

NATIONAL WEB-BASED TELECONFERENCE ON FINDINGS FROM EVIDENCE-BASED PRACTICE CENTERS FOR HEALTH IT

BEGIN TRANSCRIPT:

FEMALE SPEAKER: Welcome to the AHRQ webcast. Today's topic is Findings From Evidence Based Practice Centers for Health IT. At this point, I'd like to introduce today's moderator, Rebecca Roper. She is Senior Project Officer with the AHRQ Health IT portfolio. Rebecca, the floor is all yours.

REBECCA ROPER: Good afternoon. So I will try to be as succinct as possible, so we can use our time wisely, to hear what these three wonderful presenters have to say. And before we get started, I'm going to have Angela Lavanderos, who championed your ability to earn continuing medical education credits for this webinar, give her mandated overview of that process.

ANGELA LAVANDEROS: Thank you Rebecca. Before we begin today's session, we are required to read the following statement for CME purposes. This educational activity has been approved by the Wisconsin Medical Society for 1.5 AMA PRA Category 1 credits. Speakers and planners are required to make disclosure of any relevant financial relationships which may be related to the subject matter discussed. Speakers and planners for this educational activity have made proper disclosure and have no relevant financial relationships that exist now or in the past 12 months.

REBECCA ROPER: OK, so today we have three presenters for three different evidence based practice reports that center around health information technology. I'll give you a review of each of the presenters in sequence, and then they in turn will give their presentation and pass the PowerPoint on to their colleagues, and at the conclusion of the three presentations, we welcome you to articulate questions. We'll have folks, at the end of the presenters presentations, tell you how you can send in your questions, and then look forward to an engaging dialogue.

This may be a bit hyperbolic, but around this area in Virginia, we're celebrating the 150th anniversary of the First Battle of Manassas, and the hyperbolic part may be that these three particular EPC reports really do symbolize a breadth of activities; hundreds of different researchers who have pursued understanding how health information technology can help us succeed in our battle against insufficient quality of care, and so collectively, our presenters and you, the interested audience, are able to pursue, through insight and focus, other ways to use health IT to improve healthcare quality, to improve quality of the work situation for clinicians. That's really what it's all about.

So our three presenters are in turn, Dr. David Lobach, down in North Carolina, and he is Associate Professor and Chief of the Division of Clinical Informatics in the Department of Community and Family Medicine at Duke University Medical Center in Durham, North Carolina. Dr. Lobach has additional faculty appointments in the Departments of Medicine and Ophthalmology at Duke, and he retains a clinical practice in endocrinology and internal

medicine. Dr. Lobach is a fellow of the American College of Medical Informatics and of the American College of Physicians. His recent projects have focused on the creation and evaluation of centralized scalable knowledge resources placed on the HLC decision support service standard that can be used across multiple applications and by multiple disparate institutions. Dr. Lobach, his EPC report actually will be coming out in the fall, so this is very unusual, that he is sharing with us, a prelude to his research team's findings.

He will be followed by Dr. Ann McKibbin, who is from Canada, so this is truly a North American presentation. Dr. Ann McKibbin is Associate Professor of McMaster University, in the Department of Clinical Epidemiology and Biostatistics. She is also the director and developer of the Masters of Science program in eHealth, now in its second year of operation. Dr. McKibbin's background is in information sciences and her PhD is in medical informatics, from the University of Pittsburgh. She has been involved in producing information products and services for evidence based medicine information tools, for more than 25 years. Her research interests center on knowledge translation, systematic review production, information retrievable by clinicians and her interdisciplinary education. And her EPC report, as she will have in her PowerPoint presentations, is available, and let us say the number of abstracts and actual papers that had to be reviewed and condensed were astronomical. I mean, we've never had an EPC report as large, so I appreciate her effort and her team's effort on that.

Our third presenter will be Dr. Michael, or more commonly known Chris Gibbons, is the Associate Director of Johns Hopkins Urban Health Institute and Assistant Professor of Medicine, Public Health and Health Informatics, at the Johns Hopkins medical institutions. Dr. Gibbons is a healthcare disparities and urban health expert. He obtained his medical degree from the University of Alabama. He completed his residency training in preventive medicine, fellowship training in general surgery, as well as molecular oncology basic research. He also earned a masters of public health degree, focusing on health promotion among urban and disadvantaged populations, from Johns Hopkins. His research focuses on the use of information technologies and consumer health informatics, to improve healthcare disparities. Dr. Gibbons' work is leading the emergence of the field of populomics. He is an advisor and expert consultant to several state and federal agencies and policymakers in the areas of urban health, eHealth, minority health and healthcare disparities. And with that, I will turn the floor over to Dr. Lobach, who will begin us on our journey for today.

DAVID LOBACH: Thank you very much Rebecca. It's a privilege to be able to present this report. I thank you and AHRQ for funding us to do this work. As Rebecca did mention already, this is the first public release of the findings from this report, and the actual report will be out in full some time this fall. The report is entitled, *Enabling Healthcare Decision Making Through Clinical Decision Support and Knowledge Management*. This work was prepared through the Duke Evidence Based Practice Center and again, I have the privilege to present it.

I do want to start by first acknowledging my team from Duke, who worked on this project. There was a lot of heavy lifting that needed to be done, and I just want to list the different people who participated. I also want to recognize the technical expert panel. We had eight members on that panel, they are shown on this slide, and they gave us some good advice, some good decision making when we needed to pick different directions on which to go. And then finally,

acknowledge the peer reviewers, who gave us a lot of their useful feedback, in order to get the reports into its final form.

So with that said, what I'm planning to present today will just be initially background and then the methods we used, then spend most of the time on the results, and then talk a little bit about the implications and the limitations of the study, and then where we're headed or where we see future research going. So to begin, I want to first again acknowledge the funding that we had from AHRQ, through a contract that went to the Duke Evidence Based Practice Center. I will mention that this was a third report that's part of a three part series that really focused on the health information technology portfolio. The other two are already completed and published. And I also want to give this disclaimer, that the findings and conclusions are those of the authors, or the Duke Evidence Based Practice Center, who are responsible for the content and not necessarily represent the views of AHRQ.

So with that out of the way, let me begin by just laying some groundwork, so that we all begin with a common understanding of both clinical decision support and knowledge management, as we defined them for this particular report. For this report, we use the definition of clinical decision support system as any electronic system designed to aid directly in clinical decision making, in which characteristics of individual patients are used to generate patient specific assessments or recommendations that are presented to clinicians for consideration, and that came from an earlier systematic review and is also fairly similar to what's been used in other systematic reviews that have been done in the clinical decision support area.

