Title Page

Title of Project: Patient Reminders and Notifications

Principal Investigator: James D. Ralston, MD MPH

Other team members:
  Jennifer McClure, PhD
  Paula Lozano, MD MPH
  Linda Kiel, MA
  Luesa Jordan
  Zoe Bermet
  Wanda Pratt, PhD
  Jordan Eschler, PhD
  Katie O'Leary
  Logan Kendall, PhD
  Lisa Vizer, PhD
  Leslie Liu, PhD

Organization: Kaiser Permanente Washington Health Research Institute, formerly Group Health Cooperative

Inclusive Dates of Project: Initial grant period: 08/01/2013 – 05/31/2016
                                  No cost extension: 06/01/2016 – 05/31/2017

Federal Project Officer: Shafa Al-Showk, AHRQ

Grant Award Number: 4R01HS021590-03

Structured Abstract

Purpose:
To describe patient needs and preferences for a comprehensive system of care healthcare reminders and notifications. This work will inform future development and testing of patient-centered reminder and notification systems.

Scope:
This study identified user needs, preferences and capabilities for a health reminder and notification system by focusing on two populations of patients with disparate chronic and preventive care needs. One population was women who also manage care for their child under age 12 who had asthma. The second is patients with diabetes and other chronic health conditions including hypertension and coronary artery disease.

Methods:
Content and functional specification of reminders and notifications were developed with techniques of user-centered design and based on the Chronic Care Model conceptual framework.

Results:
User needs assessment and prototype testing established core design features for improving healthcare reminders and notifications including minimizing the extensive work of integrating healthcare reminders into the home environment; accommodating the variation of reminder tools in the home; tying reminders and notifications to individual's values and where they carry emotional meaning, like the memory of hard time or the support of a relationship; matching the design of persuasive reminding to the individual and task; ensuring that reminders reflect and support collaboration with healthcare providers: and enabling reminders to support shared tasks and interpersonal ties within social networks. These design principles can help guide healthcare providers and health information technology developers towards more effective and patient-centered care.

Key Words: patient-provider communication, chronic illness care, care management

PURPOSE

The overall goal of the project was to describe patient needs and preferences for a comprehensive system of care notifications and reminders in two patient groups. The results of this study provide design specifications needed for further study and development of patient reminder and notification systems across health care systems.

We had two specific Aims:

- **Aim 1: Establish the needs and preferences of patients for notifications and reminders** by studying patient workflow models, user requirements, personal communication patterns, and contextual factors.

- **Aim 2: Build and test a prototype of a patient-controlled health reminder and notification system** using iterative rapid prototyping and other user-centered design methods to clarify core design elements and establish the feasibility of integration with the patient-centered medical home.

Background

Patient reminders and notifications are effective at helping people reach health goals. They alert people to schedule medical visits and screenings, remind people how to take complex medical regimens, and provide a liaison between patients, providers, and the health care system. When combined with fully functional electronic health records, new communication technologies are an opportunity to contact patients more often with a more comprehensive set of reminders and notifications than previously possible.

Despite their promise, reminders and notifications, if poorly designed, can overwhelm or annoy patients and undermine their effectiveness. Questions also remain about patients' preferences for receiving more comprehensive reminders and notifications or using newer communication channels to interact with their health care providers. Moreover, the effectiveness of such enhanced communication systems is unclear.

Context

Most studies of reminders have focused on a single health care need or condition and a single delivery mode, such as postal mail or the telephone. We know little about real-world use of reminder and notification systems for multiple chronic and preventive health care needs targeting a diverse population in varied settings. We also know little about how to use new communication tools such as patient websites linked to electronic health records (EHRs), text messaging, or mobile phone applications for reminders and notifications. In combination with EHRs, these technologies offer opportunities for more frequent contact with patients and a more comprehensive set of messages. However, we do not know the ideal attributes of reminders and notifications including the frequency and timing of contact or the extent to which patients prefer straightforward reminders versus notifications designed to encourage and support behavioral action. In addition, reminder and notification systems have the potential to annoy, overwhelm, or frustrate patients. The impact of individual reminders may diminish as patients receive multiple reminders and notifications. User needs and preferences must also be balanced against threats to the integrity, security, and privacy of health care information involved with newer communication technologies, such as text messaging and social network sites. Designing optimal systems will involve addressing user needs and preferences for reminders and notifications, being sensitive to patient confidentiality, and incorporating the capacity of newly emerging communication technologies such as social media, text messaging, and mobile applications to interact daily with patients.

