Workshop on Interactive Systems in Health Care 2011

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Abstract

Purpose: The goal of this project bringing together a diverse set of researchers from across a range of disciplines, all which intersect with Interactive Systems for Healthcare.

Scope: The scope of the workshop was healthcare information technologies (HIT) and improving communication between researchers in different disciplines.

Methods: The workshop presented a mix of short talks, panels, and posters.

Results: The workshop had more than 100 attendees and helped to increase communication between researchers in the different disciplines. It also identified a set of challenges that need to be addressed as research on these topics move forward.

Key Words: health information technologies; interdisciplinary research; interactive systems; workshop

Final Report

Purpose

The purpose of this project was to bring together participants from a variety of disciplines and institutions for a one-day interdisciplinary research symposium Workshop on Interactive Systems in Healthcare 2011 (WISH 2011) that was collocated with the Annual Meeting of the American Medical Informatics Association (AMIA) on October 22, 2011. It included researchers in biomedical informatics, nursing informatics, medical sociology, human-computer interaction, and related fields. The workshop included a combination of invited panels, keynote presentations, research presentations, and posters discussing the most pressing issues in the design, development, and evaluation of HIT and the impact of the new research on commercial HIT systems. A diverse steering committee of senior scientists from across the fields was assembled to ensure the goals of the workshop were met and that these goals were well aligned with AHRQ needs and priorities.

This workshop enabled both in-depth discussion with a small group of senior-level individuals and the development and encouragement of a broader range of scholars. Furthermore, bringing together these researchers supported the development of interdisciplinary dialogs, creating an environment for exchange and conversation that will further enable progress on every project represented at WISH.

The specific aims of this workshop were:

Aim 1. To develop research agendas for interactive systems in healthcare and identify strategies and mechanisms for studying them.

Aim 2. To discuss and develop consensus around research methodological and technical issues in regards to design and evaluation of interactive systems in healthcare.

Aim 3. To establish a new channel for dissemination and implementation of research on interactive systems in healthcare.

Aim 4. To provide a forum for developing new partnerships among researchers and stakeholder organizations and building their capacity to participate in research activities and using the results of research on interactive systems in healthcare.

Aim 5. To establish a mentorship program for junior researchers in the field and provide them with the opportunity to meet with leading researchers in the areas related to interactive systems in healthcare.

Scope

Health Information Technologies (HIT) have an enormous potential to transform healthcare and have a positive impact on its quality, efficiency, and cost-effectiveness, consistent with AHRQ priorities and mission. However, despite the ongoing efforts by many government agencies, HIT continue to experience low levels of adoption (Ash and Bates, 2005). Moreover, a growing body of research questions its impact on medical care quality, efficiency and costs (Chaudhry et al, 2006), examines unintended consequences (Ash et al, 2009), and medical errors due to poorly designed computing systems (Bierstock et al, 2005). Many researchers argue that these negative consequences are due to a mismatch between clinical work as it is conducted in the real clinical practice and the structure of computing applications that are meant to support it (Stead and Lin, 2009).

To address these limitations and remove the existing barriers to the successful adoption of the HIT, new research initiatives are focusing on a better alignment of HIT and real clinical practices, and designing HIT informed by the best practices in Human Factors and Human-Computer Interaction. However, currently these efforts exist in several disjointed research communities, without established pathways for transfer of knowledge and expertise. These communities include but are not limited to Biomedical Informatics, Human-Computer Interaction, Computer Science, Social Sciences, and Medical Anthropology. Each of these fields has its own venues for disseminating research results that rarely overlap. Consequently, researchers and practitioners interested in designing patient and clinician-centric HIT have little opportunity to interact and develop a shared body of knowledge across these communities. As a consequence, there exists a largely untapped potential to create deeper and more profound connections among the biomedical, informatics, human-computer interaction, medical sociology and anthropology communities that would lead to the development of new methods, approaches, and techniques for removing the barriers for the adoption of HIT.

WISH 2011 utilized a variety of approaches to engage workshop participants.

Keynote Presentations

WISH had two well-regarded researchers, one from the field of biomedical informatics and one from the field of Human-Computer Interaction.

