Strategic Health IT Advanced Research Projects (SHARP)

Area 2: Patient-Centered Cognitive Support

ONC SHARP PI Meeting

June 2-3, 2010
National Center for Cognitive Informatics and Decision Making in Healthcare (NCCD)

PI: Jiajie Zhang

Co-Directors: Jiajie Zhang & Vimla Patel
Overview
NCCD – Member Institutions

• The University of Texas Health Science Center at Houston
• Arizona State University
• Baylor College of Medicine/Houston VA Medical Center
• Baylor Health Care System
• Harvard University
• Intermountain Healthcare
• University of Maryland at College Park
• University of Washington
• VA Palo Alto Health Care System

• And many individuals from various institutions
NCCD - Vision

• Become a national resource providing strategic leadership in research and applications for patient-centered cognitive support in healthcare
NCCD - Mission

• Bring together a collaborative, interdisciplinary team of researchers across the nation with the highest level of expertise in patient-centered cognitive support research from
  – biomedical and health informatics, cognitive science, computer science, clinical sciences, industrial and systems engineering, and health services research

• Conduct
  – short-term research that addresses the urgent usability, workflow, and cognitive support issues of HIT
  – long-term, breakthrough research that can fundamentally remove the key cognitive barriers to HIT adoption and meaningful use

• Translate research findings to the real world through a cooperative program involving
  – researchers, patients, providers, HIT vendors, and other stakeholders
    • to maximize the benefits of HIT for care quality, efficiency, and safety
### How NCCD’s Six Projects Map to ONC’s Research Challenges

<table>
<thead>
<tr>
<th>Projects</th>
<th>P1</th>
<th>P2A</th>
<th>P2B</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
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<td>Creating models that support dynamic abstraction of clinical information</td>
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<td>Techniques for parsimonious information display that simplifies, while capturing essential features of a clinical decision problem</td>
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<td>Understanding decision making under stress and time pressure, and its implications for cognitive support</td>
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<td>Communication to clinicians, addressing message content and delivery, that blends with workflow</td>
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<td>Methods to support decisions that involve multiple stakeholders, taking into account their preferences and utilities</td>
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<td>Methods for minimizing and simplifying, when it is necessary, manual data input by clinicians</td>
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Challenges in HIT Adoption & Meaningful Use

Common Use Cases for Research, Development, & Evaluation

<table>
<thead>
<tr>
<th>For Providers</th>
<th>For Patients &amp; Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review patient history</td>
<td>Communicate with providers</td>
</tr>
<tr>
<td>Conduct patient assessment</td>
<td>Manage medications</td>
</tr>
<tr>
<td>Determine clinical decision</td>
<td>Manage chronic conditions</td>
</tr>
<tr>
<td>Develop treatment plan</td>
<td>Understand health</td>
</tr>
<tr>
<td>Order additional services</td>
<td></td>
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<tr>
<td>Prescribe medications</td>
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<tr>
<td>Document visit</td>
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</tbody>
</table>

How NCCD’s Six Projects Map to ONC’s Research Challenges

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ONC-Identified Challenges for Patient-Centered Cognitive Support

- Creating models that support dynamic abstraction of clinical information
- Techniques for parsimonious information display that simplifies while capturing essential features of a clinical decision problem
- Understanding decision making under stress and time pressure and its implications for cognitive support
- Communication to clinicians, addressing message content and delivery that blends with workflow
- Methods to support decisions that involve multiple stakeholders, taking into account their preferences and utilities
- Methods for minimizing and simplifying, when necessary, manual data input by clinicians

Approach

Ideal HIT System

- Work-Domain: Explicit, unified, accurate, comprehensive work domain model
- Representation & Implementation: Clear, comprehensive, easily navigated information & knowledge representation based on human understanding of healthcare
- Task Performance: Safe, timely, effective, efficient, equitable, patient-centered task performance

Current HIT System

- Work-Domain: Implicit, multiple, unconnected, incorrect, incomplete work domain model
- Representation & Implementation: Confusing, siloed, task-specific information representations based on hardware and software limitations
- Task Performance: Disconnected, redundant, unclear, billing- and legal-centric task performance
Individual Research Projects
# Individual Research Projects

