

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

Our moderator for today is Dr. Jon White, the Agency's Health IT Director. I would now like to turn things over to Dr. White, who will introduce today's speakers.

Thank you very much, and good day everybody. You have joined us today for another AHRQ National Resource Center for Health Information Technology National Teleconference. This is one of a continuing series of teleconferences that the Agency and National Resource Center holds. This brings to you the best of the best, folks who are out there working on health IT and using it to improve the quality and safety of care in ways that are innovative and are going to make a difference in our healthcare system. So I thank you for joining us today. We have a wonderful group of presenters today. I'll get to them in a second.

The topic is, "Smart Forms and Quality Dashboards;" and what I want to impress on you briefly is that the use of Health IT simply for the sake of using Health IT is not going to help us in our quest to improve quality and deliver better care to the folks who need care. We need to use that information technology smartly, and we need to use it in ways that are thoughtful. There was an article recently published -- one of our presenters is a co-author of that article -- that indicates that simply having an electronic health record really doesn't improve the quality of the care that you deliver. And to that end, IT can make tools available which providers and others can use to improve the quality of the care that they deliver.

Some of those tools are Smart Forms and Quality Dashboards. And I'm not going to talk extensively about those now; I'm going to let our presenters talk about those. But we're really glad to hear from them, and they've been doing very exciting work for a number of years. We've been delighted to support them. So we're looking forward to hearing about what they have to say.

So with that, we'll introduce our speakers. Our first speaker is Blackford Middleton. Blackford is the Corporate Director of Clinical Informatics Research and Development, and Chairman of the Center for Information Technology Leadership at Partners HealthCare System, and an Assistant Professor of Medicine at Brigham and Women's Hospital, Harvard Medical School.

Dr. Middleton serves on the Boards of Directors at the Catholic Health Initiatives healthcare system, the American College of Medical Informatics, where he was Treasurer; the Medical Knowledge Institute and MassPRO. He was formerly Chairman of Computer-based Patient Record Institute and also of the Healthcare Information Management and Systems Society. Dr. Middleton is a Fellow of the American College of Physicians, as well as the American College of Medical Informatics, and Health Information and Management Systems Society.

Also presenting today is Dr. Jeffrey Schnipper. Dr. Schnipper is an Instructor in Medicine at Harvard Medical School, an Associate Physician at Brigham and Women's Hospital, and Director of the Clinical Research for the Pregnant Women's Foster Hospital Service. He is an internist and hospitalist caring for pregnant women and patients on the general medical wards. His research interests focus on improving the quality of healthcare delivery for general medical patients. Dr. Schnipper is a member of the Society of Hospitals Medicine National Task Force on Improving Inpatient Diabetes Management for Ideal Hospital Discharge Committee and Co-Chair of Scientific Abstracts Competition at their national meeting.

And, finally, we have Lana Tsurikova who is a Research Project Manager at Partners HealthCare. Her primary research interests focus on the use of computer systems to improve the quality of healthcare. Subject areas include communication among healthcare providers and their patients, safe and effective medication use, and improving clinical decision making.

And with that, I will turn it over to our presenters, and we're looking forward to a great discussion today.

Thank you very much, Jon, and good afternoon to everybody. I hope all are enjoying the summer, and it's our great pleasure to be here with you and for me to represent a large team that has been working on this research at Partners HealthCare.

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

My name is Blackford Middleton, and Jon has already done too much of an introduction; so let me just jump right in. I will be conducting this presentation with Dr. Jeffrey Schnipper and Lana Tsurikova. We have quite a number of slides; but hopefully we will be able to step through them in about an hour and leave plenty of time for discussion.

We were very fortunate in being funded to study Smart Forms and Quality Dashboards by the Agency for Healthcare Research and Quality during the value phase of grants made in the 2002 time frame.

The presentation today will provide a very quick introduction to Partners HealthCare to establish context for this work, and then describe the infrastructure with which this work is being done at Partners -- the Informatics Infrastructure; talk about the Smart Forms and Quality Dashboard study design; and then give some highlights with screen shots of the technology and what the capabilities of the technology are. Then we'll talk about our preliminary results from the evaluation and randomized control trial supported by AHRQ.

Partners HealthCare, for those who are not aware of what this integrated delivery network or system is, was founded in 1994 as the merger of Brigham and Women's Hospital and Massachusetts General Hospital. It now includes approximately eleven hospitals in the network; a large group of community-based and academic physicians in the Partners Community Healthcare Network; an affiliated cancer hospital, Dana-Farber, and two rehab hospitals.

The important thing about Partners HealthCare is that it is now supported by common clinical IT personnel and staff, not necessarily systems, across the entire environment. The information technology environment here is simply dramatic and vast. There are many, many devices attached to the network, lots and lots of users' accounts and locations of care and services, many servers, applications, and active projects, and now over 1,200 employees in the Information Systems Group headed by John Glasser in nineteen different locations.

The point of this is to establish the context as being a highly complex academic medical center environment with many, many different applications and services -- both clinical and financial -- in place and in use.

We are fortunate in having very strong leadership at the very top from our CEO, James Mongan, who brought forward his signature initiatives in the 2002 timeframe where he wanted for all of Partners HealthCare to seek care that is safer, better coordinated, more reliable in delivering proven interventions, and bringing forth systems that make it easy to do the right thing in all of our care delivery encounters.

The good thing is Dr. Mongan recognized the importance of information systems technology and infrastructure. And while the signature initiatives 2, 3, 4, and 5 focus our attention on enhancing patient safety; enhancing uniform high quality care; expanding disease management programs; and improving cost effectiveness of our care delivery, he recognized that underlying those signature initiatives 2, 3, 4, and 5, there needed to be this information technology infrastructure or investments in quality utilization infrastructure in information systems and other programmatic elements to support those signature initiatives.

So in many ways I oftentimes say, "I feel like a kid in a candy shop." For example, we are now marketing in the Boston environment with these advertorials that have appeared in the newspaper, etc., and how important we feel information technology is to our care delivery processes. There is, for example, an advertisement that appeared in the Boston Globe showing the mouse as being quite possibly the biggest development in patient care since the telephone. And I won't belabor the small print here; but if you'll allow me one more, here is the picture of an ancient Egyptian hieroglyphic tablet where it says, "No one

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

should have to decipher your doctor's handwriting to give you the right prescription." So it's a good environment and, of course, there's been a long history and tradition of doing research and innovation in IT here.

This context establishes the business goals that drive our IT objectives, of course: enhancing patient safety, uniform high quality care, disease management, cost effectiveness, and improving patient care access and convenience. And these business goals drive, then, IT objectives which partly informed and guided our research objectives as well. You want to support the key business initiatives through designing and implementing IT infrastructure that does the things you can see here: bridging system silos, achieving enterprise wide interoperability of data and information, managing knowledge to achieve these uniform best practices, and then making these results visible and transparent so we can drive process improvement.

One of our key objectives underlying both Smart Forms and Quality Dashboards as well as a new enterprise architecture for information technology -- particularly the clinical systems information technology -- is our movement towards services-oriented architecture, or what we like to say as "progressive homogeneity via SOA." Our environment is hugely heterogeneous. We have one flavor or one incidence of almost everything you can imagine -- whether it's a vendor-based product, EMR, or CPOE, or clinical data repository, or what have you.

But across all of this heterogeneous infrastructure, we are attempting to lay on this services-oriented architecture -- which in a nutshell can be simplified in the next two slides. In a world of heterogeneity, oftentimes applications are delivered as these silos where we have an example of a Massachusetts General Hospital order entry application with its own logic, its own dictionaries and rules, and its own patient data potentially driving that application in that environment.