Settings

This study was conducted at Kaiser Permanente Washington (formerly Group Health), an integrated care delivery system with over 660,000 members in Washington and North Idaho. The proposed study was restricted to the 391,749 members who receive primary care at one of Kaiser Permamente Washington's 28 owned-and-operated clinics. At the time of the study, Kaiser Permanente Washington's membership includes 55,239 Medicare members, 19,089 Medicaid members, and 11,623 covered by the Basic Health Plan (a state supported insurance program for low-income families). The Kaiser Permanente Washington's population is generally similar to that of the surrounding area. Kaiser Permanente Washington had a slightly higher proportion of women (53%) than the regional community (50%) and the nation (51%). Kaiser Permanente Washington's members are also older (46% ≥45 years) than the regional community (38%) and the nation (39%). Compared to the rest of the country, Kaiser Permanente Washington members are more likely to be Asian or Pacific Islanders (9% versus 4%), but less likely to be African American (4% versus 12%) or report Hispanic ethnicity (4% versus 15%). The Kaiser Permanente Washington racial and ethnic composition broadly represents the Puget Sound region. In this study, we purposively sampled the Kaiser Permanente Washington population to simulate the educational status of the U.S. population when possible (approximately 50% with high school or less educational level) and oversampled racial and ethnic minorities (see Study Population below for details). Kaiser Permanente Washington uses an ambulatory EHR system (EpicCare) that

includes clinical decision support features, secure provider-to-provider messaging, and an EHR-integrated online medical record shared with patients (www.ghc.org). Features include secure patient-provider electronic messaging and online patient access to medical record elements, including results of medical tests, after-visit summaries, and mobile extensions of the integrated personal health record for iPhone and Android smart phones. Currently, at Kaiser Permanente Washington, several reminders are part of the annual birthday letter sent out to each enrollee. Some reminders also appear on the patient website. Like many US healthcare systems, notifications of medical test results are sent through US mail letters and email ticklers recommending going to the new test results on the patient website or mobile application. Email notifications are also sent if a new secure message from a provider is present on the patient's website.

Table 1: **Characteristics of Patient Participants in Needs Assessment**

	Total	Asthma		Diabetes	
	N	N	%	N	%
	40	20	100	20	100
Median Age (Years)	54.5	37.0		64.0	
Mean Age (Years)	54.5	37.5		64.5	
Race & ethnicity					
Asian	2	0	0	2	10
Black	12	6	30	6	30
Hawaiian	1	1	5	0	0
Indian	0	0	0	0	0
Mixed	1	0	0	1	5
Other	2	1	5	1	1
Unknown	2	2	10	0	0
White	20	10	50	10	50
Hispanic*	2	1	5	1	5
Online health portal use					
User	27	17	85	10	50
Non-user	13	3	15	10	50
Education					
>High school	28	16	80	12	60
High school or less	12	4	20	8	40

*Hispanic ethnicity designation overlapped with other designations of race; total is > 100%

Participants

Aim 1: Table 1 shows the characteristics of the 40 individuals in our needs assessment. As shown in the table, we purposively sampled individuals with minority racial and ethnic backgrounds in order to more closely align our participant group with the demographics of the overall US population. Participants with high school or less formal education level were difficult to recruit, particularly for the mothers of children with asthma. We were still, though, able to recruit 30% of the overall population with a high school or less educational level. Since portal use in the KP Washington population had also grown to over 70% of members overall with even higher use among those with healthcare needs such as diabetes and asthma, we also changed our initial sampling plan from half portal users to just under 70% portal users.