<table>
<thead>
<tr>
<th>Projects</th>
<th>Project Title</th>
<th>Leaders</th>
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</thead>
<tbody>
<tr>
<td>Project 1</td>
<td>Work-Centered Design of Care Process Improvements in HIT</td>
<td>Zhang, Butler, Walji</td>
</tr>
<tr>
<td>Project 2B</td>
<td>Modeling of Setting-Specific Factors to Enhance Clinical Decision Support Adaptation</td>
<td>Greenes</td>
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<tr>
<td>Project 3</td>
<td>Automated Model-based Clinical Summarization of Key Patient Data</td>
<td>Sittig</td>
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<tr>
<td>Project 4</td>
<td>Cognitive Information Design and Visualization: Enhancing Accessibility and Understanding of Patient Data</td>
<td>Johnson, Shneiderman, Plaisant</td>
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<tr>
<td>Project 5</td>
<td>Improving Communication in Distributed Environment</td>
<td>Patel, Singh</td>
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</tbody>
</table>
Project 1: Work-Centered Design of Care Process Improvements in HIT

Project Leaders: Jiajie Zhang, Keith Butler, & Muhammad Walji

Project Advisor: Mark Haselkorn

Co-Is: Amy Franklin, Brent King, Ali Mokdad, Emeka Okafor, Axel Roessler, Yan Xiao

Consultants: Ali Bahrami, Ellen Bass, Chris Esposito, David Kieras, Mark Musen, David Woods
### Specific Aims

<table>
<thead>
<tr>
<th>Aim 1</th>
<th>Develop tools to rapidly identify and prioritize critical usability problems</th>
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<tbody>
<tr>
<td>Aim 2</td>
<td>Develop work-centered toolkit for removing usability problems in existing system and designing new systems with built-in usability</td>
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<tr>
<td>Aim 3</td>
<td>Methods to integrate vendor-focused solutions with social-organizational issues of acceptance and trust in healthcare environments</td>
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<td>Aim 4</td>
<td>Model the impact of HIT on cognitive and organizational healthcare processes</td>
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<td>Aim 5</td>
<td>Derive key HIT features from information usage patterns in care processes to “build-in” care improvements to HIT systems</td>
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<tr>
<td>Aim 6</td>
<td>Develop a work-ontology framework that builds safety and usability into HIT systems</td>
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</table>
Significance – Aims 1-2

• Validated tools and methods that can be used by vendors for improving usability, and by regional extension centers or physicians for software selection.

• Development of usability standards and guidelines that can form basis for comparison of EHR products and for certification.
Significance – Aim 3

• Increased adoption, improved processes and clinical decision-making and longer system lifespan through increased transparency, improved change management, and stronger stakeholder ownership
Significance – Aims 4-5

• Increase EHR adoption and meaningful HIT use with metrics & tools that enable care providers and managers to insert improvements directly into health care delivery systems development. These improvements will enable
  – impact analysis, prioritization, and cost-benefit analysis of HIT functions,
  – “build-in” care improvement and/or cost reduction to enterprise systems,
  – integrate work design across multiple levels with hybrid electronic and paper records, and (d) provide visibility needed to direct and monitor HIT projects.
Significance – Aim 6

- Revolutionize the reliability and usability of HIT use with model-based design. Reduce safety risk from unpredictable user behavior, and enable methods to generate optimal designs for safe, effective, efficient user interaction with HIT.
Project 2A: Cognitive Foundations of Cognitive Decision: Implications for Decision Support

**Project Leaders:** Vimla L. Patel & Trevor Cohen  
**Project Advisor:** Gary Klein  
**Co-Is:** Javy Kong, Amy Franklin, Almoosa, Parsa Mirhaji, Bela Patel, David Robinson  
**Consultants:** Tim Buchman, John Joe, Gary Klein, Andre Kushniruk
Aims

Aim 1: To create cognitive models of knowledge organization through information abstraction from clinical cases as “Intermediate Constructs” in critical care

Aim 2: To develop initial prototype EHR to include these constructs using visualization and NLP tools

Aim 3: To iteratively evaluate prototype system using both Lab and clinical-based evaluation
Structure of Knowledge in Clinical Problem Solving

System-Level

H1
H2

UL1
UL2
UL3

IC1
IC2
IC3
IC4
IC5

LL1
LL2
LL3
LL4
LL5
LL6
LL7
LL8
LL9

BC1
BC2
BC3
BC4
BC5
BC6
BC7
BC8
BC9
BC10
BC11

Observations

EHR

Paper Record

INTERMEDIATE CONSTRUCTS

UL1
UL2
UL3

Diagnostic Hypotheses

Findings
Significance

- Current EHRs do not represent information in a way that makes decision making efficient and effective.

- New approach to cognitively driven decision support based on cognitive constructs.

