Evidence-based Health IT for Patient-Provider Communication

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Abstract
Priority Contact is an interactive system integrated into the workflow of clinical care to measurably improve patient-clinician communication about test results. We describe how the system was designed and developed using a powerful, new, evidence-based approach to health IT called MATH, which includes a suite of tools that integrates the design of information systems with the design of improved clinical workflows. MATH enables workflow verification, safety analysis, and other techniques crucial for the acceptance of health or safety-critical systems.

Author Keywords
Clinical workflow analysis; evidence-based HIT; human-systems integration

ACM Classification Keywords
H.1.2 [MODELS AND PRINCIPLES]: User/Machine Systems---Human Factors; H.5.2 [INFORMATION INTERFACES AND PRESENTATION (e.g., HCI)]: User Interfaces---Evaluation/methodology; J.3 [LIFE AND MEDICAL SCIENCES]: Medical information systems

Introduction: Paradigm Shift in Primary Care
The paradigm of primary care delivery, especially for chronic illness, is shifting to one in which patients play a larger role in their care outside the clinic [5]. This

evolution requires timely, reliable and efficient communication among all members of the care team, including communication of test results and treatment planning with patients [2]. Patients' preferred mode of communication about test results is a phone conversation, which is historically the most difficult to achieve [3]. Although providers report spending a significant amount of time managing test results [8], the timely reporting and follow-up of test results remains a problem [9], one that is magnified by persistent difficulties achieving contact with patients.

Introducing Priority Contact

Here we describe an interactive system called *Priority Contact* that can improve the workflow by which both synchronous and asynchronous patient-clinician communication are achieved. We describe how the application was designed and developed using a new, evidence-based approach to health information technology (HIT). We conclude by outlining a powerful new research direction for human-systems integration, which will enable workflow verification, safety analysis, and other techniques that are important to health or safety-critical systems.

Priority Contact, which won an award in the national challenge competition *SMART Apps for Health*, was created as part of an innovative evidence-based approach to designing HIT that depends on capturing and analyzing clinical workflow. In-depth studies of primary care revealed that contacting VA patients regarding test results is a problem area that costs doctor/staff time. Based on our studies of primary care workflows, we identified and articulated the taxonomy in Table 1 (sidebar), which describes providers' prioritization and policy regarding patient contact based on the significance of the patient's lab results. We modeled the four unique workflows for contacting patients to correspond to the four priorities in Table 1.

Table 1. Taxonomy for determining contact priority

Priority	Test result
Priority 1	life threatening health condition
Priority 2	life-changing health condition
Priority 3	routine change in treatment
Priority 4	no treatment change required

In the simplest terms, *Priority Contact* achieves human-system integration for the workflow of patient communication to eliminate virtually all non-productive time spent in phone tag. Using Twillo's Web voice services,[1] *Priority Contact* was built to wait in the background until a provider decides to contact a patient at which time s/he (1) enters a patient's identification, (2) selects the contact priority (from 1-4), and (3) reviews, edits, and launches a *Contact Plan*. *Priority Contact* then harvests the EHR for the remaining information it needs to initiate the selected workflow to carry out the *Contact Plan*. *Priority Contact* does not replace real-time conversations between doctors and patients—it enables them to happen faster and with less frustration and wasted effort. The algorithms for each priority's plan were derived from the current, pre-intervention workflows and achieve the same goal, but far more efficiently by integrating HIT and manual tasks.

Designing Priority Contact

Usability is a critical issue for the acceptance of EMRs [4], however many current design methods were intended for office applications, and never intended for health/safety-critical systems. Conventional EHR design is rooted in these methods, which are feature-based: they focus on use of the software's features almost to the exclusion of any coherent account of the way it changes workflow [1]. If changes to workflow are left implicit then the resulting impact on clinical care is unpredictable and risky. To understand the impact on

[1] http://www.twilio.com/voice

Modeling and Analysis Toolsuite for Health IT (MATH)

1. MATHflow is used to capture, analyze and integrate workflow and information flow in a format that clinicians and software engineers can both readily understand.
2. MATHsim incorporates metrics for workflow improvement and discrete-event simulations to analyze candidate workflow changes.
3. MATHview is used to generate and analyze key software artifacts for HIT, such as the information architecture that is required to support a desired workflow.
4. A repository based on standards supports the management of all models and their data to enable interoperability of the MATH tool suite tool and with other systems.

clinical workflow, rigorous design methods are needed to achieve human-systems integration, which includes the roles of medical professionals who work in teams, the role of software agents, and the role of patients.