Similarly, in the second panel -- the mid panel here on this slide -- a second application might be BICS, the Brigham Information Communication System at Brigham and Women's Hospital with its own OE, a separate application; it's own logic; its own terminology and reference infrastructure; as well as underlying data structures.

Similarly, our EMR is called the "Longitudinal Medical Record" or LMR and it as well may have it's own infrastructure in this silo-type depiction here.

What we're attempting to do as we move progressively towards homogeneity from a world of heterogeneity is use services to allow us to encapsulate data infrastructure to design and implement common knowledge bases, rule bases, and knowledge management systems and then serve those up as services to the glass, if you will -- the host application -- whether it's MGH order entry, Brigham and Women's Hospital order entry, or the LMR, or any other application that wishes to use these enterprise standard services.

We're really just beginning this effort; but we're well into design and beginning to do some implementation. And actually, the Smart Forms and Quality Dashboards set of applications and services is sort of one of our first test cases, if you will.

Here is a quick look at the knowledge management portal that's been elaborated to capture all of the knowledge resident in all of the clinical information systems at Partners HealthCare, and store and organize it and tag it in a ways that make it easily accessible, reviewable, and manageable for the knowledge engineers and business owners across the environment.

We did a survey of knowledge managing practices several years ago, and found that there were rules embedded in the code of various technical applications where we couldn't tell who was the author, what was the source of the evidence, or even what was the clear delineation of the logic in human readable

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

terms, knowing what was the update frequency or management requirements for that knowledge in that application.

Our effort now is to try to uncouple knowledge from code wherever we can and subject it to formalized knowledge management process and procedure so we can assure that the most valuable asset actually in our clinical systems -- the knowledge -- is kept up to date and refreshed appropriately.

Dr. Tonya Hongsermeier has been leading the management effort in my group; and her team has developed the knowledge portal, which you can see another picture of here, which allows searching across all the knowledge assets to review, for example, what kinds of support or reminders might be available in any context -- whether it's order entry or LMR or what have you.

The other interesting feature of this development is that we have built, using some off-the-shelf documentation tools from EMC, collaborative knowledge engineering E spaces or E rooms that allow clinicians to work virtually and collaboratively across time and space to do knowledge engineering, to develop rules, review rules, and refresh them as the case may be.

All of this infrastructure has been now put to use in the Smart Forms and Quality Dashboard experiments. But before we talk about the Smart Forms and Quality Dashboards, let me just tell you where we were before we started with Smart Forms and Quality Dashboards. This is a screen shot of a summary page for our electronic medical record known as the LMR, "Longitudinal Medical Record," and this is a Web-based EMR available to all providers at all clinical desktops across the environment and available via secure connections anywhere around the world, frankly, as a Web-based tool.

It allows us to present, in summary form here, the problem list; the medication list; allergies; advanced directives or reminders; healthcare maintenance items; recent flow sheet or laboratory or clinical data; a comprehensive list of notes; and many, many other types of data. It also has a secure communications feature that allows communication without using the enterprise e-mail system. One can communicate within the EMRs with security and confidentiality about clinical activities or events and whatnot.

It also has a notification system for alerting the user about abnormal laboratory values, results, and the like. Of course there are automatic reminders for all types of things within the system. The chart summary is hopefully intuitive and can be rearranged, as the user might desire -- like a Yahoo home page, if you will. The same way here, you can rearrange these parts and pieces on the screen to fit your own workflow or your own desired rendering of these data.

Summary flow sheet information -- as I mentioned, many of the data are coded with coding schemes to support aggregation of data and reporting and the like. And of course, as I mentioned, the desk top is customizable.

It is from this point that we launched or broke away to develop a new application, Smart Forms, which was used within the LMR environment in the work flow of this application. We took advantage of the LMR for all of the log on and authentication/authorization of the user to use the Smart Forms application within this context.

First let me acknowledge that many, many folks have been very, very helpful and important in driving this project. We have a really super team here listed on the next slide here; but I'd like to acknowledge all of the clinical investigators, the clinical informaticians, the clinical quality analysis group, application development, clinical systems management folks, and some other key stakeholders and business owners who have helped to sponsor and support this research. And last but not least, of course, the HRQ, which was very generous in its R-1 Grant to us to do this large evaluation.

In a nutshell, the idea behind Smart Forms and Quality Dashboards is to bring to the user an integrated clinical decision support environment within the context of clinical workflow. The Smart Form attempts to

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

perform four key functions, with the adjunct of a Quality Dashboard, for the user at the point of care. There's some assessment and risk stratification capabilities that help to assess the therapeutic response to prior interventions. There are the familiar alerts and reminders provided to the user about interventions that are called for or scheduled. There's some guidance capabilities to bring the user to the right decision in the context of choosing therapy or thinking about therapeutic alternatives. And then this new idea of integrating the Quality Dashboard dimensions so that all those data gathered in the context of seeing patients and documenting visits could be reused in a Quality Dashboard to provide population insight, and then the ability to borrow data from a population perspective onto an individual patient record for intervention. We'll explain all of this as we go through looking at the technology.

The fundamental hypothesis, though, is to help the users abide by best practices and care guidelines where they exist for patient care, but also allow the user to understand the value of the clinical data they are gathering at the point of care and provide additional population insights based upon those data gathered through the context of a Smart Form and presented in the Quality Dashboard.

This idea is a fairly old one -- that data we gather as a part of care must be used in the context of that instance; that is, the instance of decision making or clinical reasoning at the time of the clinical encounter. We believe the user of the data should be the creator of the data; that is, I should be judged and assessed and informed by the data that I'm creating in the context of the visit. Data should be collected as a byproduct of routine care delivery, not as a secondary event by someone other than the primary caregiver or an authoritative person.

Analysis occurs within the information environment; it doesn't happen secondarily a day later, a month later -- or worse even -- years later; and that the analytic results are delivered to the provided during routine care. If we can't impact decision making at the point of care, we feel that obviously the impact and the potential for impact is simply much less.

And I'm reminded of a famous old cartoon that Mark Leavitt and I used at Medical Logic years ago: Looking at Dr. McCoy here from the Starship Enterprise, he says, "Captain, let me make something clear to you. I'm a doctor, not a confounded computer operator." And we take this very seriously. Our users have to find value not only instantaneously in using their record, but also as they use the record in derivative ways for population analysis or decision support and the like.

Another graph that we've used before many times shows how the value of data goes up when you increase the structuring of data from left to right along the bottom axis. Increasing structuring of data from free text to fully structured encoded data on the far right increases the value in the green line -- the usefulness of the data. However, there's probably a drop-off at some point where data becomes overspecified; and the clinician can't actually say what they want to say, and they free-form the clinical narrative.

But clearly as we structure the data, the impact on usability goes up as well; and that's a negative. It becomes increasingly difficult to capture a natural clinical narrative when structuring all the data at data entry. Somewhere there's a balance, where there's an optimal mix between the usefulness of the data and how much structuring or burden we place upon the user in gathering data in a structured data entry way.

We feel that actually presenting a Quality Dashboard increases the apparent value of these data and, thus, the exercise of structured data entry when the user has new insights to their care delivery pattern based upon a Quality Dashboard. And that's one of the things we'll be assessing through the course of this randomized control trial.

So specifically, our SFQD -- or Smart Form and Quality Dashboard -- project goals were to develop a common framework and approach to integrating decision support with clinical documentation in the LMR.

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

The primary method will be, as I've described, through the use of Smart Forms which we'll show much more detail on in a minute.

The secondary method will be through the use of these Quality Dashboards. Secondary goals for our research project included the desire to externalize knowledge -- as I've already described -- that is resident in clinical systems code and applications -- to externalize that from the applications and from the LMRs specifically, so that we can manage that knowledge better for Smart Forms, alerts and reminders, and Quality Dashboards.

