

Use of Clinical Decision Support and the Impact of Clinical Decision Support on Workflow
October 27, 2008

Good afternoon. My name is Brian, and I am with the AHRQ National Resource Center for Health Information Technology. In just a moment, I'll turn things over to Dr. Jon White to introduce our panel and kick things off. I have a few administrative items to go over today.

All questions will be taken at the end. Questions will be guided via the chat box in the WebEx environment, so you can type your questions in at the end. Please make sure you select "All Panelists" from the drop-down box, so that all of our panelists can read the questions and respond. Also, I'll begin a brief pre-session questionnaire in a moment. It will pop up on the right hand side of your window. I ask you to complete that. There will be a post-event survey when you log off today to provide feedback about the session. Both items really help provide feedback on the quality of these events for the future.

If you have special requests, such as if you need access to the closed captioning part of today's conference, you can send a chat message to the Host, and I will make sure you get the link to that. Also, if you have other questions about WebEx or the event itself, please send those to the Host during today's event.

Welcome. I'd now like to turn things over to Dr. Jon White.

Hello everybody. I'd like to welcome you to the next in an ongoing series of teleconferences on the topic of health IT on how to improve the quality of health care. My name is John White as Brian said. I direct the health IT program at the Agency for Healthcare Research and Quality (AHRQ). It's our pleasure to bring you a series of distinguished speakers today who are leading thinkers in the field of clinical decision support (CDS) and how to use health IT to improve quality. The topic of today's teleconference is the use of clinical decision support and the impact of clinical decision support on workflow.

Our presenters today are Ben-Tzi Karsh from the University of Wisconsin-Madison. Briefly, Ben-Tzi Karsh, PhD is an associate professor of systems engineering at the University of Wisconsin-Madison where he uses human factors engineering to improve health information technologies including computerized order entry, bar coded medication administration systems, and electronic health records. He has co-authored more than 100 journal articles, conference papers, and book chapters.

Ross Koppel, PhD has been teaching sociology for over 18 years at the University of Pennsylvania. For the past seven years, he has been the principal investigator of an AHRQ-funded study at the university medical school on hospital workplace cultures. Dr. Koppel has authored or co-authored over 160 academic articles and papers, several monographs, several books, and book chapters. Much of his recent focus has been on health information technology. In the past three years, Dr. Koppel has authored nearly two dozen articles on the failures of health IT, focusing on ways to understand and correct its difficulties.

And finally, David Lobach, MD, PhD, MS is an associate professor and chief of the division of clinical informatics in the department of community and family medicine at Duke University medical center in Raleigh, North Carolina. Dr. Lobach is a Fellow in the American College of Medical Informatics and College of Physicians. His research interest in medical informatics includes developing and evaluation of decision support systems, electronic collection of information from patients and providers, and electronic health record systems. He is well-published in the medical informatics literature with over 50 peer-reviewed articles, and he serves as a reviewer for manuscripts and grants on informatics related topics. As you can see, you have a distinguished group addressing you today, which means it's time for me to stop talking and let them start talking. With that, Dr. Karsh...

Thank you very much. First it's an honor to be here with everybody and I also wanted to start with two apologies to the audience. I have a brand new and exciting sleep schedule because we just had our first child. The posted slides that you have have some grammatical mistakes. I talked to AHRQ about posting a revised, updated version so everybody can get hold of that. The second thing is I am sharing child care duties with my wife so there might be a small chance that my son will make his presence known.

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What I wanted to do is talk a little bit about clinical decision support and workflow. The three things I wanted to do are give a brief high level overview. I wanted to give an interpretation of why that evidence is so mixed from a workflow perspective and finally talk a little bit about what we mean by workflow and what are different ways to conceptualize workflow and whether or not we have integrated CDS with workflow at our clinics.

I wanted to start with this slide as a review of the evidence. This comes from a 2008 paper called Grand Challenges in Clinical Decision Support. As you can see, it's not all that rosy. There are few implementations that have substantially delivered and it goes on to say that those that seem to have succeeded have not generally been replicated. The evidence to date with CDS is not very good. I wanted to take a little bit of time simply to review a little bit of that not so good evidence that we have and we'll start with the good.

All the citations you see are at the end of my presentation where you will have the full references. You are aware that CDS can reduce things like medication errors. It might be able to improve the safety of medication use. And there is some evidence that it can improve clinician efficiency, meaning it might be able to save time. But certainly that evidence is very, very mixed. There is also some evidence that CDS when integrated into CPOE, or even with clinical reminders, can increase compliance with certain kinds of care guidelines. There's also some evidence that interrupted alerts, which are alerts that would actually necessitate that a clinician stop and deal with that alert, if they are well designed and integrated into workflow, we can have increased alert acceptance and in this case the one study showed up to 67 percent. Now, certainly that's not a great number, but I'll show you a little bit of the data in a moment that 67 percent is probably better than what a lot of others are achieving. It can also lead to faster diagnosis if it's well integrated.

On the less good side, you have evidence that some systems are doing a pretty poor job of identifying what are probably some of the most important things to identify--severe clinically drug-drug interactions. There are a variety of reasons why it may be doing a poor job from updating to not having the latest data. Back to those alerts. In review of these alerts, they're overwritten 60 to 96 percent of the time. So again, showing the previous slide, 67 percent might actually be a pretty good outcome in light of what it seems most are able to achieve. Dr. Koppel will talk more about these alerts.