Aim 2:

Aim 2 had four stages of patient and provider engagement in design. In the first stage, we engaged three cohorts of patients in two sequential sets of futures workshops to help envision ideal reminder and notification systems; cohorts consisted of patients with diabetes and mothers of children with asthma. In the second stage, we engaged three cohorts of participants in two sequential participatory design sessions; cohorts consisted of a mix of patients, mothers of children with asthma and healthcare

providers. **Table 2** shows the demographics of patient participants in participatory design sessions. Providers involved in these sessions included 6 primary care providers, 3 medical assistants and 3 nurses

In the third stage of Aim 2, we held two sequential prototype testing sessions with 15 patients. Prototypes for the second session were iterated based on feedback from the first session. We also held 2 separate prototype testing sessions with 15 providers (7 PCPs, 7 MAs, 1 nurse). In stage four, we tested a series of designs specifically focusing on new reminder and notification functionality in the patient portal. This final stage included prototype testing with 19 patients.[1]

Table 2: Aim 2: Participant Demographics for Participatory Design		
	Mothers of children with Asthma	**Older adults with Diabetes**
	N=11	N=12
Age		
Range (yrs)	31-45	54-89
Mean (yrs)	38	73
Race		
African American	5	6
Nat. Amer/Alask.	0	0
Hispanic	0	0
White	6	6
Education		
High Sch. or less	2	4
Some College	5	2
4YR College	1	2
+4YR College	3	4

Incidence and Prevalence
Measuring incidence and prevalence was not part of this study.

Methods
Study Design
We used mixed methods grounded in a user centered design approach. Specific methods included ethnographic interviews, Q methodology, photo elicitation, participatory design workshops, and prototype testing.

Statistical Analysis
Statistical analysis was only applicable for Q-methodology. All other analyses were qualitative. For Q-methodology, we used PQMethod software in factor analysis to help identify clusters of individuals with shared attitudes towards self-management of chronic illness and use of communication technologies.[2]

Data Sources/Collection
Data sources included the following: transcribed interviews; photos by participants; surveys of attitudes towards communication technologies and self-management of chronic illness; Q data sets; recordings, artifacts, transcripts and notes from participatory design workshops; audio and video recordings, transcripts and notes from prototype testing sessions.

Measures and Survey Items
Survey measures were used only for Q methodology where we adapted self-reported survey questions from Davis' measure of the perceived usefulness, ease of use, and user acceptance of technology[3]; the patient assessment of chronic illness care (PACIC) and measures of autonomous support. [4,5]

Limitations
Our comprehensive approach to reminders and notifications did not permit us to target all redesign processes and follow-up activities involved in chronic care and preventive care. We were also challenged to make the reminder and notification system simple and visible to a large population of patients. To address this, we engaged the most diverse set of patients allowed by our methods and resources.

<center>**Results**</center>

Principal Findings

We summarize our principle findings by Aim below and then by core design principles. Further details are in peer reviewed publications (9 published, 2 in process). Results not yet published or in submission have more detail below.

Aim 1: *Establish the needs and preferences of patients for notifications and reminders by studying patient workflow models, user requirements, personal communication patterns, and contextual factors.*

Methods Development:

To begin our work, we published two methods papers to more effectively, efficiently and respectfully elicit patient stakeholder input on needs and preferences for designing better healthcare reminders and notifications. We also published a third paper on the development of Q methodology to help understand design tradeoffs for tailoring health technologies to different populations. These methods can also be applied for eliciting patient and family needs for other health information technology applications.

1. *Systematic inquiry for design of health care information systems: an example of elicitation of the patient stakeholder perspective (published).* [6] This paper describes the application of the Vicente theoretical framework to organize qualitative data during our multistage study into patient engagement with health information technology. The framework helped us develop interview probes for encouraging patient narratives of engaging with reminders in task cycles in their home. This approach allowed a more full description of individual and family work rather only on positive or negative aspects of experiences with reminders systems.

2. *Opportunities for empathetic responses in field interview scenarios investigating home health routines (published).* [7] This paper sought to identify and describe effective interview approaches for fostering empathy with participants during the design process. Empathy with participants who were living with chronic health conditions was considered essential for building trust and engaging participants in the design process. The study was performed at midpoint in the data collection from patient and family interviews in the first phase of Aim 1, which allowed application of the findings to follow up interviews and other study activities. We identified factors valuable for enhancing empathy during participant interviews including active listening methods during expressions of frustration about a diagnosis and feelings of guilt or failure in treatment and prevention of health conditions.