1. Dr. William Stead, MD is the Associate Vice Chancellor for Health Affairs and Chief Strategy and Information Officer at Vanderbilt University Medical Center. Dr. Stead is McKesson Foundation Professor of Biomedical Informatics and Professor of Medicine. He is a Founding Fellow of both the American College of Medical Informatics and the American Institute for Engineering in Biology and Medicine, and an elected member of both the Institute of Medicine of the National Academies and the American Clinical and Climatological Association. He was the first recipient of the Lindberg Award for Innovation in Informatics and the 2007 recipient of the Collen Award for Excellence in Medical Informatics. He was the founding Editor-in-Chief of the Journal of the American Medical Informatics Association, and served as President of the American Association for Medical Systems and Informatics and the American College of Medical Informatics. He served as Chairman of the Board of Regents of the National Library of Medicine, as a

Presidential appointee to the Commission on Systemic Interoperability, and as Chair of the National Research Council Committee on Engaging the Computer Science Research Community in Health Care Informatics. He is a member of the Council of the Institute of Medicine.

2. Dr. Elizabeth D. Mynatt, PhD is the Executive Director of the GT Institute for People and Technology, and Professor in the School of Interactive Computing in the College of Computing at the Georgia Institute of Technology. Her research program Everyday Computing examines the human-computer interface implications of having computation continuously present in many aspects of everyday life. Her research contributes to ongoing work in personal health informatics, computer-supported collaborative work and human-computer interface design. Named Top Woman Innovator in Technology by Atlanta Woman Magazine in 2005, Dr. Mynatt has created new technologies that support the independence and quality of life of older adults "aging in place," that help people manage diabetes, and that increase creative collaboration in workplaces.

Panels

The workshop had two panels that examined interdisciplinary issues related to HIT.

Panel 1: "Theory-Driven Design & Evaluation of Interactive Health Systems". Panelists: Suzanne Bakken, Columbia University; Tom Baranowski, Baylor College of Medicine; David McDonald, University of Washington; Stephen Intille, Northeastern University. Moderator: Katie Siek, University of Colorado-Boulder.

Panel 2: "What Does 'Meaningful Use' Really Mean?" Panelists: Mark Ackerman, University of Michigan; Christopher DeFlitch, Penn State Hershey & Penn State University College of Medicine; George Hripcsak, Columbia University; Jonathan Nebeker, University of Utah. Moderator: Mark Braunstein, Georgia Tech.

Paper Presentations

WISH 2011 had 9 paper presentations. The goal of the paper presentations was to present work that would be of particular interested to a broad range of researchers.

1. Maximizing Long-Term Impacts of Group Pedometer Interventions on Primary Cardiovascular Disease Prevention. Erika S. Poole & Dan Kestranek, The Pennsylvania State University.

2. Interactive Techniques for Labeling Activities of Daily Living to Assist Machine Learning. Edison Thomaz, Thomas Plötz, Irfan Essa & Gregory D. Abowd, Georgia Institute of Technology.

3. A Theoretical Model of Calming Technology. Designing to Mitigate Stress and Increase Calm. Neema Moraveji, Marily Oppezzo, Stephanie Habif & Roy Pea, Calming Technology Lab, Stanford University.

4. Facilitating Medication Reconciliation with Animation and Spatial layout. Leo Claudino, Sameh Khamis, Ran Liu, Ben London, Jay Pujara, Catherine Plaisant, Ben Shneiderman, University of Maryland, College Park.

5. Personal Health Records: Reflections on an Ongoing Project. Finn Kensing, University of Copenhagen.

6. Birth Record Communicator: A Pathway to Automated Health Data Acquisition System. Ali S. Sabbir, Khosru Md. Salim, Md. Raihan B. Rafique, M Omar Rahman, Md. Mustafizur Rahman, Md. Hasanuzzaman Bhuiyan, Hasan S. Ferdous & Syed I. Ahmed, Independent University & Bangladesh University of Engineering and Technology.

7. Addressing the Design Challenges for a Clinically-Informed Data Capture Tool Targeted for Caregivers of Premature Infants. Karen P. Tang, Karen G. Cheng, Sen Hirano, Marni Nagel, Dini Baker & Gillian R. Hayes, University of California, Irvine & CHOC Children's.

8. Considering Unremarkable Computing for Healthcare. Dominic Furniss, Ann Blandford & Astrid Mayer, University College London & Royal Free NHS Trust.

9. Consumer Health Informatics: Who is Ready for What? Craig Van Slyke & Cynthia LeRouge, Saint Louis University.

Posters

The workshop also had 40 poster presentations. The posters allowed junior and other researchers to present their work. The posters were available all day of the workshop and were also the focus of the poster reception at the end of the workshop.

1. Adapting medical records for shared care of chronic disease. Jørgen Bansler, Erling Havn, Troels Mønsted, & Kjeld Schmidt. University of Copenhagen, Technical University of Denmark & Copenhagen Business School.