Also, even when we have studies that have allowed primary care physicians to customize their alerts, we still have 88 percent of them being ignored, suggesting that customization is probably not the end all be all and that there are some other kinds of problems. CDS has also been criticized for being time consuming. The Veteran's Health Administration has spent many, many years and a lot of money, as their primary care clinicians rating their systems at best average. Recent review also showing that CDS has shown some improvement in terms of physician outcomes, but there's no evidence that they actually improved patient outcomes to date. So the question is why can we have these mixed results? What I'm suggesting is the reason for that is because we're having workflow integration problems. I think this is a really important point because what it means is that certain kinds of clinical decision support may be successful in one clinic or even in one part of that clinic, but that identical system might fail in another clinic or in another part of the clinic. That interpretation is shared by many others as you can see in these different quotes. These are conference studies of different clinical decision support where people are saying over and over again how critical it is to integrate CDS with workflow and recognizing if it's not integrated with workflow, there's a very high likelihood that we're going to have the systems rejected or ignored and that means both problems for the clinicians, patients and also problems with return on investment in those systems.

So clearly workflow integration is a key and what I wanted to do is transition to talk to what do we mean by workflow and what do we mean by workflow integration? At a very simple level, workflow can be thought of as the flow of work through space and time where work is comprised of three things: inputs, transformations and outputs. Work happens when inputs are transformed into outputs. That can be something physical, a physical action where the physical inputs might be a person's hand to pen to paper and the output is a written prescription. There is also cognitive work where the input is information, the work that happens is sensory perception of the word and a decision, and the output is the action based on that particular decision. There can also be information where the input might be electronic information, where the input is an electronic order for

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example, the transformation is it gets sent over to a community pharmacy and the pharmacist reads the order and dispenses that particular medication.

Now importantly, I think what's been missed in a lot of the research, talking about clinical decision support is the recognition that workflow actually occurs at multiple levels. I wanted to take a moment about what these multiple levels are. I think too often when people think about clinical decision support with workflow they think about pretty macro steps. Patient arrives at clinic, gets some information history and physical is taken etc. I think it's much more complicated. So at a very high level we have inter-organizational workflow. You can see some examples here. Workflow between a primary care physician and a community pharmacy. To the extent that CDS is going to be able to support a clinic and its needs, it is going to help integrate that organizational workflow if that's part of the CDS. There's a clinic level flow. The people and the information and the objects through a clinic. So again, CDS may have to support that clinic level workflow. So the information provided by the CDS needs to be available at the right times and the right places that the clinicians are going to actually need them for clinic workflow--the workflow that occurs actually during a visit. So it could be another physician started asking for a problem list or doing a history and is making diagnoses and coming up with a treatment. Again, because that's a dynamic process, clinical decision support really needs to be able to support those needs of the clinician during that visit workflow. Another kind of workflow that we need to be paying attention to is the cognitive workflow. Things like sensory perception of information for decision making. That may not be observable, but that's an important part from the clinician's point of view. I have an example here. A clinician may be asking for history from the patient but they're thinking to themselves and right now listening for acute problems they need to deal with. That leads them to try to investigate and focus on chronic problems. Because that's not obvious and it tends to be ignored decision support with workflow. And yet that's the dynamic workflow that's probably most important for us to make sure that decision support is going to be supporting.

So more about what is workflow. We need to think about, I mentioned this earlier, the types of things that are flowing. So people flow through space and time and because people can be located in different places in our clinics we have to make sure our CDS are available at the locations and the times they're going to need it and in different formats. And, so again, we need to make sure clinical decision support is going to be supporting where that information is and where that information is actually needed. Certainly we have objects that flow through space and time as well and it's equally important again that clinical decision support is available to support those. All those have to be supported by our CDS if they're going to be considered by the clinicians to be effective. So having said all that, we have to then ask what it means to integrate clinical decision support into workflow. From a human factor engineering point of view, what that means is that the CDS has to support the work at all those levels. Increasing the likelihood of clinicians rejecting or using the clinical decision support inappropriately has impacts for our patients. So this slide right here is one that helps explain what we mean by multiple levels of workflow and what we mean by integration. At the far left, you see the top piece of the puzzle which is the clinician HIT (in this case CDS) system. We showed that's embedded in a work group or unit, which could be embedded in a larger clinic and larger industry. You go to the middle to see how we define fit or integration at those levels. CDS systems actually fit within the work that needs to be done. We have to be concerned of the user technology unit and task fit. So the technology works for the primary users who are the clinicians the MAs, nurses, physicians and it has to support the task they're doing at those right times and located throughout that clinic where it's actually needed. As we move to the organization, we are concerned with organizational concerns. That can be the physical environment. That can also be the current prescribed rules for workflow or the current policies in those organizations. At the industry level, we might be worried about things like compliance with federal regulations. All those are ways of thinking about fit or integration that we need to be concerned for if we want CDS to work for the clinicians. You have the references at the end here and again I will be posting an updated version very soon. I'm all set and I will now pass it over to Dr. Koppel.

I'm going to speak about some of the evidence involved in clinical decision support (CDS) and about the way the alerts work or don't work with the way people actually practice medicine.

The question is, when we go from evidence based medicine to clinical decision support, there's a leap there. On some level we're going from a clinical trial, which was done on say 23-year-old weight lifters given one particular

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treatment or drug and we have to apply that to a 78-year-old patient with multiple co-morbidities whose liver and kidneys have stopped functioning quite a while ago. This is the leap, when we go from simple clinical trials to evidence-based medicine with flesh and blood patients and after all in a hospital people are quite sick.

A decision tree obviously is underlying CDS. Moving from this broad to specific is there an upside down tree?