Knowledge management systems is a little bit different. That has not been well defined in previous reports, and here we chose to define it as a tool that selectively provides information that's relevant to the characteristics or circumstances of a clinical situation, but which require human interpretation for the direct application to a specific patient. So that's a little different. You have a human in the end part, interpreting the information, and we identified really, two categories or examples. One would be the information retrieval tool and the other, the knowledge resource.

On this next slide, this is really a continuum of decision support through knowledge management, and just to highlight that, take example here, of classical clinical decision support. An example would be a preventive care reminder, and for this type of a reminder, the patient data is submitted automatically, usually via computer, and then a reply is generated automatically, that gives a specific recommendation. In contrast with the information retrieval tool, something like an info button would be an example, the content or the circumstance or the context, is submitted automatically and then several choices for our information come back, and they need to be processed and interpreted manually. And then the final type of knowledge management or knowledge management system, is what we refer to as a knowledge resource. Example here could be Epocrates, which for those of you who aren't clinical, it's a drug reference lookup that can be used fairly easily at the point of care, can be easily carried on a PDA. And again, this situation, the user has to manually submit the patient information and then interpret the information that comes back. So again, it's a continuum, but I just wanted to lay the groundwork about the types of systems that we were looking for and how we defined them for the purpose of this study.

Our overall goal for the project was to summarize the available evidence related to clinical decision support systems and knowledge management systems, and then highlight the limitations of the evidence and identify areas for future resource. This project was directed by four key questions, and I just want to go over those quickly so you understand what we were looking at and what we were asked to do.

The first question was what evidence based study designs have been used to determine the clinical effectiveness of electronic management and clinical decision support systems. Our second key question was what contextual factors and features influence the effectiveness or success of electronic knowledge management and in clinical decision support. The third question is what is the impact of introducing these systems, and looking specifically at changes in the organization of healthcare delivery, effect on workload or effect on actual healthcare processes and clinical outcomes. And then the fourth question and the final question was what type of knowledge or generalized knowledge sources, can be integrated into these types of systems, to improve care quality. And again, there were two subparts on this; what's the published evidence to show the different types of measures and how does clinician expertise influence the use of this generalizable knowledge.

With that groundwork and background in place, I want to now talk about the methods that we used to undertake this project. We first searched the peer review literature databases and the usual databases that folks would access are listed there. So we had five structured databases that we searched, and then we did manual searching of the reference lists, particularly for any review articles, to make sure we hadn't missed any articles that were germane to this topic. We established conclusion criteria. We were looking here, only at electronic systems. This time, we did not include paper based clinical decision support systems or knowledge management systems. They had to have some level of healthcare provider interaction with the system. We required a comparator to be included in the study, so it wasn't just a pure descriptive study. We looked for a measurable outcome of interest, and I'll highlight those in a few minutes, and then for question one, we looked at all study designs and then with direction of our technical expert panel, we focused on the best evidence of randomized controlled trials for questions two through four. And we only took articles in English.

There were a few exclusion criteria, and I highlight these just so you can understand what didn't make it into the group. And if the system wasn't used in a real clinical setting, so it was more a laboratory type of study of a system, they were not included. A closed loop system in which there was no provider in the decision making. Any systems that required mandatory compliance with the recommendations were not used and any studies that were particularly small, with a sample size of less than 50.

The next slide shows our breakdown of the articles that we found, and we began with identification of over 15,000 citations that we started with. Those citations were read initially by a single - for the abstracts, we had a single person read them and then we did an over read of 5 percent, to make sure there was good agreement, and that took us down to 1,407 articles for which we had to do a full text read. These were read by two reviewers completely, to decide whether the study should or should not be included, in terms of the inclusion/exclusion criteria.

We then dropped down to have 323 articles that passed the full text screening and then were included for abstraction. Initially, this was for key question one. These 323 articles actually represented 311 studies; there were some that were published in more than one article. And then when we removed anything that wasn't a randomized controlled trial, we were down to 160 articles, for a total of 148 unique studies. That became the core for the bulk of our literature review.

I want to just highlight some of the things we looked at with regard to outcomes, so that you have an understanding of the types of things we were looking for. With regard to clinical outcomes, we were looking at length of stay, morbidity, mortality, health related quality of life and adverse events. For healthcare processes, we were looking for the impact of the systems on recommending preventive care, recommending a study or treatment, patient adherence to a particular guideline recommendation. In the area of healthcare, workload and efficiency, we were looking at the number of patients seen for unit time, clinician workload and efficiency. With our relationship centered outcomes, we were looking at patient satisfaction. For economic outcomes, we were looking at cost and cost effectiveness, and then finally, with healthcare provider use and implementation, we were looking at acceptance, satisfaction, and use of the implemented system.

Also, one of our questions focused on system features, and for this particular question, we worked with a total of 14 features that had been identified in the earlier review, by finding the prevalence, which of the features that were the most common. These were grouped into four categories. First is general features, and you can see there it says integrated with a charting or ordering system for accommodating workflow. Then there were clinician systems specific features, and this is the automatic provision of the decision support, no need for data entry. You can read the request for documentation for the reason, for not following provision support at the time. Location decision making and then excluded - or executed by noting agreement, which is an action required by the user. And then the other system features we looked at were the communication of the content, so provision of a recommendation and not just an assessment, but something more specific. Promotion of action rather than inaction, justification via provision of reasoning, and then justification of decision support via research evidence. And then system auxiliary features were local user involved in development. Provision of decision support to the patients as well as providers, and in performance feedback and conventional education, to come with the decision support. So those were the main features.

So with that groundwork again in place, now I want to start going into how we answered each of the key questions, so starting with key question one. This focused on the study designs that were used for clinical decision support, and of the 311 studies, about half of them were randomized controlled trials, and 121 were quasi-experimental, and 42 were observational. In these studies, clinical outcomes were assessed in about 20 percent of the randomized controlled trials, more so in the quasi-experimental and the observational studies, and then the process measures is what really dominated the randomized controlled trials, being assessed in 86 percent of those. And then a less with the quasi-experimental and the observational studies. That's just sort of a high level view of the types of studies that were performed.