2. Chronic Care Continuum (C3): On-The-Go Life Skills Training for Young Adults with Chronic Conditions. Erika S. Poole, Todd H. Stokes, Christopher P. Bonafide, Alain B. Labrique, James H. Willig, Chihwen Cheng, May D. Wang. The Pennsylvania State University, University Emory University, The Children's Hospital of Philadelphia, Johns Hopkins University, University of Alabama at Birmingham & Georgia Institute of Technology.

3. Design of interactive decision support system to prevent adverse drug events. Christian Nøhr, Sanne Jensen, Henrik Gliese Pedersen & Anne Marie Kanstrup. Aalborg University, Cooperate IT & IBM/ACURE.

4. Designing a Sociotechnological Intervention to Improve Snacking in Low SES Families. Danish U. Khan, MS, An T. Le & Katie A. Siek University of Colorado Boulder.

5. Designing for Ease of Use of Inpatient Technology to Communicate Medication Therapies. Lauren Wilcox, Steven Feiner & David Vawdrey. Columbia University.

6. Designing interactive health risk assessments via friendly "small talk". Saraswathi Bellur, The Pennsylvania State University.

7. Determinants of Success for Healthcare Information Systems: Process, System and User Characteristics. Anna Sidorova, Alaa I. Al Beayeyz. University of North Texas & King Saud bin Abdulaziz University for Health Sciences.

8. Does Technology Acceptance Determine Attitudes Towards Health Information Technology? The case of Electronic Remote Blood Delivery. Katherine M. Sellen, Jeannie L. Callum, Jacob Pendergrast, Mark Chignel, Sharon E. Straus & Allison Halliday. University of Toronto, Sunnybrook Health Sciences Centre & University Health Network, St Michael's Hospital.

9. Dogs Walking People: A Sensing and Feedback System for Increasing Participation in Dog Walking. Jianling Fang, Rachael Purta, Dan Kestranek & Erika S. Poole. DePauw University, Hiram College & The Pennsylvania State University.

10. Factors Affecting the Competitive Advantage of the South Korean Medical Tourism Industry. Sung-Woock Cho & Vijayan Sugumaran. Sogang University & Oakland University.

11. Get Movie-ing—Machinima for Behavior Change. Pablo E. Paredes, Stephen Schueller & John F. Canny. University of California, Berkeley & University of California, San Francisco.

12. Illness Trajectory Alignment Work as a Help Mechanism for Individualized Problems in Chronic Disease Management. Jina Huh & Mark S. Ackerman. University of Washington & University of Michigan.

13. Increasing the Transparency of Patient-Provider Email with Real-Time Monitoring. E. Vance Wilson & Bengisu Tulu. Worcester Polytechnic Institute.

14. Interactive Robot Environments in Healthcare. Ian D. Walker, Johnell O. Brooks, Keith E. Green, Joe Manganelli, Linnea Smolentzov, Tony Threatt, Paul M. Yanik & Jessica Merino. Clemson University.

15. Investigating Socio-technical Requirements for an Inclusive Medical Classification. Gargi Bougie, Fernando Figueira Filho & Margaret-Anne Storey. University of Victoria.

16. Maintaining the standard: challenges in adopting best practice when designing medical devices and systems. Christopher J. Vincent & Ann E. Blandford. University College London.

17. Modeling Meaningful Use as Utility in Emergency Medical Services. Steven R. Haynes. Penn State University.

18. Monitoring Cognitive Function Using Features of Keyboard Interactions. Lisa M. Vizer, University of Maryland, Baltimore County.

19. Optimal Continuity of Care Document (CCD) Visualization Based on User Centered Principles. Hassan A. Khan & Mark L. Braunstein. Georgia Institute of Technology.

20. Seeing the Forest for the Trees: Making Electronic Medication Administration Records Usable Through Interactive Visualization. Jonathan P. Wanderer & Andrew S. Karson. Massachusetts General Hospital.

21. Social Dynamics of Coping in Telemedicine Implementations: Triggers and Reappraisals. Jennifer L. Claggett. University of Georgia.

22. Testing the Usability of a Computerized Interactive Intervention for Reducing Racial Disparities in Prostate Cancer Screening Discussions. Roxana Maffei. Columbia University.

23. The Online Personalized Vaccination Scheduler: Putting Vaccination History in the Hands of Parents and Practitioners. Sheila D. Isbell & D. Scott Appling. Georgia Tech Research Institute.

24. The Potential to Integrate Computational Thinking into K-12 Health Curriculums. Christopher L. Schaefbauer & Katie A. Siek. University of Colorado, Boulder.

25. Towards Understanding Diabetic, HIV+, Chronic Pain and Cancer Communities in Second Life: An Exploratory Study. Saira N. Haque, Elizabeth F. Dean, Ashley Richards, Brian Head & Michael Keating. RTI International.