There's an upside down tree. Now the next one is a closer approximation of the reality. Because what you're seeing there are the more likely cases in real medicine of a complex decision's system and of course the more complex it is, the more likely you're in need of CDS. Now in this one of which I can't see, you have many more branches and many more elements but of course, if it were that easy we wouldn't -- that easy.

Of course, when we look at EBM we have to look at the evidence that goes into it. I talked about the evidence based on clinical trials, but of course, the reality is infinitely more complex, and when you try to make clinical trials or evidence-based medicine reduce down to a case that has multiple illnesses and long history, it can be problematic. I will say that when we get alerts and clinical databases on a complete analysis of electronic medical records, the quality of evidence will be better. Okay. I'd like to look at decision trees still simplified, which I can't see a thing. What I'd say with this image if anyone can see it is actually even more simplified than it shows as complex as that is because it's missing the missing information and the gaps and the wrong information that physicians have to deal with when they try to do their work.

A large chunk -- 90% of alerts are overridden although few are overridden if they're tiered. One study of 300 overrides—300 of the those overrides (that is all of them) turned out to be medically correct. Now [as shown in the study, the fact that they were overridden] that does not mean that the medical advice given on the 300 alerts was wrong but it does mean they were annoying and unnecessary. The next slide, "types of CDS," shows that there are three kinds. Requesting help. There will be more on that. You should be clicking for each one of these items, alerts and alarms and order sets.

They tell you that something is amiss or the order set of course gives you more information. We'll look at each one in turn. Like requesting help. The first of this kind is "hide and go speak" I call it. There's information beneath the box. You might click on a drug and there will be additional information about it or click three times for more monitors. And then the third one is where you're connected to additional documents. So some of those documents may come up within other screens or may come up or they may be abbreviated.

Let's look at the alerts for medications and dosages. First type is the regular one. You get an alert. Second one is tier. The alert flashes on the screen and you can ignore it. The second one you have to acknowledge the alert and that would be a somewhat more dangerous intervention. The third one you have to click on it and type in why you are overriding it. Might say patient has previously tolerated this. You might read the previous statements of what was written. This patient has been taking this drug for 25 years and has no alternative.

The next two are very new and very specific. The first one is specific to the service. So for instance, oncologist, in the oncology warned about chemotherapy might be dangerous. Assume that people in that department do that all day. But a doctor in a different department might not. Provider specific is a brand new program being worked out in the Netherlands, where they are modeling, statistically modeling, the history of every medication that's prescribed by the doctor. If they see a doctor has a long history of no problems with XYZ drugs, they give no alerts. If you had a problem with ABC drug you get more alerts with that. The modeling would be wide. You would not have to be reminded.

This deals with the fact that people find ways of abusing even the most wonderful software. What we see is that people will put in a dosage and then if they don't get an alert they'll assume it's okay. I call that alerts as bumpers. It's a darn stupid way to practice medicine but it's extremely common. We also find if residents move from service to service or hospital to hospital, not an uncommon occurrence, they're getting different sorts of parameters given to them and that's also potentially problematic.

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The next slide on order set deals with the massive amounts of time that physicians are -- there are probably 300 committees going on with ten physicians each arguing about whether the overdose limit should be for one or two or three. I call that order set wars. But the basic point is that there is implicit CDS in all order sets. They're guiding what we do and what we think we should do.

Competing order sets. The same thing we saw before with the residents where as residents go from facility to facility, they have different competing order sets and that's not a great way to train people.

Trajectories of installation. The first element is where they just install off the shelf. Click once. Click again. It's quickly withdrawn when the physicians and nurses appear at the IT Director's door with pitch forks and shovels and torches. In fact, the real story at Cedars Sinai is not that they were horrified at CPOE. It was the CDS where one doctor told me, I'm 62 years old I really don't need to be reminded to prescribe Vancomycin three times before I can prescribe it. They're introduced step wise and in small increments. Then of course, you get the role of departments and powers and finally there's the issue of a tremendous amount of time.

Implementation rates on CDS are quite low. CPOE is used in about 16-17% of hospitals. CDS is used in 80 or 70% of those hospitals. We're talking about 12% of hospitals. We really don't know the success rates because very few hospital CEOs want to go on the local TV and say well we spent \$70 million on it and now we're pulling the plug because we can't find happy staff to work with it.

Another issue in achieving success is of course incorporating the physicians from the get go and recognizing that you should always minimize the number of alerts because physicians generally are not morons and they don't want to be reminded that Tylenol is a drug that interacts with everything. So you have to exercise a certain amount of organizational guts and when you find problems with the software, you have to proactively fix it. You have to be on the floor watching how it's used and correct the problems that are annoying.

We are getting better at this. We are improving the technology and we are learning from our mistakes. Couple of concerns, there is a school of thought which claims that they're sort of worried that young physicians who have never practiced without CDS, will not understand the process of thinking about these things and will rely on them more and more. Those are the same fight over calculator kids. I don't see the data showing that prohibits them doing arithmetic. But they're getting better and they will increasingly help. Thank you.

Congratulations, Ross, on your heroic efforts on not having your slides in front of you. It's a privilege presenting with Bentzi and Ross and I thank all of you for joining. My next 20 minute segment will go through actual examples of clinical decision support that's used in clinical practice through a number of projects we've undertaken, many of which have been funded through AHRQ. Before I go any further I am required by Duke University to disclose any funding sources I've had and also to mention that there is an intellectual property interest in the SEBASTIAN tool that I describe, it's one way of implementing a decision support server.