On key question two, this is where we looked at system features, and in this question, we confirmed three features that had been previously identified as being important for effective clinical decision support, given the reference of the early review from 2005. These included the automatic provision of decision support as part of clinician workflow, provision of decision support at the time and location of decision making, and provision of a recommendation and not just an assessment. So, it has been previously found and we again found, that those had a significant odds ratio, to say that feature was likely to be associated with a successful implementation. So what's new for this report is an additional six features, because we had more studies, that we were able to identify additional features or perhaps just more breadth of literature to work with; we had almost double the number of studies in this project than we did in a previous review, and the things that were found to be associated with effective decision support included the integration with a charting order entry system, no need for requiring additional data entry, promotion of an action rather than inaction, justification of the decision support via the provision of research evidence, having local users involved in the development process, and the provision of the decision report results to patients as well as providers. I thought that was interesting, that we've now sort of expanded some of the features that tend to be associated with successful decision support implementation.

Moving on to the third question, which really focused on outcome with regard to the impact of the systems on the organization of healthcare delivery, which was question 3A, there was really insufficient evidence that we found, among the randomized controlled trials. There just were very few studies that really looked at this topic and similarly, same issue related to workload and efficiency. We did find a fair amount of studies that looked at outcomes and the primary focus, at least of the randomized controlled trial, was the process measures. We found that the recommendation of preventive care service was an effective way to using decision support. And you can see the odds ratio there and the confidence interval does not cross one, so it is significant. Recommending preventive care services was an effective use of decision support. Recommending a clinical study to be ordered or completed, was also an effective way of using decision support, and then recommending a treatment, again an effective way. So these were really healthcare process measures shown to be improved by using decision support, with significant odds ratios.

In clinical outcomes, you're looking at length of stay. There weren't a lot of studies but all six of these studies were of good quality. And here we used a relative risk, as opposed to an odds ratio, because some of the results were given as a time period instead of event, per number of patients, so the more appropriate calculation here was relative risk. And you can see that for length of stay, we actually did not have a specifically significant finding there, because the odds ratio spans one. With regard to morbidity, there was evidence of statistical significance, and mortality did not show specifically significant impact. So again, relatively few studies, but at least people are beginning to look at this type of question and begin to ask what I would say is a more important question, of what are we actually doing on impacting the care of patients, as opposed to just seeing that processes are completed.

The last part of the third key question was looking at the economic information. With regard to the impact on costs, there was a trend, showing that there were lower cost and greater cost savings by using clinical decision support, but there wasn't a lot of studies in this area again; 22

studies. And on cost effectiveness, there's really only one what we call a good quality study, and we felt the evidence there was just insufficient to really report on cost effectiveness.

And now finally on our fourth key question, we found that structure cared protocols were the most common type of general knowledge used for decision support, and these are protocols that often were derived initially from a national guideline, but then they were modified or adapted for use in the environment where they were going to be implemented. So there would be some local adaptation into a specific care protocol. The second most common type of information or general knowledge that was used was clinical practice guidelines that focused on either a single or very limited set of medical conditions.

And then just to sort of begin to summarize, so what are the implications of this particular study? Well, we found that there are now nine features of clinical decision support systems that are associated with an effective impact of those systems. We found that the general system features, the clinician interaction features and the content communication features were - the features came from all the different categories basically, the system features. The other interesting thing that is, I think something new with this particular report, is we're finding that the presence of these features wasn't effective in diverse venues, both with regard to being used inside and outside of academic centers and used in very locally developed and commercially developed systems. And that's sort of an advancement of our understanding of where things were from previous systematic reviews.

Further implementations, particularly with regard to outcome, there was strong evidence that clinical decision systems and to some degree knowledge management systems, favorably impacted healthcare processes, particularly including facilitating preventive care services, ordering clinical studies and prescribing treatments. An expansion of our understanding in this area is the fact that this now could be done in diverse venues, and systems - many of you recall an older publication from around 2005/2006, said that clinical decision support is effective, but it's only been shown to be effective in four primary academic centers with locally developed systems. And I think we can now really say that through now observing effectiveness in community sites and with commercially developed systems. So again, an expansion of the effectiveness of clinical decision support into a broader venue.

In terms of gaps in our understanding, as I mentioned earlier, the effects of clinical decision support on both clinical and economic outcomes, somewhat limited. We're beginning to see studies that are addressing those issues but there are not a lot. There's limited evidence showing the impact on workload and efficiency. Those studies really haven't been done for the most part. Most of the published randomized controlled trials really focused on a very limited set of conditions, so there isn't looking at the broad impact of decision across the continuum of care of a multitude of comorbid conditions. Most of the studies have tended to focus on delivering the decision support to physicians, as opposed to other members of the care team, such as physicians assistants, nurses, other people. With regard to knowledge management systems, we only found three randomized controlled trials that actually evaluated these systems, so again, a little bit of a gap in the evidence.

In terms of limitations, I want to identify a publication bias. For most of the endpoints we did - well, for all the endpoints, we did testing to look for possible bias, and the only place that we showed that there could be publication bias, was around the finding that clinical decision support promoted adherence to ordering a clinical study. Another limitation is that this literature is very heterogeneous. It does make it a challenge to lump it together and to find common endpoints that we can make observations about specific systems. It's also difficult, in a number of the articles, to really determine what the specific features are or the impact of a specific feature, because the systems are studied as an aggregate and then we can't really unravel any one individual feature, and very rarely do they actually study system X with one feature set, and compare it to system Y that has just one additional feature, to see the impact of that feature. That's what these need really, to tease that apart. There's also just variable levels of the descriptions in the different manuscripts. Another limitation is that we did focus specifically on the randomized controlled trials, which could be one reason why we didn't see a lot of information around workload and things like that, that could be in different studies.

In terms of the future, I think the place that decision support needs to go is to look at systems that can simultaneously address a breadth of comorbid conditions, as opposed to just telling you what the needs are for diabetes, you'd want to hear about the diabetes, the kidney disease, and all the other conditions, so that the recommendations don't step on each other and they are harmonized. We need to look at different approaches for delivering clinical decision support content. There's often a need for new methods for integrating the decision support or knowledge management into workflow. And then finally, engaging other practitioners other than physicians, in the use of decision support. Future studies could focus on clinical outcome, potentially also on economic endpoints, and then we just need studies in general that look at these knowledge management systems, because there were only three that we determined in the literature.

So that's a very quick overview. As Rebecca said, this is sort of the first public review of this information, and I'll be glad to take questions at the end, but at this point in time, I would like to now pass the presentation on to Dr. Ann McKibbon.

ANN MCKIBBON: Thank you very much Dr. Lobach. We've had some similar findings. You'll see some similarities as we start through. I too am just delighted to be here, and thank you to AHRQ for funding this report and allowing us to do it.