- Framework connecting cognitive constructs, views of patient data and decisions making:
  - Methods to generate “views” that are clinically relevant.
  - Prototype of cognitively-driven EHR.
Project 2B: Context-Specific Factors for Clinical Decision Support

Project Leaders:
Robert A. Greenes, Arizona State University
Mary Goldstein, VA Palo Alto Health Care System
Peter Haug, Intermountain Health
Emory Fry, Naval Health Research Center

Project Advisor:
Robert A. Jenders, UCLA
Specific Aims

Overall

1. Overcome barriers to sharing and adoption of CDS by *modeling of the role of (a) “setting-specific factors” (SSFs) and (b) “patient-specific factors” (PSFs) – in determining effective use/reuse*

2. Develop and validate methodologies to capture and organize these attributes to more effectively tailor CDS to particular SSFs and PSFs
Specific Aims

Short-Term Aims (2 years): Immediate Impact on CDS Adoption and Use
1. Characterize a range of implemented CDS, rules-based knowledge in terms of the core logic and SSFs in diabetes and hypertension, and in a set of prevention and screening recommendations
2. Develop a taxonomy of SSFs and tools for adaptation to different environments
3. Work with the Lab Core to test usability of the systems

Long-Term (4 years): Breakthroughs Leading to Next Generation CDS
4. Develop and refine a state-based model for chronic disease, with focus on diabetes and hypertension
5. Develop a taxonomy of patient-specific factors (PSFs) as derived from state model, and expand the knowledge base for these states from existing guidelines, literature, experts, and data mining
6. Work with the Lab Core to develop clinical encounter prototypes incorporating the expanded knowledge for clinical documentation and plan/order generation and assess their usability
Significance

**Aims 1-2**
- provide a methodology for characterizing the SSFs to be incorporated into actual deployments of CDS
- can enhance the ability for CDS to be more easily adapted to different environments and more effectively shared and reused

**Aim 3**
- address the tasks of converting the conceptual model and knowledge base into actual payload format that can be used by an implementer
- assess model and KB value as a way to semi-automate the adaptation of shared CDS knowledge to particular settings

**Aims 4-5**
- address a breakthrough conceptual approach to constructing the clinical encounter for chronic disease so as to capture PSFs
- use PSFs to tailor (a) the data assembly pertinent to a patient’s state, and (b) provide integrated guidance/ workflow enhancement for the assessments, and the plans/actions to be carried out

**Aim 6**
- create and evaluate novel and potentially significant user interfaces (including interactive visualizations) for the clinical encounter
Project 3: Automated Model-Based Clinical Summarization of Key Patient Data

Project Leaders: Dean F. Sittig, Eric Thomas, Adam Wright

Project Advisors: Hardeep Singh, Joan Ash
Specific Aims

• Identify data and methods required to model interactions and summarize complex, chronically-ill patients’ history and create appropriate, evidence-based actions to improve clinicians’ decisions under information overload and time pressure.

• Design automated methods of creating accurate, succinct, condition-dependent and independent computer-generated summaries of complex, chronically-ill patients to improve patient safety, clinician efficiency and satisfaction, and reduce the cost of care.
Significance - must develop automated methods of using patient-centered knowledge to summarize and display information

• In “early EHR adopter” organizations patients have over 10 years of EHR data covering all aspects of their care
• Readily accessible, perfectly legible archives of clinical notes, laboratory results, images, and provider correspondence challenge time-pressured clinicians
• As EHRs and HIEs capable of exchanging patient-level data increases, the quantity of data that clinicians must review for safe and effective care increases exponentially
• Clinicians must integrate data with their existing knowledge and literature
• Solutions require explicit, unified, accurate, and comprehensive patient-centered models that reflect the true work domain ontology
Project 4: Cognitive Information Design and Visualization: Enhancing Accessibility and Understanding of Patient Data

**Project Leaders:** Todd R. Johnson (UTHealth), Ben Shneiderman (UMD), Catherine Plaisant (UMD)

**Project Advisor:** David Woods

**Co-Is:** Elmer Bernstam, Jorge Herskovic, Javy Kong
Specific Aims

• **Short term (2 years):** Immediate impact on clinician understanding of patient data. Focus on *individual clinicians* and the *benefits of specific visualization* tools for test cases selected based on national priorities.
  
  – **Aim 1:** Develop a clinical data by task taxonomy of visualization opportunities, and guidelines for use.
  
  – **Aim 2:** Design a visualization framework - develop and validate prototype tools to enable patient-centered cognitive support for selected use cases.