That said, what I want to focus on, initially is selective success factors for clinical decision support from a survey we did of the literature several years ago and talk briefly about the clinical support engine we're using for our given implementations and spend most of our time going over five different examples of using decision support in practice. And in the end share some of the lessons we've learned in the field.

So, to begin with, what are the success factors for decision support? This study was a randomized systematic review to identify the features of clinical decision support systems that were important for improving practice. We scanned over 10,000 manuscripts and we identified over 70 randomized control trials. Of these trials 68% showed significant improvement in clinical practice. To give you a feel for what those studies looked like 34% involved computer systems which generated some kind of form that could be put on a chart, 26% did not use an electronic system or computer, 16% dealt with CPOE and 81% chronic conditions, 23% acute, and 53% responded to therapy and 46% with lab tests and ordering; these were the types of studies we were looking up in order to do this analysis. The main finding we got from the multivariate regression is four features that are independent predictors of a successful system: You'll see that these tie in very clearly with workflow issues — the first one was

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the automatic provision of decision support as part of a clinician workflow. The second was providing decision support at the time and location of decision making, also important in pertaining to issues of workflow. The third item we identified, or feature, was the provision of a recommendation and not just an assessment. Not just saying the patient needs a medication but perhaps giving a specific medication that should be given daily. The final feature that was found to associate with a successful system was using a computer to generate the decision support, again could possibly be related to workflow.

Just to extrapolate a little more on the implications of these four items. If we looked at the systems that were successful and we found that any system that lacked any one or more of those four features we found it was only successful 46% of the time. In contrast, if the system has all four of those features it was successful in practice 94% of the time. We identified some important features that defined what enables the system to work well. I want to talk briefly about the decision support tool we're using within our applications. We call it SEBASTIAN. It's an acronym and you can see that on the slide [System for Evidence-Based Advice through Simultaneous Transaction with an Intelligent Agent across a Network].

Just to give a high level overview of what we we're trying to accomplish. We notice a lot of knowledge resources ranging from guidelines to HEDIS metrics, basic performance metrics etc. We are also aware that there is a lot of data that's available in clinical settings, claims data. There are many ways to see that data. What we were trying to do with the SEBASTIAN tool is to come up with a way that we could reutilize the knowledge through a centralized resource that was scalable and portable to other systems and that was essentially external in one application. That's what we tried to do in the different systems we're going to show you next. I will walk you through five different systems and illustrate the decision support applications. Some of these you are going to see align with what the previous presenters talked about and other places where we could have made some improvements. Those are some examples of real world settings. The first system I want to talk about is a tool we created for chronic disease management and this was implemented within the university health system.. And the goal of this tool was to provide guidelines-based support for chronic diseases at the point of care.

Just a few comments about the health system, it's an academic medical center with two affiliated community hospitals, there are over 100 affiliated academic and community-based clinics, just over 2500 physicians in practice within this system including faculty, residents and fellows. We have 60,000 admissions annually and over 1.4 million outpatients. This is a fairly large system. To give a quick orientation to see what the workflow might be, the slide I'm showing now is the viewer into the clinical data repository for the Duke Health System and on this slide you can see it lists all the available data that you can accumulate for this particular individual. You can use tabs to filter the data so you don't have to look at everything at once. To get to decision support you would have to click the summary tab or the DM—disease management tab. If you click that it will take you to a tab interface that highlights the three currently available decision support components. If you select to evaluate the patient for diabetes it will return this screen. What's on this screen is a list of the 13 items that are being tracked for diabetes derived for national guidelines, it also pulled in data that is available pertaining to that particular guideline and any relevant information that the data was last done and... the decision support piece is telling you whether that particular item is due now or not due but should be considered, as you can see highlighted in the status box. We also include a way to gain more information, something I think Ross mentioned in his presentation, you can click on the question mark and pull up a screen that takes you to health information that gives you more information about where the guideline came from and what the essence of the guideline is about. The system allows a user to put in observations that pertain directly to the guideline or to something about the patients, so you click on that section and it will bring up a box.

Click again and it will highlight the surgical exam information that wasn't collected elsewhere in the medical record. This is a way that you can adjust the particular guideline, based on the patient's current situation.

Then I'll shift to a different system and this is particularly focusing on diagnosis and management. Specifically on diabetic eye diseases in this project for seeing in private practice for ophthalmology and optometry. And the goal here is collecting complex clinical information at the point of care and then to provide diagnostic decision support to encourage care documentation, staging and quality.

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The project was funded by the National Eye Institute. Part of our challenge is illustrated by this example of these ophthalmology notes. You can see in the red box here that this note is hardly structured and there is a fair amount of information contained here but it is hard to discern. And you can see there are a bunch of comments but they're not accessible for decision support.

Part of our challenge here was to find ways to collect information in a structured format. We have to support the drawing indexes and you'll see a box where we made this structure using information that they recorded on the diagram, so we could use it in decision support.

This slide illustrates the physician support tool at the end of a visit after the data is entered. The system would let them know a particular stage is based on the data provided. It shows a diagnosis that would be fitting for that stage. It would allow the provider to modify that particular stage and provide a representative sample diagram or photograph that was consistent with the stage that had been selected. So, validate or verify what was being advised. From the field, prior to this study, there was about 30% of the time when the staging was done incorrectly and we're hoping to make an impact through that particular study.

This is the third example of the decision support. This is a clinical decision support system for population management. This is being done in an urban setting involving urban and rural safety net providers for Medicaid beneficiaries in this 6 county region in central North Carolina. In particular, this is focusing on improving utilization and care quality of a population. This is not just focusing on individuals who come to the clinic but an entire cohort of patients who we are monitoring independent of whether they come in for clinical care.