26. Tracking Technology Lessons Learned in Two Health Care Sites. Jeff Craighead, Mary Elizabeth Bowen, Angel Klanchar, Jan Jasiewicz, Chadwick A. Wingrave & James A. Haley. Veterans Hospital & University of Central Florida.

27. Visualizing Physical Therapy with Electroluminescence Wire. Swamy Ananthanarayan, Alice Y. Chien, Miranda Sheh & Katie A. Siek. University of Colorado Boulder.

28. When workflows are not so routine: A case study of a preventable adverse drug reaction in an interventional cardiology unit. Saira N. Haque, Carsten S. Østerlund, Lawrence M. Fagan. RTI International, Syracuse University & Stanford University.

29. Who should have access to my personal health record? Patients' perspectives. Kaitlin Light Costello & Barbara M. Wildemuth. University of North Carolina at Chapel Hill.

30. Using mobile technology and patient incentives to improve care: a novel approach for diabetic patients. Katherine Blondon. University of Washington.

31. "Information Management and Continuity of Care in Bone Marrow Transplant". Ayse Buyktur. University of Michigan.

32. "An Organizational Informatics Analysis of Colorectal, Breast, and Cervical Cancer Screening Clinical Decision Support and Information Systems within Community Health Centers". Timothy Carney. Indiana University -Purdue University Indianapolis.

33. "Opinion Leader Effects, Individual Learning Behavior, and Healthcare Information Technology Adoption: A Mixed Method Approach". Haijin Hao. Carnegie Mellon University.

34. "Can IT Improve Child Health in Developing Countries? Experimental Evidence from Guatemala". Sarah Humpage. University of Minnesota.

35. "Automating Clinical Audit and Feedback for Guideline Adherence in Malawi". Zach Landis Lewis. University of Pittsburgh.

36. "Designing Health Systems for Understanding". Aqueasha Martin. Clemson University.

37. "A Qualitative Evaluation of Healthcare Information Technology Used For Test Result Management in Small Independent Practices". James McCormack. Oregon Health & Sciences University.

38. "Design and evaluation of tracking tools for cancer patients: what patients want". Rupa Patel. University of Washington.

39. "Responsibility and Timeliness in Complex Workflows: Generating User Interfaces from Process Models". Sureyya Tarkan. University of Maryland.

40. "User Interfaces for Communicating Inpatient Medication Therapies". Lauren Wilcox. Columbia University.

Results

Four themes were consistently present throughout the workshop keynote presentations, panels, papers, and posters. They included: (1) How to foster innovation in HIT (2) The benefits and challenges of theory-driven HIT design, (3) Adoption and meaningful use of HIT and (4) Conducting interdisciplinary research in HIT. We discuss these themes in greater detail below.

How to Foster Innovation in HIT

Our first keynote speaker, Dr. Elizabeth Mynatt introduced the first workshop theme. In her presentation, Dr. Mynatt described the slow rate of innovation in HIT and even slower rate of adoption of novel technological solutions into standard healthcare practice. Indeed, it is a known fact that the healthcare industry is slow to adopt innovation; studies show that it takes, on average, 17 years for new treatments and procedures to become integrated into regular clinical practice (Balas and Boren, 2000). In the case of technological innovation, the delay is even greater. Whereas the first Electronic Health Record systems were introduced over 30 years ago, their adoption by clinicians remains extremely limited (Bates, 2005). Dr. Mynatt challenged workshop attendees to consider whether healthcare is experiencing the *innovator's dilemma*: a state when an industry becomes so set in its ways that it rejects anything that does not conform to the established norms (Christensen, 1997). Using terms coined by Clayton M. Christensen, Dr. Mynatt suggested that one way to overcome this dilemma is by introducing *disruptive innovations* that go against the status quo and open up the space for new concepts and possibilities. Examples of such disruptive technologies in the healthcare domain include applications that empower patients by supporting wellness and health management, independent problem solving, and knowledge sharing within communities of people that have shared health concerns. Such technologies operate outside of the boundaries of the traditional medical system by challenging a model of healthcare delivery through limited engagement between patients and providers. By opening up new opportunities for patient-centered health management and promotion, these tools have the potential to revolutionize modern healthcare.

The Benefits and Challenges of Theory-Driven HIT Design

Another timely theme concerned the use of theory in HIT research. Within Human-Computer Interaction (HCI), researchers have increasingly used theories of behavior change to guide the design and evaluation of health systems. In one panel at WISH, researchers from both the HCI and biomedical informatics communities described how they use theories and models to design system features, and the impact of these systems on users' health attitudes and behaviors. They described how they used well-established health behavior theories to design and rigorously evaluate a range of systems; from sensor-based mobile tools and social networking applications that encourage physical fitness to educational games focused on nutrition.