Here's the link to our project report, our financial disclosure. These slides will be available, so you'll be able to get my report. Here's our project team. Our project team was a strong team. We brought in some people from the University of Pittsburgh and McGill. We needed to cover the clinical world and also the pharmacy world. Our technical expert panel, you'll see Dr. Gibbons was on our technical expert panel. Again, a broad range of people who were truly helpful to our project. Our peer reviewers, they were quite insightful and gave us a lot of good work for us to think about, and the report is certainly stronger for their input.

The objectives of our report were very similar to Dr. Lobach's; review the literature, synthesize gaps and make recommendations. And for today, for the webinar, I basically just want to introduce you to our report. It was such a large report, as Rebecca was saying, that we can't do

much more than kind of show you the shape of the literature base, and I'm going to highlight some examples that I'm hoping will tweak your curiosity and get you to get into our report.

Content. Basically we were looking at all of medication management and all of health information technology, no matter how big or how small, and how they interact with each other. We had no restrictions on things like setting the study design and whatnot, so it was a fairly major report to get started and underway.

Looking at medication management, we looked at the model that Doug Bell proposed in 2004, and it includes five phases; the prescribing or ordering, the order communication, that includes the - oh, I just had a note that I need to speak up. OK, order communication, dealing with the perfection - perfecting the order between the clinician and the pharmacist, dispensing, administering and monitoring. And AHRQ also asked us to look at reconciliation and education, and that education was twofold; basically, do we need some education when we implement these systems, or are these medication management tools an educational resource of itself.

Looking at our inclusion criteria for the medication management information technology, we said that the information technology had to process patient specific information, and it not only had to process it, it had to send some clinical data or clinical direction to a decision maker, and our information technology had to be integrated with another information technology system. This restriction was in place so that we stayed away from some of the more medical devices; the infusion pumps or the individual glucose monitor. We wanted to stay away from some of those devices and concentrate more on the larger systems.

We had seven key questions from AHRQ, they're listed here. You can see we potentially had some overlap with the RCTs for the clinical decision support systems. Certainly the effectiveness of the medication management information technology systems, was the biggest section in our report.

Literature searching was fairly standard. We had 11 databases, the health certainly, the MEDLINE and the MBASE, to cover the European literature. We did nursing and pharmacy, technology. We concentrated on the computer literature, the information, the science. We tried to be as broad as possible. We were also broad in our approach to the business literature. We spent a fair bit of time looking at the gray literature, although in the end we didn't find many reports from the gray literature that made it through to our final report. We had almost 41,000 articles and we ended up with 428 articles in our final report, and most of those articles were from the 2000s on.

Now I wanted to show you a little bit, as I said, of the shape of what we found, and basically from the shape, I'm going to talk about the number of studies. First of all, we looked at the number of studies in the various medication management phases, and you can see here, the prescribing phase, the prescribing/ordering phase, was the most - was the phase that had the most studies. Monitoring; two. Monitoring had a fair number of articles, but looking at the order communication, the dispensing and the administering, the non-prescriber section of medication management, there were very few articles, almost no articles on reconciliation and even fewer articles on education.

Settings. There were no surprises here in the settings, mostly hospitals, some ambulatory care. We were surprised there were so few studies in the pharmacies, either in-hospital or other types of pharmacies. No surprises that long-term care wasn't well studied, and we were hoping we would find more articles that were set in the homes and the community. What we felt going into the study, was we would find more studies that dealt with monitoring of medications outside of the hospital, in the clinics, but we didn't.

Looking at clinicians, who were the clinicians that were studied? Again here, certainly concentrated on the physicians, some nurses, very few pharmacists. The other healthcare providers; we found very little information on the mental health clinicians of the world. We actually found no articles on dentists, although we weren't into the dental literature, and very few administrators. The patients and the caregivers, were these people in the studies? And you can see that breaking the patients and the caregivers down by ages, and we used the definition from the National Library of Medicine, that most of the studies were in the geriatric field or in the geriatric age range, or in the adults. And remember, adulthood ends when you're 44, and then you move to be middle aged. So you can see the spread on the study of the patients and caregivers.

Now, looking at what were the medication management information technologies that were studied. As a carryover from Dr. Lobach's studies, we certainly found a lot of clinical decision support systems and reminder systems. We found a fair number of provider order entry and ePrescribing, and I've made those bars a little bit of a different color, because I wanted to address the issue here that we want into, that very often, we had trouble with definitions. People who would define a system in one way and call it a provider, order entry, and the next paper that would come along that was very similar, they would describe it as an ePrescribing system. So to sort that out, we took the definition that a provider order entry system was a system that was namely in the hospital setting. The ePrescribing systems for ordering medications were the ones that were done outside the hospital setting. But I think it also showed what Dr. Lobach had said, that some of the descriptions of these systems were woefully lacking in papers.

What were the medication management systems linked with? No surprises here, mostly EMRs and EHRs, and some of the ancillary hospital systems; the pharmacy information systems, laboratory, imaging systems. And again, back to the issue of not having good descriptions. We had 50-some articles that said yes, this NMIT system is integrated with something, but they didn't bother to tell us what.

Now moving to some results, we looked at process changes as one of our components of our key question one on effectiveness. There were many studies that looked at how do these systems actually change process. Just to give you some examples, for the prescribing phase, there were 174 articles that looked at changes in process. I can just give you a few examples here. For changing and prescribing; how do we make the prescriptions better or the orders better, things like better matches on antibiotic chose, better dosing. And probably, oh 80 percent of the studies that looked for changes in prescribing found positive changes. Similar sort of thing in errors, and here we took potential errors as a process outcome. If the error reached the patient, it became a patient, a clinical outcome. Again, two thirds were positive compliance, when we looked at

compliance, and that's compliance with reminders, guidelines or best practices. Again, the vast majority were positive and workflow was not well studied, similar to what Dr. Lobach said, and one of the two studies was positive.

So moving from the 174 articles in prescribing, here's the data for the administration of the drugs, and there are only 16 studies there. You can see, probably oh, two thirds, similar outcome. So it says outcomes for errors. Eight of the thirteen studies were positive, one was negative. Two thirds were positive for compliance with guidelines. Time was improved in three of the four studies, and that was mostly time that was spent on recording of data.