Priority Contact was designed using MATH[2], a rigorous method that enables participatory design by medical professionals in collaboration with software engineers. MATH is supported by a toolsuite that builds on the recent BPMN standard[3] and uses evidence to guide HIT design that builds-in improvements to the efficiency and quality of clinical care. MATH makes this impact an explicit part of HIT design instead of an unpredictable response to the design. The MATH software toolsuite (see sidebar) delivers technical innovations in five important areas:

1. Integrates workflow modeling with information flow modeling;
2. Identifies information problems and solution options, and integrates the design of HIT functions with manual tasks to form a coherent overall workflow;
3. Prioritizes options for HIT functions on the basis of measurable benefit to workflow;
4. Adapts concurrent engineering to synchronize the information systems design with improved workflow;
5. Provides a clear connection between improvements to clinical workflow and the design of the HIT software.

Priority Contact is one example of how MATH can capture current care, analyze HIT options for measurable workflow improvement, and provide evidence to inform the selection and development of a cost-effective HIT solution. By filling the strategic gap left by conventional tools and approaches, we can move toward a vision for HIT in which it serves to control health care cost while improving quality. Our vision for MATH is not so much to design technology but to enable HIT to serve health care leaders as a means to implement better care strategies and policies.

[2] Modeling and Analysis Tool Suite for Healthcare).

[3] Business Process Modeling Notation is a standard of the Object Management Group.

Ongoing Evaluation

Discrete event simulations estimated that *Priority Contact* can reduce the unproductive time for patient-provider communication by as much as 40%.

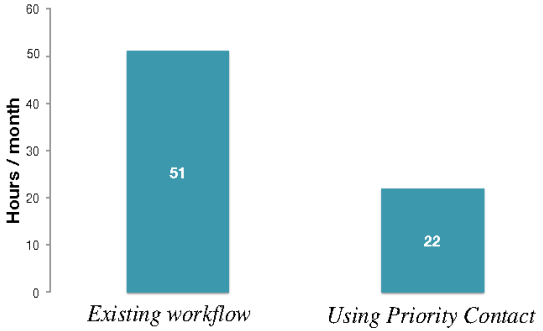

Figure 1. Comparison of hours spent contacting patients between the existing system and using Priority Contact

We are currently collaborating with the Veteran's Administration Puget Sound Health Care System (VAPSHCS) on an alpha test in which we will collect objective and subjective data to evaluate *Priority Contact* and validate predicted benefits with primary care clinicians in their own clinical work settings. The software will log usage and time data during the trial,

and we will collect users' feedback via an administered questionnaire to compare baseline measures with those obtained during the trial.

Research Directions

MATH was developed to support the growing demand that successful health IT must be grounded in an understanding of how it will improve the workflow of clinical care [6, 7]. The near-term research on MATH is focused on validating simulation results for *Priority Contact*, and plans are in place for new studies in clinics for MS, pain management, and hospital admissions.

In the mid-term we will focus on iterative design. Successful workflows must address a wide range of factors, including appropriate patient care procedures, facilities, local clinic policies, staff strengths and weaknesses, and the allocation of work functions among people and computing devices. Iterative design is an important technique for achieving the necessary balance among this complex combination of factors.

Although MATH enables iterative, model-based design that is far more affordable and accurate than conventional software prototyping or release-over-release corrections, in our experience there are two important obstacles: (1) the amount of highly skilled labor required to create and revise workflow models; and (2) the complexity of models and the importance of verifying them. In order to reduce the labor of modeling, the new release of MATH includes the capability to save sub-processes into a library of reusable components. For verification, we are planning a three-year project with NASA/Ames to adapt AI planning technology to implement a verification-critique capability to operate on the next generation of MATHflow models.

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References

[1] Beck, K. (1999) Extreme Programming Explained: Embrace Change (2nd Ed.). Addison-Wesley.

[2] Bipartisan Policy Center Health Information Technology Initiative. Improving Quality and Reducing Costs in Health Care: Engaging Consumers Using Electronic Tools. Washington D.C. 2013.

[3] Elder NC, Barney K. "But what does it mean for me?" Primary care patients' communication preferences for test results notification. Jt Comm J Qual Patient Saf. Apr 2012;38(4):168-176.

[4] Health IT Policy Committee Certification/Adoption Workgroup. *EHR Usability and Its Impact on EHR Adoption and Use.* 2011.

[5] Joint principles of the Patient-Centered Medical Home. Del Med J. Jan 2008;80(1):21-22.

[6] Kellermann AL, Jones SS. What it will take to achieve the as-yet-unfulfilled promises of health information technology. *Health Aff (Millwood).* Jan 2013;32(1):63-68.

[7] Middleton B, Bloomrosen M, Dente MA, et al. Enhancing patient safety and quality of care by improving the usability of electronic health record systems: recommendations from AMIA. *J Am Med Inform Assoc.* Jan 25 2013.

[8] Poon EG, Gandhi TK, Sequist TD, Murff HJ, Karson AS, Bates DW. "I wish I had seen this test result earlier!": Dissatisfaction with test result management systems in primary care. Arch Intern Med. Nov 8 2004;164(20):2223-2228.

[9] Sittig DF, Singh H. Improving test result follow-up through electronic health records requires more than just an alert. J Gen Intern Med. Oct 2012;27(10):1235-1237