Theories of behavior and attitude change provide a useful starting point for creating interactive tools: medical frameworks and models can help designers identify empirically validated influences on behavior, as well as the factors that mediate those influences. However, while these models may be of potential use, an important challenge lies in choosing theories that

are in line with the behavioral target of the system features being designed (*i.e.*, the behavior that the tool is attempting to encourage or discourage). Consequently, it is important to expand the repertoire of theories that designers employ (Consolvo et al., 2009). Furthermore, in the ongoing effort to bridge the HCI and biomedical communities, theoretical frameworks can give researchers a common language for characterizing the health issues we focus on and for evaluating the impact of our tools.

Adoption and Meaningful Use of HIT

Not surprisingly for the workshop on interactive systems, the issues of user adoption and acceptance were central to the subjects discussed during the workshop. One discussion revolved around the concept of "meaningful use" that has been recently applied to Electronic Health Record (EHR) systems (Blumenthal and Tavenner, 2010). In this context, meaningful use represents a vision and a set of criteria for evaluating the level of adoption of EHR systems by their intended users. Recent government initiatives allocated considerable funds to foster adoption of EHR through incentives. However, to become eligible for such incentives, users, in this case, healthcare providers will need to demonstrate that they not only purchased EHR software but that they also "meaningfully" integrated it in their practice. A Meaningful Use Committee, consisting of representatives of researchers, legislators, physicians, patient advocates, among others, has generated a set of criteria that define what it means for a clinic to meaningfully adopt an EHR system (Blumenthal and Tavenner, 2010). These criteria reflected a set of requirements for the vendors of commercial EHR systems for features and functions their products must support.

The participants of the workshop, and particularly, of the panel on Meaningful Use, raised a diverse set of issues relating to this concept. From the perspective of the government initiatives, having a clear and consistent set of criteria that help to fairly distribute incentives is critical for the success of these initiatives. From the perspective of the clinical and hospital IT management, these criteria have the power to introduce much desired consistency among vendor products. At the same time, as HCI research has highlighted, the adoption of technologies is often messy and unpredictable; users of technologies often find ways to reinvent and redefine the technologies through creative appropriation. Setting strict criteria for meaningful use too early in the adoption cycle may prevent users from creatively exploring the potential of EHR technologies and contributing to the shaping of these technologies in the future. In addition, such set of criteria may stifle innovation and prevent new entrepreneurs from entering the HIT market. The panelists agreed that while there are clear benefits to defining meaningful use criteria, they should be approached with caution and may have a number of unintended consequences.

Conducting Interdisciplinary Research in HIT

A reoccurring theme of the workshop was the need for interdisciplinary approaches to addressing HIT research problems. Both keynote speakers discussed the importance of having researchers from different disciplines collaborating on HIT problems. Their comments connect to the growing call from bodies such as the National Institute of Engineering and the Institute of Medicine (Reid et al., 2005) to address HIT issues from multiple perspectives. HIT research involves not only understanding the technical challenges but also requires an understanding of the wide variety of users and the particular organizational/social contexts of these technologies.

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However, there are some important challenges to conducting interdisciplinary research in this field. One that was raised by many participants was the different disciplinary languages. For instance, the term "adoption" could raise a very different set of understandings in the HCI community as opposed to the biomedical informatics community. Consequently, it is important to bring together members of these different communities at events such as WISH so that they can learn about each other's languages and understandings.

Furthermore, within HCI and also biomedical informatics, there is an increasing focus on designing technologies that will empower the patient by providing them the ability to keep their own medical information, by connecting them to a broader community of individuals who have the same problems, or by motivating them to stay healthy. Hence, the importance of interdisciplinary research is growing because of the spread of health technologies outside of the "traditional" clinical settings and the changing nature of what constitute a HIT. This requires not only HCI researchers but also biomedical informatics researchers, healthcare researchers, and many others to successfully tackle the complex HIT challenges.

Summary

WISH 2011 successfully brought together disparate communities to address issues of mutual interest related to the design, implementation, and use of interactive systems in healthcare. We had over 100 participants from both the HCI and biomedical informatics communities.

One of the key outcomes of WISH was the agreement that we need to foster greater collaboration between the various communities that are interested in the design, implementation, and use of HIT. It is important that we do more than mutually respect each other's work but rather truly reach out and try to collaborate with members of the different communities. Attendees acknowledged that this is not a simple task, but one that we must attempt if we want to really address the wide variety of issues in HIT specifically and healthcare more generally.

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