Clinical endpoints, probably more important than the process changes. We have 76 studies that looked at clinical endpoints, and we took a very broad definition of clinical endpoints, and included things like levels of cholesterol or glucose levels, as a clinical endpoint. With 76 studies across all methods, about half of them showed improvements, although when you moved to randomized controlled trials, a little less positivity was shown. Of the 23 articles that had clinical outcomes as their primary measure, 43 percent showed improvements. We had 26 studies that looked at clinical outcomes as their secondary outcome; 12 percent showed improvements and I think that's probably an issue of power. A lot of these studies were not strongly powered.

More clinical endpoints. Half of the studies showed a decrease in length of stay, although one showed an increase in length of stay. Not much done on quality of life and only 20 percent were positive. Real adverse drug events; two thirds were positive. Disease events. About a third of the disease events were improved, and had looked at things like blood clots, presence of infection, decreased depression, using care that was based on these medication management information technology. Lots of changes in sort of physiological measure, blood pressure, glucose levels.

Just to take it one step further, here is some data on mortality, in a subset of the provider order entry studies in U.S. pediatric hospitals. We found three cohort studies, historical controlled. The first one, done in 2005, showed that the mortality is quite substantially increased. The 2007 article in New York, showed no difference, and then the study done in California in 2010 said that there was a fairly substantial decrease in mortality with the use of CPOE. And it just shows the diversity of the results and how hard it is to put these studies together.

So moving to economic cost endpoints; almost exactly what Dr. Lobach had said. Not many economic evaluations, some cost studies, and it looks like cost savings are possible over time, although a good number of the studies didn't include cost data for capital investment and implementation, both issues that can be fairly substantial.

The qualitative studies. The qualitative studies were really quite rich, and we found 56 of those. Certainly, Joan Ash and her colleagues have contributed strongly in this area. We found that there were strong emotions involved with implementations of these systems, and quite often the expectations were really unrealistic and set up these unrealistic expectations and set up some really difficult situations in which to implement. And no matter what happened, they all said that technology affected working relationships. We also looked at unintended consequences. Some of the consequences were negative but some of them were positive too. Communication, in a lot of studies, was improved, and in some studies it was not improved. And these are some of the

issues that came up in looking at the unintended consequences of medication management information technology.

Looking at the RCTs of clinical decision support systems for medication management, we only found 77 of them. Most of them were in the prescribing and monitoring phases, most of them were in hospitals, and most of them concentrated on physicians. Similar to what Dr. Lobach said and our findings were similar, about two thirds of the studies showed improvements in the process of care, but only about a third of the 16 studies that looked at clinical endpoints showed improvements in clinical outcomes.

The value proposition question that we were asked. To do a value proposition you need financial, clinical and organizational data. We have some of each, certainly some cost reductions and a little bit of productivity gain. Certainly some evidence of clinical improvement. We had some satisfaction too, so the bottom line on our key question three was that the evidence is leaning towards a positive value proposition.

Sustainability. We were asked to look at sustainability. Very little showed up in the body of literature that we had, so that what we came up with was to suggest that sustainability needs to be studied, and here is the definition that we thought would best serve that possibility. Certainly appropriate care and the appropriate quality of care, in both a cost effective and a health effective manner.

Question six looked at the two-way electronic data interchange, that perfection of the prescription, in the order communication between the prescriber and the pharmacist. There wasn't a lot of data on two-way, so we went to one-way EDI. We found the literature supported three facilitators of EDI, and three barriers to EDI.

A call to action. Just in summary, I think we need more work on some of the other phases; the phases that affect the pharmacists, the nurses, the patients and their families. We need more work with those groups of people, and certainly the information, the medication management information tools that these people use, are used for these people. This list of research expansion, I think it's a list that we've seen many times before. We need good, solid studies with control groups, move beyond process, balance the qualitative and quantitative. Yes, I'm sure those are fairly standard results seen in these types of reports. For researchers, I think it's maybe time for us to develop new research methods using some of our own data collection capabilities. I would really hope that we would seriously look at better adherence to reporting standards. So many of the articles would say things like, we studied all the nurses on the ward, and that's not very useful. Or, we integrated with an imaging system. We agree with Bill Hersh when he says we need better use of terminologies and standard definitions, and I think we need to seriously consider how well we're doing with knowledge translation or our translational research efforts. I think individually, we know a good bit about medication management information systems, but we need to communicate that knowledge to other people.

For implementers, we feel that implementers need to be very careful with managing expectations and unintended consequences, and then there's the whole issue of updating. We found very little in the literature about either updating the systems themselves or updating the knowledge bases

that are behind so many of our systems. So in conclusion, I think we've come a long way. This is the oldest picture I could find of medication management in the historical collection of photos at the National Library of Medicine, like pens were invented in 1952. We've come a long way. We know a fair bit about medication management information technology, and I think we've still got a ways to go in certain subsets. And with that, I think I'd like to close up and move to Dr. Gibbons from Johns Hopkins, and he's going to move us into the consumer world. So thank you.

MICHAEL GIBBONS: Great. I will go right into my talk. We were also funded by AHRQ, REPC here, to look at the impact of consumer health informatics applications, and here's the link to our report as well. Just a little background. As we all know, health information technologies are being touted and many believe, as enablers of future transformations in healthcare delivery, quality outcomes and cost. But there's also a growing interest in electronic tools that are owned and operated primarily by patients and healthcare consumers, the distinction there is that consumers are not yet patients but will one day be patients, or they may also be caregivers of patients.

The field of consumer health informatics is actually quite new. The first definition was posited by Eysenbach in 2000 and several definitions have been out there. We used this definition which we put together, and I'll explain why. Consumer health informatics is defined as any electronic tool, technology or electronic application that is designed to interact directly with consumers, with or without the presence of a healthcare professional, that provides or uses individualized, that is personal information, and provides the consumer with individualized assistance, to help the patient better manage their health or health care. And the reason we did that is similar to Ann's talk. This field is voluminous, I mean especially when you're looking at descriptions of consumer health informatics, it's huge. Interestingly - and I'll talk a little bit more about this later - most of the developments in this field are coming from outside of healthcare, and it's our belief that that needs to change. But whereas most devices - the vast majority of the scientific work within the healthcare systems, focus on tools that are primarily for doctors, nurses, hospitals and those in the healthcare system, and secondarily, are tertiary for patients. But there is a huge, huge body of work coming from outside the healthcare system, developing and using tools for patients. Patients love them, there's a very large demand for them. The question is do they work. So, the objectives of this report were to review that literature on the evidence of the health impact of currently developed consumer health informatics applications, to identify the gaps in the CHI literature, and to make recommendations for future research.

