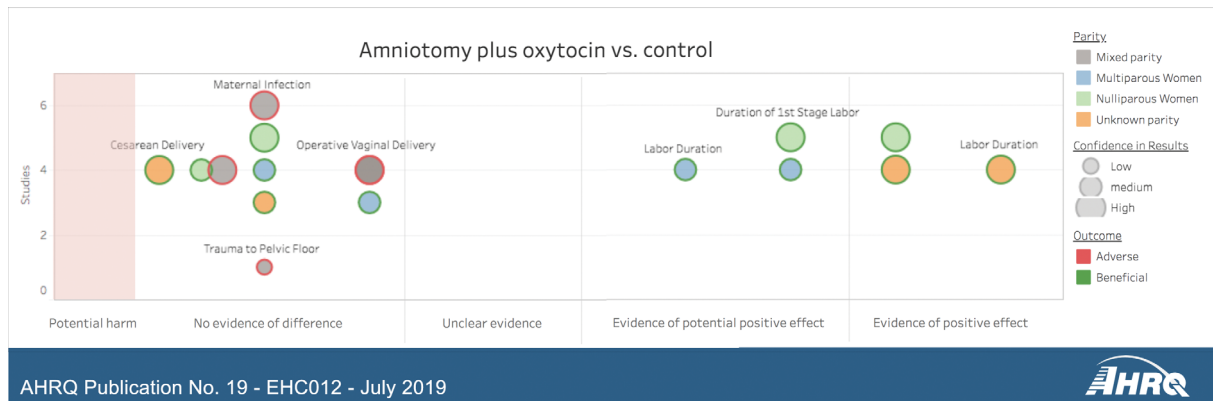
**FIGURE 1** Links within the summary of findings table reveal visualizations on specific interventions. In this example, we show forest plots of the meta-analytic results of exercise interventions for the treatment of chronic back pain [Colour figure can be viewed at wileyonlinelibrary.com]

### 3 | A PRINCIPLED APPROACH

The Scientific Resource Center for the EPC program—an AHRQ contractor since 2005—developed this NxGen approach beginning with a set of design principles. We wanted to make report findings:

- Accessible**—The site needs to improve access for all types of end-users to the information contained within EPC reports and make it easier to engage with the findings. We must permit users to interact with the evidence, and where possible, expose report information on differences in costs, populations, and settings.
- Customizable**—We want to provide customizable and tailored views of the evidence within a given report without sacrificing reliability of the information. NxGen would enable users to start with summaries of the bottom line but allow drill-down to ever more granular data, depending on user’s needs and interest.
- Adaptable**—The modular and interactive format of NxGen would lend itself to easier updating of the evidence base, looking to the future of living systematic reviews.
- Interactive**—We would increase visual presence/appeal, not just as a design element with static images or infographics, but as an interactive means of delivering content.
- Shareable**—NxGen would make our reports more sharable to facilitate more rapid diffusion of findings within a system and/or among individuals.

This set of goals speaks to all of the FAIR guidelines, but leans most heavily on the principles of findability and accessibility. And, while these are all laudable goals, they



LABOR DYSTOCIA OUTCOMES

[Structured Abstract](#)

[Tailored Evidence Summary](#)

[Full EPC Report 3.6 MB](#)

SUMMARY OF FINDINGS (SOF) TABLES

[+] Amniotomy vs. Control					visual data
Outcome	Parity	Studies	Patients	Finding	SOE*
Cesarean Delivery	Unspecified	4 Studies	16812	No improvement	●●●
	Nulliparous	4 Studies	13595	Moderate improvement	●●○
	Multiparous	4 Studies	16812	No improvement	●●○
Duration of 1st Stage Labor	Unspecified	4 Studies	11450	Moderate improvement	●●●
	Multiparous	4 Studies	11450	Moderate improvement	●●○

**FIGURE 2** For studies with qualitative assessments, the visual data links provide bubble plots that display both directionality and strength of evidence. Here, the display explores outcomes for the use of amniotomy plus oxytocin for the treatment of labor dystocia [Colour figure can be viewed at wileyonlinelibrary.com]

can be expressed in many ways. In their expression, we also recognize that we need to accept real world limitations.