3. *Understanding design tradeoffs for health technologies: a mixed methods approach (published).* [8] In order to better tailor reminder and notification systems, we sought to understand how participants' attitudes towards use of communication technologies intersected with their attitudes towards self-management of chronic illness. In this paper, we describe an approach involving a novel application of the Q-method, a mixed methods approach providing a few key advantages for health design science including: a structured framework to guide data collection and analysis; enhanced coding of unstructured data with statistical patterns of polarizing and consensus view; and elicitation of participants active expression and weighting of competing values relevant to healthcare design(see below for separate paper on Q method results).

Patient Work, Mental Models and Motivation

In a series of analyses, we developed an understanding of how participants remember what to do during daily life to inform better design of healthcare reminders and notifications. For these studies, we viewed healthcare reminders and notifications within the larger context of self-management of chronic illness.

1. *Shared calendars for home health management (published).* [9] Our home visits and interviews quickly established that home calendars were a central tool for helping participants and families remember tasks to do each day. This paper described the how 40 of our adult participants (20 each of mothers of children with asthma and individuals with type 2 diabetes) used shared calendars to support home management. We report on both the diverse systems of home calendar management, including the common use of multiple calendars within a home, and failures experienced. We then describe implications for schedule management strategies for

<center>7</center>

individuals and families who need to remember and incorporate the common tasks of caring for chronic illness.

2. *Engineering for reliability in at-home chronic disease management (published).*[10] In this paper, we examined remembering to perform healthcare tasks in the home from the perspective of prospective memory theory and systems reliability engineering. Based on participants' experiences, failures in remembering to perform self-management activities should be viewed as system failures rather individual failures. Participants also described several design strategies used to enhance the reliability of systems designs for remembering to perform self-management tasks. We discuss how these results can be used to improve the reliability and experience of healthcare reminder systems.

3. *Understanding patients' health and technology attitudes for tailoring self-management interventions (published).*[2] In this publication, we used mixed methods approach (described in publication #3 under Methods Development) and maximum variation sampling to describe the intersection between attitudes towards communication technologies and attitudes towards self-management of chronic illness in 40 of our participants. We found three participant clusters, "Proactive Techies", "Indie Self Managers" and "Remind Me! Non-techies" which were independent of education level, race and age. These results are valuable for informing tailored design of reminder and notification systems.

4. *Designing Asynchronous Communication Tools for Optimization of Patient-Clinician Coordination (published).*[2] Since an increasing number of healthcare reminders and notifications are communicated asynchronously between provider visits, either electronically or through US mail, we sought to understand how designers can avoid pitfalls and optimize new opportunities in this growing and evolving form of communication. Key themes emerged associated with both unsatisfactory and satisfactory asynchronous communication. For good communication, these themes included the following: enhancing care with followup; reducing uncertainty in plan of care; and providing an automatic health archive to reference later. Themes of unsatisfactory asynchronous communication included failing to track issues, including closing the loop on reminder and notification communications, and exposing patients to inconsistent communication patterns. Key design recommendations for asynchronous health communications included incorporating patient preferences for non-urgent information exchange and incorporating status indicators in asynchronous communications including reminder and notifications.

5. *Finding Reminders in the World: How Individuals Support Motivation and Tasks in Managing Chronic Illness (in revision for submission).*[11] In our home visits, we heard clearly that day to day remembering and performing health self-management tasks can be a tremendous burden for patients. Motivation to complete these tasks is often a big challenge. After sending our participants home with Polaroid cameras in the followup phase of the study, we discovered participants were often appropriating everyday things to both remember and motivate themselves to perform healthcare tasks. These included artifacts in the home, such as the display of a cane that prompted a memory of former disability associated with lack of self-management; and emblems of motivating relationships, such as pictures of loved ones. These were the most potent reminders we found and highlight new opportunities for providers to engage patients in identifying and developing a motivating and effective environment for health in the homes.

Aim 2: *Build and test a prototype of a patient-controlled health reminder and notification system using iterative rapid prototyping and other user-centered design methods to clarify core design elements and establish the feasibility of integration with the patient-centered medical home*.