So our key questions were for, what is the evidence that consumer health informatics applications impact. Health outcomes, and we looked at health outcomes in several different ways. We looked at process outcomes, for example receiving appropriate treatment. We also looked at intermediate health outcomes. Can these tools help with self-management, health knowledge, improve health behaviors? We also looked at relationship centered outcome, shared decision making or clinician/patient communication. Can they facilitate the traditional clinical outcomes that most providers would be interested in, including quality of life. And finally, can these tools have any economic benefit on the healthcare system, among those who use them.

Question number two was what are the barriers that clinicians, developers, consumers and their families or caregivers encounter, that limit utilization or implementation of consumer health

informatics applications. Question number three is what knowledge or evidence exists to support estimates of cost benefit, net value, with regard to these applications. And finally, what critical information regarding the impact of these tools is needed to give consumers, their family's clinicians and developers, a clear understanding of the value proposition particular to these tools.

Our methodology. We decided to only use randomized controlled trials for question one, that is the impact of these tools, but thought that there would be a lot more information in non-randomized controlled trials for the other questions. We didn't exclude RCTs but we used all study designs for questions two, three and four, and RCTs only for question one. You can see the list of databases there. We too looked at the gray literature, as well as the medical literature. Our exclusion criteria included the obvious, no health informatics application, but more specifically, if an application was just described and not evaluated, we excluded those papers, and if the application did not apply to the consumer, that was excluded. General health information applications, the reason we put in there, used personalized health information and gave back personalized health information, is to distinguish these tools from WebMD websites and National Library of Medicine websites, which can be useful, but they don't give generally and they don't use generalized - sorry, specific tailored information, and they don't give back specific personalized information help, and so we wanted to exclude those from this search. We also included devices that could reasonably be thought to be used within the context of, at the point of care, and saw those as if they required a clinician to be used, those would be considered medical informatics tools rather than consumer health informatics tools.

We assessed the quality by two different methods; using the Jadad method and the grade working group criteria. We had at least two people reviewing the data and the quality of each of these papers, and there was a lot of iterative feedback and review. We not only had a technical expert panel, but we also solicited some external advisors who were really leaders in this field around the country; Patty Brennan, Gunther Eysenbach of Canada, and a few others. Before I give you the outcomes, let me just tell you - I didn't include a slide on it but we reviewed about twenty-four, twenty-five thousand papers and got it down to 146 final papers that we reviewed for this study; 121 of them were for the health impact key question one, and 31 of them were for key question two. We did have six studies that were eligible for both key question one and key question two.

In terms of the applications that were studied, extremely diverse, which made really summarizing this field a challenge, but over half, about 55 percent of the studies evaluated were dealing with interactive websites or web based applications or web based tailored educational websites. About 15 percent of the studies evaluated computer generated tailored feedback; not web based but on a home or personal computer. Then we had some interactive computer programs, personal monitoring systems or devices, were evaluated in about 8 percent of the studies, and then the final 5 percent of studies was for a wide variety of types of things, including health risk assessments and other decision aids, cell phones, laptops, CD-ROMs, PDAs, smartphones, text messaging, short message systems, discussion or chat rooms or chat groups. Computer assisted imagery, there was one study in there, but as a group, all of these things consumed less than 5 percent of the studies.

In terms of the age groups of the patients that were using these tools that were studied, more than three quarters, about 77 percent of the studies, reported targeting adult consumer health informatics tools. You may have thought oh, this is really futuristic kind of stuff that would be mostly in kids, but in fact there wasn't, it was mostly in adults. Only 12 percent of studies targeted adolescents, 3 percent of studies targeted seniors, and another 3 percent of studies targeted children. In terms of environments, 58 percent, or almost 60 percent of the studies evaluated, people who were using these tools in the home environment or in their communities. A very small amount of studies, about 15 percent evaluated, use in schools, about 17 percent in clinical settings and 3 percent in communities and 5 percent online. There were a couple studies looking at kiosks that could be anywhere.

Over 92 percent of the studies had study populations that were greater than 50 percent white or Caucasian. There was only one study with greater than 50 percent of any kind of minority, and that was African Americans. There were no studies where the majority of participants were Hispanic, American Indian, Alaska native or Asian or Pacific Islander.

So what did we find? In terms of process, results or process, in intermediate outcomes, we found only five studies in the process outcome category. They were all asthma related studies, but four out of the five studies showed at least a significant positive impact in at least one outcome. We had to summarize it this way because the studies were so very diverse. They were all talking about asthma but they could have been describing three or four or even five different consumer health informatics tools to deal with asthma. In terms of intermediate outcomes, we found a fair number of studies here. Three studies looking at breast cancer, but all three had significant positive impact in at least one outcome. Almost 90 percent of 32 studies looking at diet, exercise, physical activity. All of seven alcohol studies showed positive impact. Almost 60 percent of 19 smoking cessation studies; 40 percent of 12 obesity studies, all seven studies looking at diabetes showed positive impact. 88 percent of eight mental health studies, and these were some of the best studies that were done. One out of four asthma and COPD studies, showed basically a significant positive impact. One of two studies looking at menopause, hormone replacement therapy, showed positive impact, and then there were 13 other studies, single studies looking at only one paper looking at that condition, so you can't really make a conclusion about that condition or that device, but all 13 studies had significantly positive impact in at least one outcome, one intermediate outcome.

In terms of clinical impact or clinical outcomes, relationship centered outcomes, the doctor/patient relationship, five of eight studies showed positive impact. In terms of the traditional clinical outcomes, a little less positive but still positive; one of three breast cancer studies, 80 percent of five diet, exercise and physical studies, all seven mental health studies, all three diabetes studies, and all of the 13 miscellaneous single studies were positive for at least one clinical outcome, but they were only one study for that particular clinical outcome. There was no evidence of consumer harm that could be attributed to the use of consumer health informatics. We can't say there is no harm, but there at least was no harm reported in any of these studies. There's insufficient evidence to determine any economic impact. There just were no studies that really were sufficient to do that, and there were many, many, many barriers to utilization, both at the individual level, at the system level. They ranged from all kinds of things; being unfamiliar with the device or the computer, computer literacy or sometimes you had to pay, or some other

things. And then there were some systems level that didn't have Internet access in the home or a community, things like that. There was just many barriers that were reported.