This goal could be achieved by making use of the externalized knowledge in an enterprise rules engine to capture LMR inference and decision support that was occurring outside of the LMR in this enterprise rules engine, and to improve the usability of the LMR, frankly. This is a homegrown, academically-oriented application which may not be as pretty as many of the vendor-based products that have many more dollars to apply for its usability and look and feel. But we wanted to improve the usability and actually tried to bring forward more advanced features and functions than some of the vendor-based products.

Specifically, our research proposal stated the following specific aims: To design and implement an integrated documentation-based clinical decision support and physician feedback system in an EHR to improve the management of patients with both acute and chronic medical conditions.

Secondarily, specific aim two: To determine the effectiveness of this approach, the Smart Form approach, on the documentation and clinical management of these patients with coronary artery disease, specifically, for the chronic-care management case and acute respiratory illness for the acute care case, again using Smart Forms and Quality Dashboards.

And, then, three: To assess the perceived value, as perceived by the end user of the EHR, Smart Forms, and Quality Dashboards and to assess the marginal impact, if you will, of the Smart Forms on compliance with best practices in ARI and CAD.

One of the things about our environment is that we already have an EMR that's fairly well used and effectively used by most of the population in primary care already and more than half of the population in subspecialty care. There is a bit of a ceiling effect -- that we're starting from a very high compliance already, and there's some concern that it's difficult to show powers or impacts of some of our interventions because the environment is already so well-tuned with the existing technology in place.

Our research design was fairly straightforward and simple. We took practices and randomized them to one of three arms basically: the EMR alone -- the Longitudinal Medical Record or LMR alone; the EMR with Smart Forms; or the EMR with Smart Forms and Quality Dashboards. Of course, we then looked for impacts on patients in these three different arms; and if we have time, we can discuss at the end how it was very difficult in our environment to actually get a clean randomization schema, given the fact that we had multiple different IT interventions being evaluated in the same environment at the same time. We paid a lot of attention to randomization in trying to do this very cleanly and neatly.

The two conditions that we chose to discover the differences in Smart Form utility are Acute Respiratory Illness (ARI) and then Coronary Artery Disease (CAD) and Diabetes combined. Of course, ARI is an acute condition. As Dr. Jeffrey Linder (one of the co-investigators on this grant) who is very expert in ARI would point out, there are many errors of commission often with ARI. Often it's a standalone, urgent care visit, not complicated by comorbidities or other healthcare maintenance issues, so it's strictly a visit focused on ARI. Often the visits are in the ARI months of course -- winter, fall, spring -- and decision support is really relevant only at the time of seeing the patient in the context of the encounter. That's when the opportunity for intervention on physicians' decision making or behavior is paramount.

CAD and DM on the other hand, are chronic conditions, oftentimes with many comorbidities, and often errors of omission or inertia effects, making it simply difficult to do the right thing -- usually in the context of

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

a full visit with multiple problems, as I stated already – with the comorbidities. And decision support actually may be relevant in preparing for the visit, during the visit, and after the visit to assess therapeutic response to do the right thing at the time of the clinical encounter and then assess the population outcomes after the visit.

So in ARI, there's often limited time -- extraordinary time demands. And in CAD/DM, chronic care management often has competing demands, possibly in addition to time demands as well.

So let me see now if Dr. Jeffrey Schnipper is with us and available to go on and describe what is a Smart Form. While we're finding Jeff, I will continue; and he can chime in at any time.

In summary then, before we launch into showing you the technology and describing the evaluation, let me summarize what a Smart Form is and what our goals and objectives were: a clinical documentation-based tool resident in an EMR attempting to actively engage the user during the clinical workflow which organizes historical data; presents data based upon knowledge-based rules to guide the user for intelligent data review; guiding the user on how to request new data or orders and procedures, and integrating decision support, ordering, patient education, and documentation.

In the ARI Smart Form, there were features for structured data entry; patient data display and review; diagnosis detection; presentation of treatment options with integrated decision support; the availability of clinical workflow tools to support printing patient handouts easily and seamlessly in the workflow; and access to the medical literature.

Here, for example, is the picture of the ARI Smart Form as the user would see it at the outset, not when all the decision support is available. But the outset is a tool which allows both free text data entry and structured data entry, with some keyboard acceleration tools to make the clinical documentation fairly easy and straightforward.

Navigation tools occur on the left-hand side there. Those words in black allow you to jump between sections within the ARI Smart Form. In the middle is the documentation environment. And on the right side is where the orders and plans -- based upon the data that is reviewed or the documentation which occurs, that will be dynamically generated to guide the user for this clinical encounter for ARI.

Here is how the documentation would work -- both structured data entry for these cardinal findings for ARI, as well as the opportunity for free text data entry. Data entry, as one becomes familiar with this application, can be very facile and straightforward.

There are "all normal" checkboxes to facilitate gathering lots of data. There are free text fields; and free text fields allow the user to capture the clinical narratives in any way or form they wish.

The good feature of the Smart Form is that it's auto-documenting as much as possible. From this data gathering of free text and structured data elements, a clinical note is generated -- in the background -- that then becomes part of the medical record. The clinical note is available in document form; and the clinical data gathered in the course of making of this note are available to the database.

Now, what happens when the Smart Form becomes populated with data? At the end the user selects the primary and secondary diagnoses of interest -- and that's when additional logic is used to infer, for example, the probability of strep throat. In other words, the Smart Form for ARI has a built in strep throat risk calculator which, based upon the evidence and guidelines for strep throat risk calculations, predict what is the probability for this particular patient. It could actually indicate what the change in probability would be with a positive rapid strep or throat culture as well.

The diagnoses as selected then lead to diagnosis-specific and appropriate order sets for the ARI. Here for example, one might choose streptococcal pharyngitis; and then the decision support pops up, and

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

guidance is provided on the probability of strep throat. In this case, based upon the evidence and based upon the findings documented in the ARI Smart Form, there's a 41% risk of strep throat in this patient. If the strep throat test is negative, then the probability goes to 12%. If the rapid strep is positive, it goes to 72%.

Further, we then provide treatment decision support, recommending appropriate antibiotics. Given the patient's allergies and documented evidence and past reactions, we suggest which medications would be appropriate for the various diagnoses. Most importantly, it gives the user a sense of confidence in not prescribing antibiotics if the risk of strep throat is low or if that's not a plausible diagnosis whatsoever.

Further, OTC-type meds, recommendations, and handouts for the patient can be selected very, very quickly in this workflow support on the right-hand side. And all of this is dynamically generated based upon the ARI problem of course; and you'll see the recommendations for ARI are going to be different than the recommendations, suggested workflow, handouts, etc., for CAD and DM.

As these things are selected, the note is being automatically generated in the background; and the idea for our busy practitioners is when finishing and exiting this note that workflow completion is documented.

Now, the CAD and Diabetes Smart Form actually represent our second-generation technology.

Dr. Jeffrey Schnipper: I can take over from here if that's okay with you.

Super, Jeff. Welcome.

Hi, everybody. I apologize for coming in late. I'm also going to apologize for not having direct access to the slides, so someone else is going to have to advance them for me. I assume that's okay.

The CAD/Diabetes Smart Form means, as Blackford mentioned earlier, that one of the major barriers was that patients come in not just with CAD or diabetes, but also with ten other medical problems. And so our documentation solution has to really integrate these problems into a full note for a visit where a patient could have multiple comorbidities.

Another issue was we wanted to customize our reviews, tailored to the specific combinations of medical conditions that a patient has. They could have CAD or diabetes, both, or neither. As we add more chronic conditions down the road, we'd like to accommodate having any combination of both chronic and really acute conditions. There's really only one Smart Form that's customized for the patient.