We are using a system that is referred to as COACH that is an acronym for Community Oriented Approach to Coordinated Healthcare in a health information exchange. This system receives and displays external billing, claims and clinical data from five hospitals, eight clinics and the North Carolina State Medicaid Office – it supports care management activities for two care management teams and we also connect with five hospitals, 34 primary clinics, urgent care facilities and government agencies—from the health departments to the Department of Social Services. So we are currently servicing over 40,000 Medicaid beneficiaries.

This is a screen shot from the COACH system and shows the viewer what would be used by care managers and others to access the available information in the health information exchange. This highlights the tabs that can allow you to drill down to different sections and different parts of information that are available. We also collect multiple identifiers for a given patient so that we have a type of medical record index—a health information identifying index in the system so we can pull together data from multiple sites. I'm just going to walk through a flow of information in the interface so you can understand what the workflow might be. We pull in data from community partners, as well as data that is entered by patients into kiosks. That goes into our COACH system, which we then move to a query database, which is queried by the SEBASTIAN decision support tool. This tool can send out email alerts that go to care providers. It also can send out feedback reports which are summaries, so if patients find a particular clinic the report can go to clinic managers and then send out reminders directly to patients. There are three different modalities of communicating information and evaluating those in a randomized control trial. I will show these different communication examples.

This is an example of an alert that would be sent through email. It highlights a particular incident that happened for a patient. In this case there is a frequent amount of emergency department utilization. When we have to focus on a particular patient we also use decision support to identify other issues that could be addressed while working with this patient, particularly with adherence measures that were not completed. We have a way to assign a priority score to this alert so they come up in priority order for the care manager who incidentally restructures workflows to become very central to how they spend their week taking care of patients. The next slide is another version of the feedback report that would be done in a clinic. The information is similar to an email alert. You'll see that this specific clinic had over 2,000 Medicaid patients enrolled. We will send the top two or three hundred patients who have care needs identified through a decision support system. The information addresses care seeking behavior as well as care needs for diabetes, health management needs and

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other health issues. These reports are sent out quarterly to clinic managers. The patient letter was particularly created so they could be focused on a particular clinic by using letterhead from a particular clinic. We focused on the particular issues that a patient could address to him or herself. And incidentally we were actually able to use the same rules for diabetes across multiple applications and similarly across the decision support system. These are examples of how we're doing population health. In this next slide we are going to talk about the medication management project that we're in the process of getting ready to go out in the field for. This involves 14 primary care practices and their affiliated care managers who are serving Medicaid beneficiaries in our 6 county network. The goal here is to improve medication adherence to evidence-based therapy for high-end priority conditions.

The next slide is just a little more about this project. We try to deliver point-of-care information about filled prescriptions. We also include evidence based pharmacotherapy recommendations related to 7 priority conditions including heart disease, hypertension, congested heart failure, stroke, asthma, COPD and diabetes. And again, there are 14 clinic sites that are being notified as well as the care managers who are servicing the 14 clinic sites. We're starting reports in March that we have tests already in process. This slide shows the intervention in the summary before we pull in data from community partners. That data goes into the COACH network and moves into the query database followed by SEBASTIAN. In this case, we're sending out the medication management reports to clinicians who work directly with patients. On a different arm of this project we're sending out email alerts to care managers who then can work with the clinicians. The clinicians are the ones who directly change the medication management for the patients. We did not have care managers changing medication recommendations for patients directly. This is a sample of the medication management report. If you click you'll see that it identifies a particular medication by class. On this report we provide a summary of the days covered in a diagram so that you can see where a particular prescription was filled. We calculate a percentage of dates covered by a particular medication as well as the medication class. Then we highlight anything that's less than 80% coverage for a given class. Because we know what conditions these patients would have, we are then able to provide pharmacotherapy based recommendations suggesting that this individual should be on an ACE inhibitor or because they have diabetes and hypertension or maybe because they have heart disease and you can see that they are being covered by an ACE inhibitor.

The last example I present relates to clinical decision support for care transitions. This again involves the 6 county regional health information networks that are seeking to increase the awareness about care transitions to augment information availability across those transitions. In this particular project, we are identifying care transitions that include hospitalizations, emergency department visits and specialty care consultations. We are sending notices to patients' medical homes or their primary care clinic but also sending notifications to the patients and the care managers so that this is going to be a three arm evaluation project. We will be then requesting information on behalf of a patient assigned a medical home relating to the care provided for transition. Such as the ED encounter notes and specialty consult notes. Just to present a flow of information, we received data from multiple sources, these flow into the COACH system, move to the query database and then they are submitted to the SEBASTIAN system. From this system we generate the events reports, which I'll show you in just a minute, and they are sent to the patient's medical home. We are also generating letters that go directly to the patient and we are generating email notices for some the patients that go to the care manager so they might be involved in facilitating getting patients in or helping with care transitions. We are then sending a release of information request on behalf of a patient's assigned primary care practice, which goes to a care site to the hospital's emergency department or specialty clinic and then forwards on to the medical home directly and they can then service the patients by having that additional information.