• **Long term (4 years):** Breakthroughs leading to visualizations that support enhanced team-based coordinated care and a variety of clinical situations
  
  – **Aim 3:** Design and develop techniques for customization of the visualizations based on care team roles
  
  – **Aim 4:** Generalize the visualization framework and tools to support team-based care and management, and a variety of clinical situations.
Significance

• In current EMRs Clinicians are data hunter-gatherers
  – data required for a clinical understanding of a patient is scattered across dozens or even hundreds of screens and notes

• Interactive visualizations can compactly represent and facilitate understanding of large amounts of clinical data
Project 5 - Improving Communication in a Distributed Environment

**Project Leaders:** Hardeep Singh & Vimla Patel

**Advisors:** Dean Sittig, Gary Klein

**Consultants:** Andre Kushniruk
Specific Aims

• Aim 1: Design a state-of-the art prototype system for communication of key clinical information (e.g., abnormal test results) between individual providers
• Aim 2: Identify best practices to increase individual clinician’s situational awareness by overcoming failures of perception of electronically communicated information
Significance

• Reducing communication breakdown is the centerpiece of achieving patient safety.
  – Missed and delayed diagnoses, often a result of missed test results, are among the most common safety concerns in the outpatient setting and persist in EHRs.
  – They lead to substantial harm and cost and are a frequent reason for outpatient malpractice claims.
## Synergy across Projects

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<tr>
<td>P1</td>
<td>Usability, design</td>
<td>Usability, WDO</td>
<td>Usability, design</td>
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<td>P2A</td>
<td>New design</td>
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<td>P2B</td>
<td>CDS</td>
<td>Patient state</td>
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<td>SSF</td>
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<td>P3</td>
<td>New design</td>
<td>Intermediate construct</td>
<td>Patient model</td>
<td>Visualization</td>
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<td>P4</td>
<td>Visualization</td>
<td>Visualization</td>
<td>Visualization</td>
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<tr>
<td>P5</td>
<td>Team design</td>
<td>Team decision making</td>
<td>CDS</td>
<td>Team visualization</td>
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### Contributions
Project Management
Personnel

• 40 investigators
• 17 consultants
• 20 advisory committee members
• Other personnel
  – Postdocs
  – Students
  – Developers
  – Others
Project Advisory Committee
## Project Advisory Committee (PAC)

<table>
<thead>
<tr>
<th>Roles</th>
<th>Names, Titles, and Institutions</th>
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<tbody>
<tr>
<td>Chair</td>
<td><strong>Edward H. Shortliffe</strong>, MD, PhD; President and CEO of AMIA; Professor, UTH Health Information Sciences</td>
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<tr>
<td>ONC Liaison</td>
<td><strong>Charles Friedman</strong>, PhD, Chief Scientific Officer, ONC</td>
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<tr>
<td>Academic Institutions</td>
<td><strong>Donald A. Norman</strong>, PhD, member of NRC Committee for Report “Computational Technology for Effective Health Care”; Professor of Design, EE, Computer Science, Psychology, &amp; Cognitive Science, Northwestern University</td>
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<td><strong>Jack W. Smith</strong>, MD, PhD, Dean and Professor, UTH Health Information Sciences</td>
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<td><strong>David Woods</strong>, PhD, Professor, Dept. of Integrated Systems Engineering and Director, Center for Complexity in Natural, Social and Engineered Systems, Ohio State University; Past President, Human Factors &amp; Ergonomics Society</td>
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<td><strong>Thomas Payne</strong>, MD, Medical Director, Information Technology Services, University of Washington Medical Center</td>
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<tr>
<td>Vendors</td>
<td><strong>James Ingram</strong>, MD, Chief Medical Officer, Greenway Medical Technologies</td>
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<td><strong>David McCallie</strong>, Jr., MD, Vice President for Medical Informatics, Director of Cerner Medical Informatics Institute</td>
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<td><strong>James Spohrer</strong>, PhD, Director, IBM Almaden Services Research</td>
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<td><strong>Sameer Bhat</strong>, Co-Founder, Vice President, eClinicalWorks</td>
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<td><strong>Jacob Reider</strong>, M.D., Chief Medical Informatics Officer, Allscripts</td>
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<td><strong>Eric Horvitz</strong>, PhD, Principal Researcher, Microsoft Research; Past President of AAAI</td>
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<td><strong>W. Paul Nichol</strong>, MD, National Director of Medical Informatics, Patient Care Services, Veterans Health Administration</td>
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<tr>
<td>Professional Associations</td>
<td><strong>Patricia B. Wise</strong>, RN, MS, MS, FHISS, Vice President, HIMSS</td>
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<td><strong>Michael Speer</strong>, MD, Representative for Texas Medical Association, Baylor College of Medicine</td>
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<td><strong>John Joe</strong>, MD, President, Harris County Academy of Family Physicians</td>
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<td>Patient Groups</td>
<td><strong>Laura Batz Townsend</strong>, Founder &amp; Director, Louise H. Batz Hospital Awareness Fund</td>
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<td><strong>Mellanie True Hills</strong>, CEO, StopAfib.org &amp; American Foundation for Women's Health; Author, Award-Winning A Woman's Guide to Saving Her Own Life</td>
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<td>Hospitals/Providers</td>
<td><strong>Michael Shabot</strong>, MD, Senior Vice President &amp; System Chief Medical Officer, Memorial Hermann Healthcare System</td>
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<td><strong>Ralph Farr</strong>, Vice President for Information Services, University of Texas Medical Branch at Galveston</td>
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<td><strong>Charlotte Weaver</strong>, RN, PhD, Senior Vice President and Chief Clinical Officer, Gentiva Health Services</td>
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Dissemination
Dissemination