1. *Persuasive Reminders for Health Self-Management (published).*[12] During participatory design sessions, patients used a combination of storyboards, collages and cultural probes to describe future reminder systems that could support fulfillment of tasks of managing chronic illness. Participant's ideas and prototypes for these idealized reminder systems identified four key types of persuasive healthcare reminders: introspective, socially supportive, adaptive and symbolic. Including these features in reminder design can help support patients to understand why and

how to complete healthcare tasks ahead of time.

2. *Collaborative Health Reminders and Notifications (drafted for submission).* During this final phase of the project, we iteratively designed and tested prototype reminder and notification systems in two iterative phases. To develop prototypes, we began with a synthesis of needs analysis from Aim 1. This needs analysis then fed into value scenarios which were used with designers in an inspiration workbook. Based on the results, we developed and tested with participants low fidelity prototypes including a Symbolic Reminder Band, Social Reminder App, a Reminder Invitation, a Discovery Tool (**figure 1**) and a Conversational Tool (**Figure 2**). We show picture of two of these tools below. The discovery tool was created to explore how patients gain clarity around their healthcare and how they communicate their need for that clarity with their provider from outside of the clinic after receiving a notification.
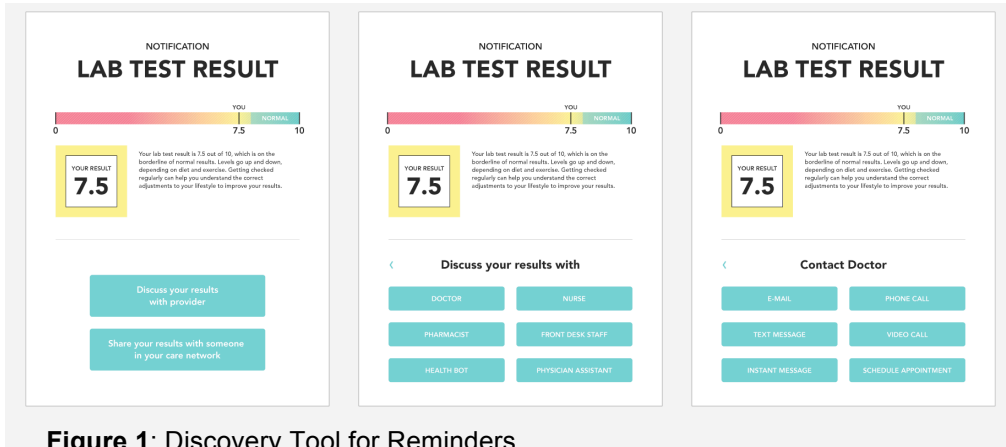

Figure 1: Discovery Tool for Reminders

The conversational tool was created to explore how patients and providers might collaborate in the clinic on creating reminders around unique patient challenges and strategies to overcome those challenges.

Preliminary analysis of the results of prototype testing found that participants emphasized the importance of designing collaborative health reminders and notifications with particular attention to three domains: (1) Enable the patient-provider relationship; (2) Support shared action on health tasks; and (3) Promote interpersonal ties based on shared health tasks and goals. Participants also reported on the potential challenges of collaborative reminders, including administering reminders across social networks.
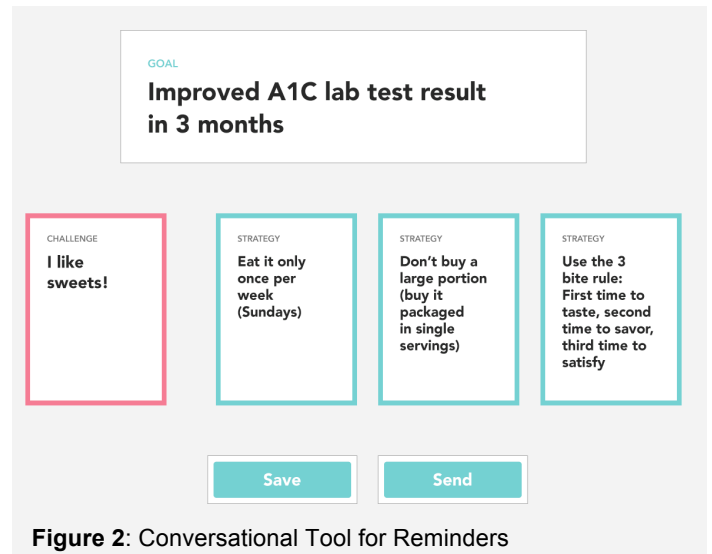