So, in a nutshell, what we found in this review is that the current literature is very broad. There are many studies looking at this area, but it is often quite thin, limited numbers of studies in each particular topic area. But as a whole, when you stand back and look at it all, there are some emerging themes. The evidence is suggestive that consumer health informatics applications, in the right circumstances, can significantly impact certain select health outcomes. Consumer health informatics applications may also be effective adjuvants to traditional care. So it's not that all these studies looked at whether you use these things or went to a provider, but in several of the studies, they looked at the provider outcomes without using the consumer health informatics tools, compared to provider outcomes when providers and patients were using these tools, compared to controlled. And in fact, in many of the studies, the outcomes when the patients were using these tools in collaboration with their providers, was better than what the providers were able to achieve alone, without the use of these tools.

And finally, those tools that seemed to be effective, generally had these three characteristics. They used individual tailoring, personalization, and gave regular behavioral feedback to the patient. It's not clear from the study, what the periodicity of that behavioral feedback has to be, and it may be different for different conditions or different tools. And it is also not clear that the behavioral feedback itself has to be electronic. It could be a person, but the reality or what seemed to emerge is that regular behavioral feedback was a key component of effective interventions.

So the knowledge gaps, there are many. Here are just a few. The role of consumer health informatics applications generally has not been well studied in children, adolescents, the elderly or in caregivers. The role of Web 2.0 social media, social networking, on demand television and health gaming technologies, which are all out there, have not been evaluated for their potential consumer health informatics value. Consumer knowledge, attitudes, beliefs and perceptions, and practices regarding the utilization of these tools within the context of their health, has not been systematically studied, although there is a lot of evidence out there that patients not only want these things but are avidly going after them where they are available. And if you use the use of Google and the Internet as a proxy for some of these things, you can find a great deal of information. The number one search topic on Google is now health. It used to be pornography but health topics have eclipsed that.

The effect of consumer health informatics applications on health outcomes among ethnic and racial minority populations had not been well studied. Low literacy groups and the potential effect of these applications on healthcare disparities has not been evaluated. Finally, the impact of the content design, the software itself or the messaging within the application, versus the platform design, the hardware, on consumer utilization. This is getting to the human factors elements. There were no studies that systematically looked at human factors, barriers, although many of the barriers that came out could be seen as human factors related.

Finally, research needs and opportunities. The way these tools were described in the literature was so diverse and nonstandard, that it made the search extremely difficult. And in fact, we spent

a lot of time coming up with what we thought was a good search strategy, involving both our technical expert panel and our advisors, and then after we ran the search strategy, we then fed the results back to our experts and our advisors, and what we learned is that even after doing all that work, some major studies that our advisors and experts knew about didn't get picked up. And as we looked at it closely, we found that the terminology that was used in some of these studies was absolutely not what we would have thought or thought anybody would have thought to use, and the reason that's the case is because many of these studies again, are not being written by physicians or healthcare providers or healthcare oriented people. They are being written by social entrepreneurs, they're being written by engineers, bioengineers and mechanical engineers and others, and they have a different way of referring to same kinds of things.

And finally, the descriptions of the tools themselves, very nonstandard, very random, what's included and what's not. It's very hard to have any detailed way of comparing tools with each other based on attributes of the tool or anything else, and so we felt strongly that a consumer health informatics design and evaluation registry could significantly help comparison for a variety of reasons in this area. I'll stop there and I guess we'll open it up for questions and answers.

REBECCA ROPER: Rebecca Roper for AHRQ. So just to remind you that if you wanted to send us a question, you can use the Q&A function, which is the fourth tab in the top. We've already received a few questions. Thank you very much for the presentations and I believe they have, as intended, whet your appetite to pursue their work and delve into their EPC reports available today and in the future, as well as of course manuscripts that will be published in peer review journals. One question came up Dr. Lobach for you. With respect to framing which research articles you would include in your evaluation, some of the key questions had the requirement for a randomized clinical trial, others did not. Could you please elaborate on your expectation or objective in allowing RCTs to some extent, and using these for other questions.

DAVID LOBACH: Sure, thanks Rebecca. Just to give a little insight into the process we used to determine which study type we should apply, we did all the studies for our first key question, which was designed to focus on just sort of what types of studies were done, to the studies and decision support. So clearly, we needed all the different types. Then for the other questions, key questions two through four, we actually worked with AHRQ and with our expert panels, to say you know how - there's a pretty large volume of literature here, how do we best get a handle on it. And the guiding decision was, this is an evidence based practice report. We are really looking for the best evidence, and that's why we went down the path of looking at randomized controlled trials, to look at system features, outcomes and other impacts with regard to the generalizable knowledge.

REBECCA ROPER: Thank you. Dr. McKibbin, I'm going to pose two questions and then you can answer them in turn. So the question came up, one of our leaders listed, not quite understand what the term gray literature meant. And also, with respect to your presentation, will you talk about technology effected working relationships. They wanted you to elaborate on that and whether or not it was bi-directional, was it both positive or negative, or perhaps in different studies it had different impact direction. So, we'll just start off with, could you just elaborate on gray literature.

ANN MCKIBBON: Gray literature is a term that comes out of the information science, the library and science literature, and it basically describes non-journal articles. These are articles that quite often are technical reports. Certainly the public health agencies across the world put out an awful lot of these reports. Quite often they're internal reports. So to find the gray literature is quite often a challenge. There are several databases out there, but in many instances, the gray literature is very useful information. Working relationships, I'll answer the easiest one first. The effect on the working relationships was both positive and negative, and it certainly was bi-directional. When we say - I'm just looking for some examples to give you about what those working relationship effects were. Sometimes, I think maybe go back to the pharmacists. The pharmacists had to do some changing in their working relationships, in that they spent less time on the phone, so they did not have that informal communication with the clinician. The communications were more often electronic and sometimes the pharmacist missed the ability to talk on the phone with the physician. I think I'll leave it there and I'd be glad to extend the answer if someone wants to e-mail me.

REBECCA ROPER: Dr. Gibbons, since your report has been on the street the longest, and it deals with such an important issue, an often overlooked issue, the consumer with health IT. I just wanted to give you a little additional platform, whether there are some challenges or some inroads that you feel are occurring with respect to this area, and you can challenges left or some inroads that have been able to be achieved.