**4 | ONE SIZE DOES NOT FIT ALL**

We know there is no single data visualization design that will fit all reports. In order to meet the wide variety of report topics and evidence limitations, we have accepted the need to compromise our vision.

In the ideal world, data would be homogenous and unambiguous and we could picture findings with a forest plot clearly showing findings (Odds Ratio, Risk Ratio, or Standardize Mean Difference), 95% confidence intervals, population size (N), and whether the confidence interval crosses zero (or one). However, not all evidence is created equally. In cases where heterogeneity or other data or methodological issues exclude forest plotting, we plan to

provide other means for evidence consumers to access findings in both text and visual formats.

So, while we have an idealized vision of the kind of visual representations we would like to provide, some reports will present opportunities for more or better visualization than will others. But as these opportunities are reduced by virtue of the nature of the evidence, we still plan to offer as visually appealing approach as possible. We also must live within practical resources limitations that require solutions to be as close to “plug and play” as practicable. Subsequently, we have developed four basic models or templates to cover the universe of AHRQ EPC reports.

The first template will be applied to any report in which meta-analysis is the predominant analytic mode and visualizations will be rendered in forest plots (Figure 1). We estimate that more than half of AHRQ EPC reviews fit in this category and will use the forest plot



## for CHRONIC PAIN

**FIGURE 3** Tooltips within the visual displays provide a more detailed look at the underlying data, including a live link to the PubMed entry for the original study. Users can navigate from systematic review data to the original research within two clicks [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

template. In the second instance (perhaps 30% of reports), we apply bubble plot visualizations for those reviews that primarily synthesize findings narratively (Figure 2). For most other reports for which either of these first two approaches is unsuitable, we will offer basic evidence or heat maps in the visualizations. Where visualizations cannot be used to describe findings, we will at least attempt to provide visualizations about the state of the evidence.

In the final case, where either the report topic or the findings data are so outside the norm that the data cannot fit any model, we will provide no visualizations. This latter approach will be used for the current library of AHRQ reports that were developed prior to the advent of the NxGen approach. For some of these, we hope to have the resources to provide a retrofit to accommodate this more interactive display. Others will age out of currency. Reports the Agency deems to be “retired” will not be presented in a visual format, given that the underlying data and conclusions will be out of date.

In any case, the base web page for all new reports will feature a bulleted list of major findings, details in a summary of findings table, and links to a tailorable evidence summary. As new reports come in, we will continue to explore new ways of visualizing data (treemaps, scatterplots, or streamgraphs, for example), particularly for those reports without meta-analysis.

A key element to all of this change is the re-conception of a methodologically sound systematic

review as an interactive web presentation first and a written report second. This paradigm shift moves beyond previous notions of traditional flat-file brief summary formats to give greater consideration to report use and report users. Current tools for brief summary are still primarily text based and lack connection between high-level summary statements and specific data. The interactive tools we propose bridge this gap. The ability to seamlessly move beyond summary to specific detail through an interactive, digital format represents a significant step forward in meeting the needs of evidence users.

## 5 | GOING FORWARD

We are currently working on a formal implementation evaluation within major health systems to test the NxGen platform. This pilot will include several rounds of cognitive testing to better understand the acceptability and applicability of proposed visualizations. With direct feedback, the Agency will better understand what parts of evidence are most useful to Learning Health Systems and what features of translational tools allow easy uptake and spread of evidence throughout these systems. This effort is one attempt to realize the symbiosis possible at the heart of the evidence producer-consumer equation.

While the inclusion of the data visualization and other tools in the NxGen framework primarily address the first two of the FAIR guidelines, we are also making efforts in the direction of interoperability and reusability. The reimaging of the Effective Health Care website will also expose the underlying data used to form the visualizations, allowing access to website users. Data will be formatted in commonly used open source data formats such as tab- or comma-delimited files or JSON datasets, supporting interoperability. This project is also working closely with another AHRQ-funded project, the Systematic Review Data Repository (SRDR) version 2.0. Along with sharing data with the Effective Health Care website, that software will make interoperable versions of all report data available for reuse.

We plan to launch the NxGen version of the Effective Health Care website for the public in the latter half of 2020. While we have no illusion that this first release will be perfect, it will be both attainable and a giant leap forward for both producers and consumers of health evidence.

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#### CONFLICT OF INTEREST

The author reported no conflict of interest.

#### DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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