We also wanted to emphasize that this is really, for the user, mostly about documentation. So the note writing section is in the center. It accommodates the multiple ways that people document the note currently in the LMR, whether or not they use structured notes or templates. We also created little "formlets." The idea was to gather just the amount of coded information that we need to drive decision support. And as Blackford talked about, it was important to really get the optimum amount of coded data into the system, but no more -- because people don't necessarily like to enter more coded information.

On to the decision support section -- the only other part that's unique to this over the ARI Smart Form is a patient view, which gives in patient-friendly language an assessment of how well they're doing in their areas of chronic disease management. But you'd really have to activate the patient around their goals of care in order to get a real change to happen in chronic disease; and that's been shown over and over again, especially with diabetes.

This next slide gives a rehash of what Blackford was talking about with Smart Forms being an example of service-oriented architecture. I'm going to skip this and go on to the next slide.

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

Here is a screen shot of the CAD/Diabetes Smart Form. As you can see, it's divided into three columns. You will see that what's on the left is a SmartView, which is a data display. And it's basically that LMR summary screen that Blackford showed earlier put into vertical format. You've got problems at the top and then medications, etc., all down the left side. All these pieces of information can be looked at as you're writing your notes. They can be modified. And they can also be imported into your notes, and I'll show how to do that in a few minutes.

The middle section is the documentation window which, as we've said, let's the person write a note using any method that they currently use. On the right is the orders, assessment, and plan section. This is where all the decision support comes in. All of it is actionable. By checking off an action, you are carrying out that order, you are updating the LMR, and you're also teeing it up to be imported into the note very easily.

You can see a blown up version of what the assessment looks like. All the stuff that is not perfect is in red. As you can see, this is a fake patient. But all of these highlight what the problems are with their CAD and/or Diabetes treatment, and if that's consistent with therapeutic goals.

All these sections and recommendations do come from an external rules engine. Just like the ARI Smart Form, they are invoked in real time and specific to all the data about that patient and what we know about CAD and diabetes.

These are all the areas that the CAD Smart Form deals with: lipids, anti-platelet therapy, blood pressure, glucose control, microalbuminuria, immunizations, smoking, weight, and eye and foot exams. And here's an example of a blood pressure above goal. Notice because the patient has diabetes, that the goal is 130/80 based on guidelines. It's taking the average over the last two visits. It's pretty sophisticated real time decision support.

As you can see on the next slide, this is the vital section blown up. You can see that some of the blood pressures have an exclamation point next to them. That means that they are above goal. Here is an example of some smart, one-time decision support.

We've talked about the rules, and you can see how all those rules were put together to create the assessment.

You can see on the next slide a note form created; and then you can see on the following slide, on the right side, the blood pressure management order set. So the blood pressure is above goal. What are you going to do about it? And here are some examples of things you could do about it. It notes the patient is on Lisinopril and Acebutolol, so it makes it easy to adjust those. You could start a new medication. You could order a bunch of labs.

If you advance, you can see that there are medication orders. If you advance again, you can see that there are lab orders. If you advance again, you can see the referrals. If you advance again, you can see the handouts and patient education. Those are all the kinds of things that you might want to take action on.

On the next slide, you can see that we created some more passive, but "just-in-time" decision support which we called, "Help Me Choose." For example if the patient is already on a blood pressure medication and you want to add another one and you're not sure which one to add, right next to where it says, "Add a blood pressure medication/help me choose," it can give reasons why you might want to start a Beta-blocker versus an ACE inhibitor versus an ARB versus a thiazide.

You can see on the next slide if the person decided to order a thiazide, you would see a list of all the thiazides; and they are sorted by how expensive they are, from cheapest to the most expensive based on

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

the patient's insurance. It would be very easy to order just generic hydrochlorothiazide with that little green light next to it.

The next slide shows there's already decision support built into our LMR -- things like drug allergy checking, drug/drug interactions, other checks along those lines.

The next slide is an example of some just-in-time decision support -- help me choose which Beta-blocker to choose. Again, on the next slide is a list of Beta-blockers based on how expensive they are.

On the next slide you can see a warning about Atenolol -- a Level 2 drug warning.

So you decided to start Atenolol or adjust Atenolol. One click would take you to a prescription pad. And all it would take is one more click to actually order this; and now your Atenolol has been ordered. It's fairly simple to do what you want.

Once you've done that, you can see that now there are some red check boxes next to the fact that you adjusted the Lisinopril; you ordered a Chem 7; referred the patient to the nutritionist; and you printed out a "Control High Blood Pressure" document for the user. And these are all going to be ordered and carried out and teed up for documentation.

It includes assessments and orders into the notes. If you advance two slides you'll see the assessment and plan. With one click you import the assessment and the plan in two notes -- and here's all the assessments, and here's all the things that you just did. You should never have to do something and then say that you did it at the same time.

The next slide shows automatic inclusion of data into your notes. You're importing stuff from the left column into the center column -- things like medications. If you can advance, you can import all the data elements in from the left -- things like the problem list. You could do the entire problem list; you could do one problem at a time.

Another really fancy thing is what we call our "dot" macros. Essentially it's a period. You have the ability to import a lot of information with just a couple of keystrokes. For example, you could move in any exam elements into your note with just a couple of keystrokes. You can move in a formlet to do an entire physical exam. And here's where you can see it looks a lot like the ARI Smart Form -- a little bit of coded information regarding physical exam. You can make everything all normal. You can do any of these things; you could say that they are abnormal or normal through the entire physical exam. -

You'll see on the next slide there's a graph section to replace the notes section, if you want to, where you can look at the BMI. You can look at the patient's weight. You can look at their blood pressure. LDL will be there. Almost any lab value will be there. Medications can be there as well. You can see when meds were started or when doses were changed.

You can actually stack -- say blood pressure medications and doses against blood pressure so you can see which medications are having the most impact.

You'll see on the next slide the CAD/DM patient view. This takes the entire assessment section and translates it into English, and again gets the patient activated. It says here, "On average, your blood pressure has been running high recently. The recommended blood pressure goal is really 130/80." There's a graph of your blood pressure. You may want to discuss with your doctor things you can do to lower your blood pressure. Again, all attempts to get the patient activated.

So before the surveys, we looked at some characteristics of overall EHR venues. 223 clinicians responded to a pre-survey, with a response rate of 45%. You can see 39 men responded (40% were

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

men.) 197 or 88% were physicians, and also some nurse practitioners and other clinicians responded, including RNs and LPNs. And we had 92 residents as well.

We asked them some questions based on computer use and electronic health record use during patient visits. Let's skip this and go on.

Jeff Winder gave a great talk last year about barriers to using an EHR during a patient visit. And as you can imagine, a lot of this decision support is most useful to physicians who actually use EHR during the visit itself. And if they're not, it may make decision support less useful. And here you can see some of the answers that people gave for not using an EHR during a visit, including loss of eye contact; concern about falling behind schedule; computers being too slow, inability to check quickly enough; feeling that the computer in front of the patient is rude; and preferring to like long prose notes.

These are all barriers that we can attempt to overcome or work around. Keep in mind, as we said before, that for a chronic condition like CAD, you can get decision support before or after the visit, not just during -- in contrast to an ARI visit that really just has to be during the visit.

After the ARI RCT, we did a post survey. We had 73 intervention clinics respond. 56% had used the ARI during the period. 75% of the survey respondents said they would recommend the ARI to a colleague. And you can see that they felt sort of lukewarm, but positive about the ARI Smart Form helping them comply better with ARI guidelines, improving patient care, etc.

We asked respondents to rate which Smart Forms features they thought were most helpful. Again, these are the ARI Smart Forms. Organizing data being rated most highly, calculating the strep throat risk was also pretty high; providing decision support; documenting actions, etc.