MICHAEL GIBBONS: I'm sorry, sure. I think actually, from our perspective, certainly my perspective, one of the biggest challenges is that this field is, at least in the past and to a great extent now, although I do think it's changing, is largely ignored by the healthcare system. The overwhelming majority of interest is on developing tools for hospitals and providers, which I'm not saying we don't need, we absolutely need them, but the statistic that I use to help people understand both the challenge before us, as well as the perhaps unrecognized fallacy in that approach, is that our healthcare system right now, the core of our healthcare system not the entire healthcare system, but the core is composed of about 700,000 doctors. About 300,000 of them are primary care physicians, the rest are specialists. There are about 2.6 million nurses in this country and about 5,200 hospitals and health clinics. And that's the core of our healthcare system, and if we eventually get to the point where they're all connected and all information from all patients can flow seamlessly to all institutions and all providers at any time it's needed, that would be fantastic, and had all the decision support that we needed to follow with all of those things, that would be absolutely amazing, probably reduce costs substantially and allow some improvements in health outcomes. However, increasingly, as we move into a new era of healthcare, where providers no longer just get paid for doing things, but they are increasingly in the healthcare systems in which they work, increasingly responsible for the health, improving health, the value based purchasing, et cetera, for whole populations of patients. Then what that really means is we have essentially 3 million entities - doctors, nurses and hospitals - that are responsible for the health of, as of the last census, 308 million potential patients.

And so you can see that just fixing the healthcare system alone, through electronic technology, will not get us to where we need to go, and we have to find ways of connecting people to their providers, to the healthcare systems, but also to each other and to the resources that they are

going to need within their homes and communities. The major killers are chronic diseases that you have for 20, 30 or 40 years, of which you're in front of a doctor or a hospital a very short period of time. So if we're perfect for those people who are able to see us only during the time they can see us and have no influence over the 20, 30 or 40 years when they're not seeing us, you can see that we only limit ourselves in our ability to help people be healthy. And when you think about it this way, it's hard to see how you can overcome these challenges without using technology in this way. So in our opinion, that's the biggest barrier. The good news is, patients are looking for this and in a big way, some social entrepreneurs and others are trying to meet the need, who are at the very beginning edge of this. I think this has huge potential.

And the last thing I'll say is, it's not just - this actually has real import for every provider in this country, as we even move through electronic medical records and meaningful use. Stage 1 has just been rolled out and Stage 2 is due to come and Stage 3 will come out in 2015, if it doesn't get pushed back. But it has to be fully decided what that will be, Stage 3, but in the legislation as it exists now, it already calls for in order for a provider to get full reimbursement at the Stage 3 level, to 2015 and beyond, they not only have to have these systems and use them, but the systems that the providers have must include advanced electronic tools for priority patient populations. And in our estimation, this is exactly - somebody who wrote that federal legislation recognized that we have to go beyond the providers and healthcare systems, and go to patients and consumer informatics. And in our opinion, an EMR that has a portal where you can schedule your patient visits and things like that is just not enough, it's just not going to cut it. So there is actually really importance to this field that will touch every provider in the not too distant future. I think I'll stop there.

REBECCA ROPER: Thank you very much. We at AHRQ truly recognize and appreciate what's been characterized through these EPC reports, and in our recent update of an overview of our different funding opportunity announcements, do encourage applicants to consider carefully if they are going to be pursuing this particular type of research endeavor, to consider the context of what has been found through these EPC reports, sort of the background work for any applications, just to emphasize how we consider them to be quite important.

Dr. Lobach, I have a question for you. Having conducted this research, what different directions or priorities do you think need to be pursued with respect to CDS research, knowledge management in general, for future investigations?

DAVID LOBACH: I think we can clearly see from this review that the field has advanced, and we've gone from studies just focusing on really four major academic centers where they showed it was effective, to now being able to say clinical decision support is effective at multiple locations, including community sites, and with commercially developed systems, not just locally developed systems. I think we've made a step forward, but I think the direction that needs to come next is beginning to look at the content of these systems and diversifying it to look at multiple comorbid conditions. I think that there are other places where we need to start looking at decision support that goes to other individuals, not just physicians, and this is a place where Dr. Gibbons' work comes in, and we need to start even thinking about decision support for consumers.

And then I think we also need to look at how we deliver the decision support. I mean, we have some insight from this current review, that talks about the important features, at least nine features that seem to be important for an effective system, but I think there's still more that we need to learn about sort of how to effectively integrate into workflow, because that seems to be where the failures occur, and you hit the alert fatigue or distraction, too much noise. Thank you.

REBECCA ROPER: Thank you Dr. Lobach. Dr. McKibbon, you had to process a great deal of information, sometimes it was contradictory in findings across studies, and it was difficult to articulate comparable findings because of different nomenclature, different strengths of the analytical plans, both conducted and articulated, and reported in the manuscripts or gray literature that you included. I was wondering if you'd care to elaborate on how you think we, as a research body, can improve our abilities to extract useful information from published reports.

ANN MCKIBBON: That's a good question Rebecca, thanks for sending it along. I would say it's not an issue so much as extracting information from existing published reports, but I think it needs to go one step before that, to how do we as the people who write these reports - excuse me Rebecca.

REBECCA ROPER: Yes. Ann?

ANN MCKIBBON: Yes.

REBECCA ROPER: You got cut off.

ANN MCKIBBON: Did I, OK. Where did I get cut off?

REBECCA ROPER: I think it would be best to restate it.

ANN MCKIBBON: OK. There is certainly nomenclature problems. Dr. Bill Hersh from Oregon has been talking about those sorts of issues quite a bit in the literature. The question was, how do we extract data in the articles. I think we have to go back one step and say, how do we get that information into the articles in the first place. There's a set of standards that are available now, that talk about what sort of information that needs to go into these articles, so that people who are doing systematic reviews or evidence reports for AHRQ, can actually pull the data out. So I would propose that we seriously, as a profession, look at meeting those standards in the articles that we do publish.

REBECCA ROPER: Thank you very much Ann. We have a few other questions that are rather complex in their phrasing, and so I will be sending those to our presenters, and then we will provide their response as appropriate, in the follow-up notes to this. I want to say thank you very much for the presenters' time and for listeners giving us time to encourage your awareness of these particular reports, and to phrase the questions, we're happy to follow up with our responses. And with that, I will say thank you on the behalf of AHRQ and look forward to your participation in further national webinars. Thank you very much.

FEMALE SPEAKER: Thank you Rebecca. I'd like to thank all of you for joining us today and for your participation. I'd also like to thank the presenters for their excellent presentations. Please take a moment to fill out the brief survey, in order to help AHRQ improve future programs. We certainly appreciate your feedback. You will be receiving an e-mail with instructions for submitting your CME certificate. The instructions are also on the credit tab at the top of your screen. Again, thank you very much for joining us today. We hope that you have a wonderful rest of your day.

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