• Website: http://sharpc.org
• Collaboration with Vendors and RECs
• Workshops at HIMSS and AMIA
• Webinars and eBlasts
• Project Advisory Committee
• Intellectual Property Management
  – Open source
  – Licensing
  – Free download
http://sharpc.org

National Center for Cognitive Informatics and Decision Making in Healthcare

Home

The National Center for Cognitive Informatics and Decision Making in Healthcare (NCCD) is funded by the Office of the National Coordinator for Health IT under the Strategic Health IT Advanced Research Projects (SHARP) Program, which seeks to support improvements in the quality, safety and efficiency of health care through advanced information technology. NCCD is a consortium of nine institutions led by The University of Texas Health Science Center at Houston.

The award was one of four presented by the Office of the National Coordinator for Health Information Technology (ONC) through the American Recovery and Reinvestment Act of 2009 to address key barriers to health information technology. NCCD’s research focus area is Patient-Centered Cognitive Support. Dr. Jiajie Zhang is the Principal Investigator of this award and Dr. Jiajie Zhang and Dr. Vimla L. Patel are the Co-Directors of NCCD.

Participating Institutions

The University of Texas Health Science Center at Houston (lead institution)
Arizona State University
Baylor College of Medicine
Baylor Health Care System
Harvard University
Intermountain Healthcare
University of Maryland at College Park
University of Washington
VA Palo Alto Health Care System
The following links are MP4 files. These files play well on both Macintosh and PC computers.

The links below split the teleconference into sections, for ease of playback.

- Introduction
- Project 1: Work-Centered Design of Care Process Improvements in HIT
- Project 2A: Cognitive Foundations of Cognitive Decision: Implications for Decision Support
Evaluation
Evaluation of Center

• Formative and summative
• Evaluation will focus on
  – Execution of project plans
  – Functioning of PAC
  – Roles of multi-stakeholder network
  – Dissemination
  – Collaboration with other SHARP projects
Evaluation of Center

• Yearly Evaluation
  – 2-year plan to be developed in collaboration with FSC (after June 2-3 meeting with FSC at ONC)
  – Evaluation at 12th, 24th, and 36th month
  – A formative review by PAC at the annual meeting

• Quarterly Evaluation
  – Reviewed by PAC at its quarterly meetings
  – Covers plans as well as performance
Evaluation of Individual Projects

• Reviewed by the Scientific Committee
• Yearly Plan and Review
  – 1-2 page yearly summary plan
  – milestones, activities, and outcomes
• Quarterly Plan and Review
  – 1-2 page quarterly detailed plan
  – research, development and dissemination plans
More Evaluation Plans

• Continue Matrix project management
• Expect Crystalline growth of projects
  – Baldridge assessment of domains
• Develop responsive agility to accelerated technology
• Apply continuous quality improvement
  – PDCA, metrics development and evaluation
Meeting Schedules

• Annual Meetings (face-to-face)
  – In Houston
  – First one: March or April, 2011
  – Participants: PAC, ONC, Project Leaders, selected project team members

• Quarterly Meetings (WebEx)
  – PAC, Scientific Committee

• Monthly Meetings (Teleconference or WebEx)
  – Scientific Committee

• Other scheduled or ad hoc meetings
  – As needed
Thank you