Here are some quotes that people gave about the ARI Smart Form. "Usually I do my notes after the clinic ends, so I end up writing my intake physical in brief shorthand, but with the ARI Smart Form I did notes while the patient was in there." And that's a great thing. The issue usually comes up as to how much do you work around people's current workflow or try to get them towards a better workflow -- which we would argue this is and this person bought into that idea of improving their workflow.

With respect to CAD/DM -- we also did a quick pilot survey and 15 pilot users (48%) completed it. 11 of those 15 also had completed a pre-survey, we could compare their responses. 56% would recommend the Smart Form to a colleague. The other 5 suggested improvements to make it better. At least two of those suggestions have already been implemented.

Here's the post pilot survey. A majority of the pilot clinicians agreed that the CAD/DM Smart Form helped them comply better with guidelines -- 60%. It helped them improve the quality of patient care -- 67%. Not all of them said that it was easy to use, and we'll get to this issue when we get to implementation and training in a little bit.

Here are the most helpful Smart Form features: providing assessment for each area of disease management; organizing the data, again very highly rated; providing suggested orders; printing patient instructions -- those kinds of things.-

Here is a pre- and post- comparison -- How satisfied are you with your ability to carry out the following components of chronic disease management? You can see that the percent that were satisfied with their ability to help manage the condition increased: smoking increased; weight increased a little bit; and diet and exercise increased a lot. And I guess that people usually ignore diet and exercise. At least having the ability to print out handouts and show patients their goals were things they didn't have before.

Here are some of the quotes from users about the CAD/DM Smart Form. "It is the first LMR item that has allowed us to update the health maintenance (smoking status), which is great." "I like the graphs. Being

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

able to have them right there without having to go out of my note is really nice, and the way it sorts through meds and problems in a disease focused way."

Here's some more feedback from Alan Cole, a big fan of ours. Let's skip this in the interest of time.

I'm going to move on to Quality Dashboards. Blackford's already talked about what a Quality Dashboard is. It's a physician feedback system. It provides clinicians to be able to view the performance of an entire panel of patients that a clinician has and get some quality indicators. You get to compare your performance to that of the other physicians in your clinic, and it gives some national benchmarks when those benchmarks are available.

And you've got a drilldown capability. You can go from this global panel view, to a list of individual patients you might want to take action on, to a single patient where you might want to take action -- and that would obviously take you down to the Smart Form and close the loop.

The ARI Quality Dashboard features really focused on total and unnecessary antibiotic uses. As Blackford mentioned before with ARI, the issue is one of co-mission -- unnecessary antibiotic use. That's a little bit narrow versus broad spectrum antibiotics. We stratified by type of ARI, and by conditions that are more likely to responsive to antibiotics versus those that are not. But it's relatively static because, as we said, unlike the chronic condition or the acute condition, no further action can be taken on the patient once they leave the office. If they leave with an unnecessary antibiotic, the damage has been done on that patient. You can learn and maybe do better next time, but that's all.

The next slide provides a view of the ARI Quality Dashboard (QD) -- and if you advance, you'll see a blowup of the first section which is a percentage of ARI visits with any antibiotic use at all. You are at 40% compared to your clinic average of 32%, and compared to the national average of 62%. You're not as good as your peers, but better than the national average.

On the next slide you can see how it's broken down for each individual condition, some of which need antibiotics more than others. The ones on the left need it less. The ones on the right -- like otitis, sinusitis, and pneumonia -- need it more.

The dashboard shows 50 percent of broad spectrum antibiotics with ARI use. You're not doing as well as your clinic again. And on the next slide is the percent of ARI visits by level of service. Thus, the majority of patients are getting a Level 3 visit; some are getting a Level 4. The ARI Smart Form actually helps you do a Level 4 visit, which might be a carrot to using it. You can build better reports.

ARI QD feedback - users found the report with the billing data actually very useful, not surprisingly. They found the tool a good test of system data because reports are better with better coded data. And again, this shows the value of encoded data which Blackford referred to before.

The CAD Quality Dashboard focused on several measures of CAD quality as I mentioned before -- things like blood pressure; lipids; again, graphic and tabular views; and everything is actionable. Because these are chronic conditions, they can still have these problems. And you can drill down to the individual patient, and you can drill down to the list of patients.

Here's the CAD Quality Dashboard front screen -- summary screen -- where you can see each of the areas -- things like ACE inhibitor use; BMI documentations; and smoking status. And for each one of these, you see you get a little light -- either red, yellow, or green -- depending on how well you're doing compared to targets. And then you can see the actual numbers. For example, 52% of your patients are on an ACE inhibitor when indicated compared to 59% of the clinic average, with a target of greater than 78%, based on a national -- I think that was actually on a Partners-wide level. Some of these actually do have national benchmarks. But you're in the red because you're not doing as well.

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

On the next slide -- red, yellow, and green indicators -- 90 percentile for HEDIS for Partners providers is the target.

And the last measure is a zero defect care -- patients with zero deficiencies. Obviously this is what HEDIS healthcare improvement wants us to do -- not just do some of the things right, but do all of the things right simultaneously on the patient.

So if you go to the screen that has all the graphs simultaneously, here's a graphical version of how well you're doing in each area. Here's a blowup of the blood pressure management. You can see that you're overdue for blood pressures in 55% of your patients; you're above goal in 12%; you're at goal in 28%; and 9% aren't recorded at all.

Let's drill down on blood pressure. Now here is a list of all the people who are not doing well with their blood pressures. And they are sorted from highest blood pressure to lowest blood pressure. You can actually click on any one of those graph elements and create a list on those. So, for example, if you wanted to look at all of the people with an overdue blood pressure, you would click on that grey bar that's got the 55%; and you could see exactly who those people are.

You can sort on any one of these particular fields in the bottom in any direction. You could really take a snapshot of how well certain of your patients are doing and which ones are sort of in trouble. We can sort; and we can prioritize by deficiency points. You get a deficiency point for every error in management or deficiency in management. You can see which patients are in most need of things like case management.

You can filter your list in one of several ways. You can see we can filter on patients who have a blood pressure that is not at goal and who have zero or one visits in the past year, and yet still are above goal. And you can see who those patients are -- maybe you need to get them back into your office. And if you clicked on any one of those patient's names, you would then drill down to their Smart Form.

With respect to CAD QD feedback and pilot results -- in general the pilot user feedback has been positive. Physicians have liked the disease-specific snapshot of reporting to all. They like the ability to define the query and create their own list of CAD patients. They have liked the ability to see snapshots graphically and both in summary format. And we talked about system data check issues.

According to experts, the Smart Forms work together. We make the point that Smart Forms and Quality Dashboard work together to improve quality. Next, the same data feeds Quality Dashboards and Smart Forms. Things like contraindications to medications can show up in a Quality Dashboard and eliminate those patients from a denominator. You've got some patients above goal, and that obviously gets fed into a Quality Dashboard.

Smart Forms capture structured and coded information that inform the Quality Dashboard. The Quality Dashboards allow you to drill down from a population view to individual Smart Form to take action.

So what did we do for evaluation? I'm going to talk briefly about usability testing, about pilot testing, about randomized controlled tryouts that we are doing or have done or plan to do.

So how do we develop and then use our tests on Quality Dashboard and Smart Forms? Well, we started with focus groups. We really wanted to base this from the ground up on what physicians wanted. We had about four or five focus groups with about ten physicians each and asked them what their values were to acute and chronic disease management; how they currently use the LMR; what they would want out of decision support; and mainly how we could integrate decision support into their current workflow.

We then used that to develop prototypes -- first on paper and then on the computer -- of successfully higher and higher fidelity. We get them showing them back to our core group of users and to our own

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

groups and improved them over time. Essentially these prototypes became functional. And then eventually we kept on iteratively refining those until we had a version that we could pilot test.