The next slide is an illustration of the event report. In this report we highlight the particular individual and this is geared toward a particular patient's assigned medical home. So we have the specific individual-- care transition that transpired and some relative information that we can obtain from the claims data about this event. We also highlight any appointment information that we have for the patient within our system. We highlight any previous encounter activity that this patient has had within the last 12 months or 12 encounters. On the bottom of the sheet you'll see we have information related to the patient's medical home like who might have seen them last so they can make appropriate connections, perhaps with a primary care provider who is working at the assigned site. We also have a disclaimer at the bottom. This just highlights that this is all derived from claims data

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and could have some inaccuracies because it is claims based. The next slide illustrates the sample notice that would be sent to a care manager regarding a care transition and then it highlights the specific transition that has occurred to make this care manager aware that one of their assigned patients has had a recent transition such as a hospitalization discharge that they might be able to follow up on. And we are able to detect the discharges within about anywhere from 24 to 48 hours after the event has happened. So they can follow up fairly quickly.

The last example here is what we're doing to facilitate information transfer. We will send a written request for release of information on behalf of a specific site where a patient is assigned as the primary care center. It highlights these specific individuals and a particular care event that we are interested in gaining information from. It sends the information directly to that site. It doesn't go through our system but directly requests to release information as if it were sent from the primary care site itself, again this will facilitate the flow of information.

I want to share a little bit about our experiences. These I've divided into three categories. This pertains to working with diverse stakeholders. The politics, which involves working with the systems, institutions and their policies. Then lastly the pragmatism, which is where the rubber hits the road on what we wish we had known sooner.

So with regard to people issues one of the biggest challenges in working with decision support and workflow issues is controlling expectations. Say you're going to provide one type of decision support, they will usually have a lot of other ideas for ways they would like to have the systems implemented, and that can also lead to scope creep. It's a frequent problem as many of you know. There's also the issue of getting buy in from the end users and we have learned that getting end users involved early on through focus groups and other means can be extremely helpful to decision rules and to the content of the information that is available and that might be going out to patients. We also involve patients in focus groups to comment on the things that they'd like to have in letters. Finally, creating familiar associations like we did with letterhead from clinic sites so you create a context in which to deliver the decision support.

With regard to politics—one of the biggest challenges is being able to obtain data from our partner sites to create the health information exchange. Working in this environment we have to comply with HIPPA regulations. Working with the IRB has been a challenge at some level because they think of everything as a drug and don't quite understand information intervention as a form of therapy. Working with our community partners has been a challenge and a pleasure in terms of getting them involved. Getting along as partners and not just excluding—not just using them but making them partners in the process. Working in the community setting can be challenging because there's different levels of health information info-structure that you have to work with. And then even navigating our own academic institutions where folks aren't as accustomed to using information as a therapeutic modality for decision support.

Some of the things we've learned, I know you have already heard this from the other presenters, limiting the volume of notification, coming up with ways to prioritize, just making crucial notices come to the top. For example we topped the number of alerts for care managers to 25 a week because they were overwhelmed with more than that. Another point that we've learned is that we have to provide the right content in the notices. This is what we learned from our end users that wanted to have specific dates and specific values. The more specific we could be the more valuable the decision support was. We needed to accommodate some flexibility, either based on provider indications or on specific patients and be able to record that in the system like I said with the disease management for diabetes.

Another key point is making sure that when you do tell somebody something, it is accurate. We found you may get as many as three strikes with a clinician before they completely tune you out.

Learning from local configuration of a clinical decision support is a little controversial, we found in some settings that it is going to be absolutely necessary if we were going to proceed and get by with a particular set of users. Similarly, configuring the decision support for individual patients, these general rules don't apply and the

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providers want to be able to make those kind of adjustments. For example, mammography may not be indicated in someone that's had a bilateral vasectomy because they want to be able to adjust and increase the recommendations accordingly. Finally, there is really understanding the data well. We get lots of different data from multiple different sources and we've really had to accommodate those differences in order to generate accurate physician support in order to understand the data we were receiving. So in closing, I want to acknowledge the many people on the team of the Division of Informatics and the Division of Community Health within the Department of Community and Family Medicine. As well as other groups at Duke that helped us with statistical support and collaborators like AHRQ, Duke, HRSA, and others.

Concluding are a few publications that relate to today's work. Again, thank you all for your attention.

Thank you very much. Can you take us back to the chat? I wanted to thank our listeners as we make our way through the technical difficulties. I would observe that I think far and away this is the most participants we have had on one of these calls and the mode may have been much or the slide complexity -- I appreciate you bearing with us. I encourage the participants to use the chat function as we enter the discussion phase of this. We've had great presentations talking about the critical importance of human factors and how not considering human factors can screw things up. If you wish to submit a question, use the chat box and send it to all panelists. I'm going to turn to our panelists and ask if you have any comments on each others' presentations that you want to share with the group.

No problem. We have great questions rolling in. So we'll start with the top question, which is how can informaticians help spur clinical decision support adoption from local to national levels. Standards? More clinical support tools more trained individuals. Where can we get the most bang for the buck?

It's a great question. I definitely don't know the right answer but I'll give you my bias. I think we have to actually start with better designed tools. All the standards in the world and all the training is probably not going to help stem the tide of rejecting clinical support if the tools aren't designed to meet the needs of the clinicians. One of the things we know from decades of research on decision support systems throughout industries is that to the extent that a new tool requires more physical or cognitive effort than what was the standard status quo, the less likely it is to be used. So if the tools continue to provide support at the wrong time, I think people are going to keep rejecting it. I would say we need to invest in making sure we have well designed tools that are easy to use and secondly, that there's a compelling clinical case for the tools. That is, they're obviously going to provide utility to the clinicians.

Ross?