Figure 2: Conversational Tool for Reminders

3. *Integrating the Patient Portal into Health Management Work Ecosystems User Acceptance of a Novel Prototype (published):* [1]. In this paper, we built on our earlier to work to elicit feedback about reminder and notification features in patient portals. We used a patient centered approach to design and test prototypes of new features for managing health tasks within an existing portal tool. We iteratively tested three prototypes with 19 patients and caregivers. Implications for design based on our findings included building on the positive aspects of clinician relationship to enable engagement in the portal including patient reminders; using face to face visits to promote clinical collaboration in portal use including reminders for healthcare tasks and notifications of test results; and allowing

customization of portal modules to support tasks based on user roles.

4. *Prototype Feasibility within the Primary Care Setting:* In two group sessions with primary care team members including PCPs, RNs and MAs, we evaluated the feasibility of three prototypes developed with patients and described above. We focused on prototypes most amenable patients and with the most significant potential to impact primary care workflow. The first prototype focused on a new reminder for getting a retinal screening exam in a patient newly diagnosed with diabetes, who did not remember why an exam was needed. The prototype allowed for different options to contact the healthcare provider. Most of the providers emphasized the value of the reminder existing within an ongoing relationship that includes educating patients on the importance of recommended healthcare tasks including retinal exams. While participants endorsed the prototype's overall concept of easily sending questions to providers from a reminder, participants were concerned that the patient didn't sufficiently remember the value of the exam and identified a missed opportunity for the team to inform the patient during prior in person visits. In the second reminder, a patient is notified of a medical test result online and has a followup question. Multiple options for reaching different members of the care team or a health bot are provided. Primary care team members were concerned about being overwhelmed with messages from patients in this prototype and liked the possibility of an automated health bot being the first stop to provide patients with a potential answer. The third prototype was the conversational reminder tool described above. Overall, providers liked this tool the most and thought it had potential, as long as the patient was excited to use it. Providers struggled some, though, with how the tool could be integrated into current primary care staffing and roles. Several providers thought using a health coach or similar new role would enable use of the tool rather than adding to the existing roles of nurses or MAs.

Core Design Principles
Based on the combined analyses and publications above, we outline below the study's core principles for designing better patient reminders and notifications. We have grouped these principles within four broad categories of our findings: reminding and notifying within patient and family workflow; opportunistic reminding; persuasive reminding; and collaborative reminding. Further details describing these principles are included in our publications.

Reminders and Notifications within Patient and Family Workflow. To integrate with the broad ecology of calendaring and scheduling, reminder tools in the home should

- Incorporate patient preferences for modality of non-urgent information exchange.
- Enhance patient followup on reminders and communicate with providers about questions or concerns relating to the healthcare recommendation in the reminder.
- Incorporate status indicators into reminders and other asynchronous communication. These indicators would help build shared understanding and accountability between patients, providers and family members for healthcare tasks and communication.
- Support need for some redundancy in home reminder systems including repeated reminders and diversity of systems used in the home (e.g. paper and electronic)

Opportunistic Reminders. To enable the most potent reminders we identified in our study,

- Healthcare providers should engage patients in identifying or developing artifacts, activities or routines that can both remind and motivate for healthful behaviors.
- Heath IT developers should work to move the power of the opportunistic reminders outside of the home environment and onto mobile applications and into communications with patients and families.

Persuasive reminders. To help reminders be more meaningful and persuasive, tailor reminder design to one of four types to match the task:
- Introspective reminders to trigger reflection goals.
- Socially supportive reminders to enhance motivation and mentoring relationships.

- Adaptive health reminders that change to meet the shifts in health status, task status and modality preference.
- Symbolic reminders reminding of personally significant reasons for health behaviors (e.g. images of a child, dog, garden)

Collaborative Reminders. To support collaboration and relationships with healthcare providers, family and friends, reminders should
- Enable the patient-provider relationship. Participants expressed a strong need for reminder to reflect collaboration with healthcare providers on health goals and tasks and the reminders themselves should in turn enable the patient-provider relationship.
- Support shared action on health tasks across social networks including family and friends.
- Promote interpersonal ties based on shared health tasks and goals including both weak and strong ties.