And once we pilot tested it, we did four things to try to get usability data. One was we had real time online feedback, so a user could just click on a button and tell us what they thought or if there was an error that they found. Two, we gave surveys to the clinicians before and after they used it. The after-surveys really focused on usability questions. Before and after, we asked about satisfaction with doing acute and chronic disease management.

We had a usability lab where we had a usability expert go on-site with a clinician, give them a standardized patient who was basically an actor playing out a role with some fake documentation; and we had the user use the Smart Form to carry out tasks and think out loud. And we captured every time they hit a button or clicked on a mouse and what they said. We recorded the audio.

And then finally, we had interviews by an outside consulting firm to give us more of an objective view of how we were doing. Those focused on both pilot users, but also naïve users to the Smart Form, to get their opinions on how easy it was to use.

Here are some pilot results from the ARI Smart Form. Actually we wanted to see what the impact was on patient care -- not just on satisfaction. The outcome here is antibiotic use, and we stratified it by those antibiotic appropriate diagnoses -- things like pneumonia and otitis -- versus those non-antibiotic appropriate diagnoses. As you can see in the pilot period, compared to the previous cold and flu season -- obviously with many more patients -- the use of antibiotics in appropriate diagnoses was actually higher -- 100% compared to 42%. And in non-antibiotic appropriate diagnoses, antibiotic use was lower -- 15% compared to 26%. Both went in the right direction.

The next slide shows some pilot results from the CAD/DM Smart Form. I'll take you through the first case here. We looked at beta-blocker prescriptions. During the pilot period, we had PCPs where a beta-blocker was indicated non-prescribed, and no contraindications noted in 3 out of 134 cases, or 2.2%. And of those three cases, two out of the three were addressed in the months following use of the CAD/DM Smart Form in a visit. In comparison during the previous period, looking at the same PCPs with different patients with CAD or diabetes before they used the Smart Form -- again, 2.6% had deficiencies, but in only 1 of those 24 cases was the deficiency addressed. And that difference was significant.

Similarly with blood pressure -- there are 14 deficiencies in it being up to date; 13 of those 14 were addressed, compared with 43 out of 133 deficiencies addressed in the previous time period -- and similarly with smoking status documentation, and height and weight documentation.

So after this pilot period, we've then been doing randomized controlled trials. The ARI Smart Form RCT is completed. We're currently analyzing the data. The CAD/Diabetes Smart Form randomized controlled trial is in progress. In the ARI Quality Dashboard, randomized controlled trial is nearing completion. In the CAD Quality Dashboard, our RCT will be done after the Smart Form RCT is done for CAD and diabetes.

So I'm going to switch gears now and talk about some of the challenges that we've had in both implementing and developing our software, and also doing the research on it. And in this area, there were four categories. The first is dependence on external software development. The second is physician versus clinic level randomization -- an issue Blackford touched on earlier. Another is reconciling your research agendas with several simultaneous IT projects -- which some of you may not have at the moment, but you surely will be going forward. And finally, another challenge is creating a knowledge management infrastructure.

First, dependence on software development -- the Smart Forms are dependent on outpatient order entry. You already could order meds directly with the LMR, but not labs; and that needed to be there for full

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

functionality. We built the LMR as service-oriented architecture. We needed some "get" and "check" services to basically retrieve and send data back to the LMR, and some of those needed to be developed. And if they hadn't been developed, it delayed our product development and our RCT start.

The solution keys really to gets to support at the highest levels. You have to make your needs clear; prioritize and pick your battles and minimize your dependence on software development as much as possible. Having Dr. Middleton fighting for us made a lot of difference. In some cases, we actually did without certain elements that we thought we needed. The lesson learned here is really to anticipate and manage.

What about physician versus clinical level randomization? The pros of clinical level randomization are that it makes training and support easier, and it minimizes contamination of one physician in a practice telling another physician about this new feature that they have. The cons are that you can have clustering by clinic -- all physicians in a clinic act the same way. And the results are the potential for uncontrolled confounding. Some clinics are more technology-savvy than others, and you really can't control for that.

In the end, we actually decided to do the CAD/Diabetes Smart Form physician level randomization. The pros here are that there is no clustering, and there is more effective randomization. You don't have to worry about potential uncontrolled confounding. The cons of the training control and support are more difficult, and there is a potential for contamination among physicians -- those who do and don't have the intervention. The lesson learned here is to be flexible and to re-evaluate as situations change -- as they did for us.

What about multiple IT projects? The questions asked here are, "Looking at these two different IT projects, how similar are the interventions?" "How similar are the target patient populations?" "What about the external requirements that you need?" "What about the logistics of implementation?" "What about the outcomes to be measured?"

You can see that there are multiple ways that you can reconcile the research agendas of multiple IT projects. First, you can convert from several two-arm studies to a multiple arm study. And this is good when your interventions and your outcomes all overlap. The bad part here is that you're sacrificing statistical power -- as much as 50%.

Another approach is to do simultaneous studies in different populations; and this is obviously ideal if your populations can be cleanly separated -- so, for example, diabetics in one group and non-diabetics in another.

A third is to do simultaneous studies in the same population -- this would be a 2x 2 factorial design. This is good when there's little chance of synergy between your interventions. For example, two studies may have nothing to do with each other. You split the populations in two in two different ways, and you have two two-arm studies. If there is synergy though between your interventions, you've now just created an underpowered four-arm study; and that's a problem.

Finally, there are head-to-head comparisons. And you can do this when there's no overlap of the interventions, and each one can serve as a control group for the other. Lesson learned here are the need for broad dialog among all your stakeholders to understand what your pros and cons are, and then make a decision based on that.

Creating knowledge management infrastructure -- the cons are obviously a large upfront investment, the potential delays in design, and bureaucracy. The pros we already touched on earlier, including a real mechanism for connecting subject matter experts with programmers, and it's much more scalable as decision support expands -- which is likely to happen everywhere.

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

We used a knowledge management group, as Blackford mentioned. We used some I-log software which helps us with our knowledge management. Some of the lessons we learned were to use flow diagrams for subject matter experts; other formats for analysts and programmers to get closer to code; finalize the logic among a small group of people; have a public e-space to promote dialog; and have detailed indexing of all the logic elements so you can reuse them and also prevent redundancy across your entire network.

The general lessons learned -- I think our pilot data are encouraging to date. There is potential synergy between Smart Forms and Quality Dashboards. There is a real new paradigm for decision support that's really documentation-based.

What did we learn about Smart Forms? One of the major barriers to use really relates to workflow and human factors issues more than anything else. For coded data entry, what is the correct amount? And I would say that the right amount may depend on the complexity of the condition -- the degree to which the data influences decision support, billing requirements, and the style of the individual practitioner.

What did we learn about the ARI Smart Form specifically? Interestingly enough, it has a greater impact on promoting appropriate antibiotic use than on discouraging misappropriate use. It's always easier to steer people towards doing things than away from doing things.

Did we actually improve care? Was there more appropriate care or just better coding of diagnoses and alignment of diagnoses and treatment -- which isn't such a bad thing, but maybe has less impact on care? And so far the ARI Smart Form is limited to standalone ARI visits, but it can be integrated into our chronic care model where we can address this in future versions -- where we really address any combination of acute and chronic problems.

What did we learn about the CAD/DM Smart Form so far? Well, we had a greater impact on improving documentation than on decreasing clinical inertia. The biggest barrier to use relates to workflow and human factors issues, and the Smart Form changed current workflow. In future versions, we're going to have more features -- incorporation of health maintenance, other acute and chronic conditions -- to really tip the balance so people really want to use this all the time; in fact, for all their patients -- even if it's a change in workflow.