Can you hear me? Yes. I'm not sure what the answer is. I sure as heck have one suggestion that I think is important. That is, it is completely and absolutely nuts that there are five thousand hospitals, each working at its own set of order sets and its own alert levels. If we believe there's something called evidence-based medicine, if we think we learn from experience, then why can't we have a national guideline for alerts and for order sets? Yes, I could see if one community has a greater proportion of people who are obese or something like that. Some slight modifications might be appropriate, but the idea that each institution, each medical practice, each nursing home is hacking this out separately is anathema to all we supposedly believe in the 21st century. I'll stop there.

David?

I echo what Ross just said. Part of this is generating national resources so that everybody doesn't have to reinvent the wheel. I think the other thing is we need to make the right thing the easy thing to do. I don't think that we've done that enough so I think it really is taking it from two ends. The grand scale which is getting the national resource available, but also at the very local level making it easy to do the right thing. I think we need to do more to gain more understanding on how these tools work and integrate this on a broader level.

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I think that's a great point. My boss often boils it down to making the right thing to do, the easy thing. I'm going to bundle a couple of questions here. I have a couple that are directed at David Lobach. I'm going to put these together. How do you plan to move the clinical decision supports at the time of decision making?

Well, SEBASTIAN is a rule engine and we could work with an application that works at the time and place where decisions are made so the private different applications that I showed were different ways of using SEBASTIAN to deliver decision support at the point of need. It's important to recommend the knowledge but then working at the logistics of getting it to the point of care is where the challenge is and going into the workflow, understanding the workflow and figuring out what information is needed by whom. I hope that answers that question.

I think that's close. Let me get you specific with you. Are you working with the folks who support or implement the clinical tools whether it's electronic medical record or at the time of decision making to try to get the decision support into the clinical workflow at the time when some of these decisions are being made?

Yes. We work with -- it varies from the project a little bit when we work with the community partners where there's a little less technology presentation. In some cases send us a fax with the medication management information in it and they'll do the work with putting it on the chart. We worked with the health technology folks on the operational side and developed a tool that fit directly into their existing browsing tool that looked at the clinical repository for Duke. We look at what the environment is going to support and work accordingly.

So piggy backing off of that is the next question. Has anyone looked at CDS impact as a function of charting habits. So in other words trying to fit with a particular clinician's particular workflow to do all their charts at the end of the day or at the time they do the visit? Has anyone looked at that that you're aware?

I can't remember any specific studies where applications have done batch decision support feedback reports that we use for the community health project. I can see in general that batch methods are less effective at really presenting information at the time and the point of decision making. I should allow my colleagues to comment.

This is Ben-Tzi. I don't know of anyone who has studied that systematically. But the interesting thing is integrating CDS and workflow, what is the workflow even without CDS that might best support the clinician. One problem with charting at the end of the day that all of you who practice know, is the need to remember things and many of you will try to jot down notes to try to prompt you to remember and many of you who do that sometimes an hour or days later, something might have been forgotten. Design to help facilitate charting during the visit.

Okay. This is Ross. First of all I think it's a fabulous question. The second thing is there's already an issue of the quality of the physician's attention when she or he is talking with a patient and trying to enter information into the electronic chart or into progress notes. If computer decision support notices were to come up while the physician were doing that that would be another source of distraction. On the other hand it might be extremely helpful information. There's always going to be a trade off but one that should be examined.

The next question is to Ben-Tzi. Are there specific technologies to give guidance on how far to go on workflow modeling. And your answer cannot be all the way.

It's a very good question. So workflow modeling can be done in many, many different ways. There isn't a particular method that I would recommend. I think the important part of the workflow modeling is to understand that what we're trying to accomplish is we're trying to understand what it is that the system needs to support to make it effective. We need to understand what the needs of the clinician are when they are using the CDS. We need to know how things are supported in intra-visits and among the different clinics. A particular application or a particular method, I don't think matters as much as making the choice to try to figure out what are those actual needs that the CDS has to support. To that end there are all kinds of workflow model design techniques to make sure that even if we think on a macro level supporting workflow does it actually improve reaction time? Does it allow the visit to go more quickly? Are decisions to be made more accurately if it's being used?

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It's important to make sure that we try to consider the different facets, what are the requirements that are CDS has to achieve and we're understanding how that flows.

I guess I would add one other quick comment. One thing I would recommend now I'm thinking more about it. I don't think anything can replace actual observations of the work being done. Even if you bring together a bunch of clinicians from your clinic in a room how do we do things here? There's so much missed because of how many steps and how many steps are internalized. That is a necessary first step is to spend some time actually observing how work is conducted as a baseline.

I'll add my final comment. I think it's a great point. It's a real valuable tool thinking the director health IT program, how do I do that with 160,000 practices of 2-3 doctors at a time? You can't do it for all of them. You can do it for exemplars of them. That's why you do a sample. With that let me bundle a couple of other questions here.

The first are there any clinical decision support systems designed to support nursing practice? What has been your experience with clinical decision support with non-physician clinicians and the third was addressed to David, but is relevant to this. Is your filled prescription alert project involving pharmacists in the community/retail setting?

I know the physicians' assistants are working on clinical decision support systems and they face the same issues that nurse practitioners face in terms of prescribing and integration with CPOE. Nursing clinical decision support is extremely active and a major new thrust within the field. The answer is yes.

I would agree. I also define call decision support. Electronic nurse charting and bar coding administration records are clinical decision support systems because they are presenting the nurses with information that they need to care for the patients. So certainly those have been studied, implemented. In my experience and this is only anecdotal, the nursing staff I've seen that have begun to use charting with EMAR, if they don't like it they tend to acquiesce and fight through it. They are less likely than the clinicians to outright reject or change things at a very high level. They feel more like -- they feel as if they have to accept it and fight through it which is not always the best for care.