What about Quality Dashboards? I think the biggest barrier to use here related to our healthcare systems. What are the current carrots and sticks for a physician to use a Quality Dashboard? That may be changing. Pay for performance is going to be a major carrot to using these in the future. There will be reimbursement for case management -- if the case manager wants to use a Quality Dashboard. And for chronic condition, that may be Quality Dashboard's best use -- it's really as a case management tool.

The other major barrier to Quality Dashboards is the quality of the data in it. You have to have an absolute need to tie patients to providers. You can judge their quality fairly quickly, and to be able to edit a panel of patients that a physician has, and to deal with missing data. And you're not going to change physician behavior unless you can convince them that the data are good, and that's a major barrier.

And then some of the big societal trends that are going to drive quality measure going forward -- and providers can be more proactive. If you've got a good Quality Dashboard, it means you can convince your next contract that you want to use your EHR data which is definitely superior to the billing data. It'll capture who really is in your panel, what contraindications they have, and use the data at a much higher level of refinement than when possible using just billing data.

What did we learn about HIT research in general? Well, we've talked about the challenges: IT implementation, external dependencies, randomization issues, competing interventions, and knowledge management. Concurrent RCTs are definitely superior to before and after trials, if you can do them. You had to anticipate and manage problems, but also be prepared to be flexible if conditions change.

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

In conclusion, Smart Forms and Quality Dashboards are new paradigms to manage acute and chronic medical conditions using EHR technology. Both have the potential to improve care, demonstrate the value of EHRs to providers, and drive EHR use -- but much work needs to be done.

With that, I'm going to turn this over to Lana Tsurikova, who's going to talk about managing the Smart Form's project and what she's learned from three years of being a project manager extraordinaire -- the separate issues really from the research and development issues. Thanks.

Hello. This is Lana Tsurikova, and I will talk about what is involved in managing these big projects. Anybody who manages such complex projects knows how challenging they are, and we have tough goals to achieve, smart and educated people to manage, and endless new tasks to deal with. But it's also rewarding at the same time.

If you listen to the accomplishments and how we have succeeding in reaching top goals, you learn something new in all the tests. Working with creative and energized people is also very interesting and rewarding. Every stage of this grant has its own unique challenges, and it requires the right resources to work on each of them to do well. Development -- during this stage, we were dealing with some significant challenges. We designed and built four different applications. Each of them has it's own unique set of clinical and functional requirements. For each, we started mostly from scratch.

And the development team that we had to work with is a very small and a very busy team with its own operational agenda.

The design stage presented us with major challenges. The software created was very complex. Also the LMR team had its own agenda and we needed to balance the agendas of different departments. Another challenge was choosing the right type of feedback -- clinical versus usability -- to incorporate in our application.

There were multiple research studies ongoing at Partners, which created a need for very careful study design and complicated randomization schemas. This also meant that we have to juggle multiple studies. In our case, we had to coordinate with two other big research projects to avoid physician overload and results contamination. We also had to gather disparate data, often stored in multiple places, in different formats, and of course it changed over time.

In the handouts, you will see we conducted several online surveys and getting the response rate as high as possible was not easy because physicians need multiple survey reminders. Even these reminders didn't seem to help much.

For training and implementation -- we found every practice has unique workflows, and each of them in a different stage of readiness for accepting the applications. Likewise every user has unique preferences in workflow. Overall, after the project is built and tested, this is one of the most important phases for the whole project. The user implementation of the application ultimately depends on how well you do the job selling the project to practice leaders and physicians.

Training and implementation will impact usage. Getting the information to do the initial sales to project leaders is critical. It is also important to accommodate practice readiness and schedules before initial training of end users. Some implementation challenges including setting up Microsoft live meetings and having someone available on a particular date to conduct the training.

Analysis is always time consuming, and you cannot underestimate the amount of time that has to be built into the project schedule to analyze the data. There was extremely complex programming, and cleaning data requires on-going involvement of co-investigators. The data retrieval process was unique for BWH and MGH patient data, and there was no central place to get data

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

So in hindsight, we wished we had built a separate utility in the Smart Form that would allow us to run patient data through it outside of the clinical process in order to generate necessary data. The workflow and process data preparation of all elements of analysis was time-consuming. This starts from designing and testing different data bases, preparing data dictionaries, multiple data retrieval attempts, and they end with numerous e-mails between research team members, clarifying those data.

There were team issues too. There are likely to be smart and educated people on teams, but it's not simple to manage the project when people have quite different opinions on how things should be done. In fact, nothing is going to be perfect.

Finally, during the life of the project, there were always two or three people from a team; and team development is hard work. The nature of doing HIT research at Partners added some interesting twists to the work. And as the users are involved in many projects, it sometimes it created the feeling that they were spread so thin that any additional workload from the project would be impossible. The research team works mostly as an intermediary for different departments. They worked with developers and physicians, who speak in different languages professionally.

It was important that co-investigators stay involved and help streamline the communication to make sure that important messages were delivered on time.

We also attempted to identify and involve other departments in order to accomplish the project's goals. Without that, the final application would not be that effective. And the research work is still developing.

So how did we succeed? The first and foremost component of success is your team. We had a very goal-oriented team with representation from all areas we needed, including clinical knowledge, expertise in health systems, and previous research experience.

Since the moment the grant was funded until today, our investigators and project staff were highly involved at all stages. Their enthusiasm and stamina continued to inspire the whole team. Early determination of research questions and data interests are also the keys to success. This work identifies what data will be collected and taking the time up front to plan and to coordinate the data collection process is very important.

This project had strong project management – and this slide lists all the pieces of our learned wisdom, starting from the most helpful ones from a research perspective. The strengths included clear decision-making hierarchy that starts with the PI. Our decisions were mostly made by consensus, but sometimes the PI was the final decision maker, which helped a lot. Project managers documented every decision and continued the work based on what was decided.

Communication was more difficult between different professions. Proactive planning was another key element. Thinking ahead often saved us time and prevented any unexpected complications. We held weekly meetings which were all well attended, where we started as early as 8:30 in the morning. We always had the full agenda sent out in advance and minutes available for everyone on the team a day or two afterward. Every week we sent out new items to keep our project on top of people's busy e-mail boxes.

Documentation was also important because very often information is lost and numerous e-mails are involved. Important to document besides what is in just in somebody's mind. Announcing pilots before going into randomized controlled trials helped us to understand and polish the logistics of the implementation and the data analysis.

I listed five rewards on this slide, but the whole project has been and continues to be very rewarding. We have accomplished very difficult and complex tasks. We heard positive feedback about our product, and

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

we have preliminary data showing that our applications made a difference in patient care. They are publishing and presenting our findings at national conferences. When we go, we stimulate research and get feedback from all over the country.

We hope that our study will make a difference in patient care on a bigger scale and are looking forward to learning more as we complete our project. And with this, I will turn it back to Blackford.

Thank you, Lana; and thank you, Jeff; and thank you, everybody, for your time and attention. We still have a few minutes left. We've gone a little bit over time, but there's still time for questions; and, Jon, I'll turn it to you.

Well, thank you very much, Blackford. It was an outstanding presentation, and I really appreciate that. There's a couple of questions that have come up on the chat. If you haven't taken a look at them, do so. Before we go to that, though, I'm going to take moderator's prerogative and ask you a quick question.

So this is amazing work, and it's being done in amazing settings. When we think about what it would take -- let's say you get through your randomized trial and things are in progress -- and you wanted to take it to the next level and out to the healthcare system - what would need to happen, given all the processes that you've described? What needs to happen for something like this to become part of the healthcare system more broadly?

I think the basic answer to that question, Jon, would be that EHR vendors and developers -- both academically or commercially oriented -- need to consider evolving their projects -- towards this service-oriented architecture so they might then be able to partake of both private and public services. Whether they're coming from vendors or from academic settings, some of these knowledge-based services, such as the things you've seen today, might be made available then in vendor products as well as academic products. That's probably number one.

Number two, I think that we have a long way to go still in this country to bring forward a convenient and easy way to access the knowledge and implement it in clinical systems. I would love to see the day when there's a national repository of the knowledge, for example, that we've used here that could be made available to any application -- whether it's a commercial system or another homegrown system. Such a repository, I think, would be also critically important in moving these kinds of ideas out towards the public market, if you will, or healthcare at all.

The third thing I'd say though -- also equally importantly -- is that there needs to be an alignment of the incentives for physicians to actually adopt, care about, and use effectively healthcare information technology. As many of you know, I feel there's a strong misalignment of incentives for physicians who bear the brunt of the costs for HIT, yet most of the reward is going to others than the physicians -- particularly payors among them.

So if we could incent physicians to use HIT in some fashion and actually reward physicians for higher performance, I think that would also then be a powerful market stimulus for both its services, or its architecture kind of evolution and then perhaps a knowledge-based repository as well.

Great answers, thank you. Brian, do you want to either have hands raised or address questions that have been brought up on chat?

Yes, either method will work; so if you want to raise your hand and ask a verbal question, there's a hand icon in the participants' box. It should be the top right-hand box on your screen. Or you can feel free to send a chat message to all panelists. We do have a hand raised, if you want to take that now, Jon.

Absolutely.

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

Go ahead.

I was just wondering how much of this intellectual property you've created in terms of these wonderful forms. By the way, it was a great presentation, and I enjoyed listening to it. How much is this in the public domain available to other people who are trying to build similar types of forms and EMRs from scratch, or is this the intellectual property of Partners and therefore not available to others?

Well, certainly the evaluation research supported by the AHRQ -- the results of that research are in the public domain, and we'd be happy to amplify upon that for anyone who is interested. The software technology, architecture design, implementation, etc., are the intellectual property of Partners HealthCare; and, again, we would be happy to talk to folks who might be interested in that technology.

Thank you.

Thanks for your question. Do you want to take another hand; or do you want to go to some of the chat, Jon?

Let's take one more hand, and then let's get to the chat.

James, are you with us?

While we're trying to get his line up, why don't we jump to one of the other questions? The first question we have here is, "Is there any medication reconciliation functionality?" And my guess is that's being built into the system.

Not actually in the Smart Forms environment itself. We have a different application which serves medication reconciliation between inpatient and outpatient environments.

The next question on the chat was, "How do patients actually access that patient view?"

Patients are not users of Smart Forms or our EMR. The physician providing care would access the patient view on behalf of the patient at the time of care and print it out for the patient.

Very good. There's a quick one here to define service-oriented architecture.

Jon, that's not a quick one. The best way -- in a nutshell -- is essentially breaking down what previously have been monolithic applications designed sort of unto themselves into this idea of a shared set of services that worked across applications or modules, if you will. It's really the way web development and modern software architectures are moving.

Okay, similar to ASP?

ASP determines how an application is hosted, not so much how it's designed.

Got it. Okay. A good question here is a question about response times and logging on the servers and how many concurrent servers can you support and what kind of response times you have.

We've done a lot of performance characterization of the ILOG server for the enterprise event engine, and Dr. Howard Goldberg here can talk to these issues in great detail. I'd be happy to hook anybody up with him, if they're interested. But our goal, of course, is sub-second response time; and to have that occur across potentially multiple services working in concert, means that some services have to be in the 100 to 200 millisecond response time.

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

Very good. Let's jump up to the next one. It says, "Please provide more information on the ILOG software." I don't know, maybe if you can give 30 seconds on the ILOG software?

Sure. ILOG is a French company. There's a Web site easily accessible on the Internet that provides enterprise class inference engines and a variety of other tools and technologies for performing essentially rule-based inference in a wide variety of environments. They have been successful in many other settings beyond healthcare, and we're one of the first folks to work with them on this application in healthcare. But in a nutshell, they provide an event engine.

Next question, "Did you look at the impact of this pretty extensive documentation effort on patient encounters and physician/patient communication during visits?" This is a great point -- the impact and technology on the interaction between provider and patient. And I'm assuming the gist of that is, there's a lot of work with the computer that's happening during the visit; and did that impact positively, negatively, or not at all, the interaction between the provider and the patient.

Very interesting question. It was not a focus of the Smart Forms/Quality Dashboards randomized trial to look at that issue specifically. Other research is underway here looking at documentation; communication; empowerment, if you will, through a patient portal; but Smart Forms -- that was not addressed.

I think you have your next grant application, Blackford.

So the next one is, "How did you represent knowledge? Were you able to use any standards?" Now I know that's also a question with a potentially long answer. But if there is some way you feel like you can succinctly answer that, though, it would be good.

Well, it's a great question; and in fact, we keep abreast of all of the competing standards for knowledge representation that are being developed around. But one of our goals actually here was to make the knowledge very human readable. We actually broke it down into English words and spreadsheet tables so that our physicians and programmers could have a dialog -- well, first, physicians and other clinicians could have a dialog about the right knowledge elements for all the different rules working in the Smart Forms. And we have not, as yet, adopted a national or international standard representation of all the different competing forms here at Partners. We're basically trying to capture it in a human readable form. And when those standards evolve and become mature and further become executable in a robust and reliable way in our environment, then we would move towards a knowledge representation standard.

And I'll just add on to that a little bit. This is something that we think about a lot in the Health IT group. It's a fairly complex question. Some previous efforts have been made—GELLO for example, but it's not clear that we have a perfect answer yet; but we'll continue to work on it.

Blackford, you could comment on how you envision the Partners services will relate to the standard service interfaces being defined through HLO7 and the object management groups through their healthcare services specification projects.

We're tracking with Bob Greenus and others here -- the HL7 developments -- and really just so far we haven't had to adopt them directly in this application; but again, when those are ready for "industrial use," we'd be very interested in looking at them.

There is one question that I'm going to read and then answer briefly, and then I think offer more of an answer offline. The question is, "What commercial entities are also engaged in healthcare IT?" Really, who isn't? It's quite broad for the commercial entities that are engaged in healthcare IT. And for that question asker, I will see if I can connect with you after we're done with this and discuss that with you a little more directly.

A National Web Conference
Smart Forms and Quality Dashboards
July 19, 2007

Any other questions?

Jon, we'd be happy to take a chat question list and respond to them and post it with the presentation, if that would be useful.

Okay. Yes.

So I'll definitely make sure you get the questions, and then we can work through that offline as well. Great. Thanks for volunteering to do that.

Actually, we had one more question come across. "In terms of integrating Smart Forms in the physicians' workflow -- for example, if a physician saw an ARI patient -- do they have to seek out the form?" I guess they're asking, how did this get integrated into the workflow? Was it automatically brought up by logic; or if they saw an ARI patient, do they have to go find the form?

Looks like a smart question. The Smart Form you use -- both ARI and CAD/DM -- is purely optional. It is not invoked automatically, based upon a presenting complaint or the receptionist finding the patient's chief complaint.

Any other questions? Last call out there.

Well, let me close by saying thank you so much, Blackford, Jeff, and Lana for a fantastic presentation. We are delighted to have funded your work. It's really exciting to see it moving forward. And as we grapple with this larger question of decision support -- both at the mode of decision making as well as potentially afterwards -- it's great to see efforts like this out there that we can see progress and then think about taking it up to its next level.

So I greatly appreciate your presentation today. I thank everything for taking the time to be on the call.

Thank you, Jon; it's our pleasure.

And this is Brian from the Research Center, Thank you to the panel. Great presentation. And to Jon too for moderating. Thank you for your time. And to everyone who joined. Please just fill out the post questionnaire before you log off today. It really does help us prepare future events. So with that, I want to thank everyone and wish everyone a great Thursday.