From our experience, we are working with nurse-practitioners and physicians assistants in the settings where we worked with some of our point of care clinical information and within that community project is where we involve non-MDs, we are sending alert information in decision support information to potentially non-licensed care managers to facility access to care. This has been quite beneficial. We're also involving other groups who are part of the safety net. Some of our alerts go to people who work in the health department, not even part of the Duke health system because they were the ones best situated to act on the notification. We already made decisions for a number of practitioners looking for the best person to act on the information. With regard to the medication management alert involving pharmacists and local pharmacies, we have not included them in that project. The goal was to help the providers be better informed about what medications patients need. Pharmacists have information in their pharmacy system provided the individual filled all their prescriptions at that one site and what we are trying to address is the clinician who thinks they prescribe something and the patient is taking it, when often we're trying to provide information to inform the clinician about what the patient is actually filling from the pharmacy--which prescriptions are being filled.

Okay. Great thoughts.

I'll note we have about ten minutes left in the teleconference. I'm going to thank our participants for sending questions. There's a lot of great questions here. I'm going to say I'm not going have time for all of them. I'll do my best to get them all in. Don't take it personally if I don't ask it.

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One I will throw out to the entire panel how do we address tensions of private information versus public? How do we address the tension between these public sources of funding like NIH, or AHRQ, and private developers of these kinds of information and logic support systems. How do we settle on a good place between those two? Any thoughts are welcome.

This is Ross. I'm just going to make the waters more muddy by adding a sort of corollary to that. One of the reasons why there's no national decision support structure is that the vendors are reluctant to be sued if they put one or another system in because they would possibly be responsible if somebody following those guidelines messed up.

Nothing like muddying the waters.

That is a tough question because in part, I think the development can be funded through public funding like AHRQ does but when it does get down to what's involved in maintaining it, there's a lot of resource that goes into that. At least within our United States, it's tended to be better served within the private sector because there's an incentive to keep things up to date and decision support is continually changing, the rules are changing, the support is changing. It has to be about balance -- the fact that it hasn't taken off -- not found the right fix on how to do this. A path way to explore, would be a commitment to not only create the initial tools but to support things on an ongoing basis as a national resource. I would be interested to see if that would be possible.

Anything to add?

No. I really don't know how to address that.

Carefully. We at the agency fund a lot of research about decision support so it's something we have been considering for a while and I appreciate your input to it. Let me get down to a few brass tacks questions. Has there been a change in the length of time of an ambulatory stay in CDS with your representative institutions?

What I'll say is I conduct research on a number of institutions and depending on what the CDS has been and how it was implemented, the answer has always been yes. The question is it can save time and sometimes it lengthens time.

That particular parameter we tracked is hard to measure sometimes the length of an ambulatory visit. The process measures and testing are significant.

I'll ask you a related question which says, the same system in the same clinic can impact clinicians in great ways. Which clinicians may have problems with the clinical decisions support idea in general?

There have been those studies, both in health care and outside of health care. They tend to show there's some percent of studies that show older people are more likely to reject it. Younger people are, women are, likely to accept information technology more than men. I think in many ways the studies miss an important point which is from a design point of view our gold standard should be to design for a range of users so that's sort of the baseline philosophically. Design should accommodate the range. We're going to have older and younger clinicians. Some who's vision is worse and need larger lettering for example. I think we have to believe that all of those doctors and pharmacists are equally important and the goal should be not to figure out how to tailor but how to accommodate that range of flexibility.

There's lots of different users out there. We have to be able to support them.

I can say this -- they have all kinds of alerts and alert fatigue takes a very slow physician about 10 minutes to develop and the smarter ones about 2 minutes.

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Okay. One of the things I guess to keep in mind when we are able to, is to design for the people who we might want to call the biggest problems; that actually helps everybody else. If we found a way to make it easier and useful for the "difficult group" it's going to be more easy or useful for everyone.

Okay. I'm going to take time for one more question. We're about two minutes away. I think I can roll up a couple of questions to this. What can you recommend to ensure successful buy-in from the users of the systems that you implement and then study?

This is Ross. Study what they're doing while they're doing it. People are terrible reporters of their own actions. You have to shadow them and ask them questions about why they are acting. You can't assume they know in advance what they want. You can have to keep on looking and being vigilant about correcting the stupid parts so they don't annoy people continuously. Period.

I was just going to comment that I think one of the things we've learned is sort of like what Ross is saying. We do try to get the users engaged very early on through focus groups and discussions when we are bringing in the decision support tool in their area. We ask what they're looking for and really try to understand the workflow issues. We also go back to the study I presented that is associated with CDS success factors. We try to make sure we address and have all four of those included in anything we create.

I would also add that it's important to think about these HIT tools in the same way we might new medications and that nothing actually replaces good testing. A particular design would work but actually having a lab in which you can bring people in and again measure how quickly can they respond? How accurately do they respond? This could provide you with hard data to tell you if they're being integrated effectively.

I wish I could ask for applause for our panelists; sadly, this is one of the downsides of the virtual world. I want to thank our panelists for a well spent hour and a half. I want to thank our participants for wonderful questions. Sorry I couldn't get to them all. Brian, do we have any closing polling issues for our participants to address?

No. When people log out of the session a survey will pop up. Fill that out and provide feedback on today's event. We apologize for the technical glitches.

Thank you everybody and appreciate your participation.

Please save the date for our next event on CDS; it will be on November 18th from 3:30 to 5:00 p.m. eastern time. We'll send out information on how to register for that shortly. I want to thank Jon and the rest of our panel today too. Good presentation.