Discussion
The findings of this project helped address a critical junction in the design and use of patient notifications and reminders. We developed several core design recommendations that can be used by healthcare providers and policy makers as well as health information technology developers. The value of our work was emphasized by the enthusiasm received in its publication including nomination of two of our papers for the outstanding paper award at the Annual American Medical Informatics Conference[2,12] with one paper winning the award.[2] During and after our presentations, we were also sought out by health information technology companies for our results and how they might be applied to current EMRs and patient facing health information technologies. We expect that our results will continue to help guide both health information technology developers and the design of healthcare delivery.

Grounding our project in the approach and methods of user centered design allowed us to identify unexpected challenges and opportunities for designing reminders. We entered the grant believing the main challenges facing patients related to incorporating multiple reminders across an increasing number of platforms of communication into daily workflow and management. We came out of the grant recognizing that the biggest challenges and opportunities focused on designing reminders which better reflected each patient's values and goals developed within collaboration with healthcare providers. We expanded our design probes and prototypes to accommodate this broader set of patient and family needs.

Our study had a few limitations. Due to our use of in depth investigation with individual patients, families and providers, we had a limited number of subjects, all of whom lived in the greater Puget Sound area. We sought to mitigate this limitation by recruiting a sample which better reflected the overall demographics of the United States, including greater representation from those with minority racial and ethnic background and lower formal educational levels. The needs, preferences and abilities for healthcare reminders and notifications, however, may still be different among populations in other regions of the United States. Our participants may also have expressed needs and preferences which may not persist if we had built and deployed a fully functional reminder and notification system within the patient centered medical home. Although our prototype testing helped attenuate the potential for the well-known discordance that can occur between expressed and realized needs and preferences, only a real world testing over months to years would fully clarify the system requirements.

Conclusions
Current healthcare reminders and notifications are not sufficiently meeting patients' needs, preferences and capabilities. Improving healthcare reminders and notifications will require minimizing the extensive work of integrating healthcare reminders into the home environment; accommodating the variation of reminder tools in the home; tying reminders and notifications to individual's values and where they carry emotional meaning, like the memory of hard time or the support of a relationship; matching the design of a persuasive reminding to the individual and task; ensuring that reminders reflect and support

collaboration with healthcare providers: and enabling reminders to support shared tasks and interpersonal ties within social networks. These design principles can help guide healthcare providers and health information technology developers towards making care more effective and patient centered.

Significance

This project addressed a critical junction in the design and use of patient notifications and reminders. The increasing engagement of patients in care outside of office visits, including through using patient websites and mobile communication technologies, offers new opportunities to improve care. The number of potential reminders and patient notifications and the variety of delivery mechanisms also risks overwhelming and alienating patients. In this study we identified key design principals that can help keep reminders and notifications meaningful and effective for patients and families. Many of our findings challenge current approaches to how we remind patients for common health care tasks and notify them of medical test results and other health information.

Implications

Many of our findings can be applied immediately to the design of both healthcare delivery and health information technology. Simple design changes, such as status indicators on a reminder for a task received over a patient website or mobile application could substantially improve communication with patients and may improve the effectiveness of care. Other findings, such as the collaborative reminder tool, have strong potential to improve how we currently deliver self-management support programs for chronic conditions including diabetes. These implementations could be done with little impact on provider workflow and would not require significant changes in staffing or the delivery of care.

The results of our study, however, also highlight many of the larger challenges remaining for the design of better healthcare reminders and notifications. We heard consistently that reminders for healthcare tasks need to reflect a patients values and a shared understanding of healthcare goals and tasks established during collaboration with a personal healthcare provider. Even our best healthcare systems are ill equipped to create and maintain this level of personalized care. The depth of detail needed for individual patient and family engagement in this approach to care is beyond the current structure and financing of healthcare in the United States. These challenges will only grow as the number of healthcare tasks recommended for individuals continues to rise along with the increasing complexity of many patients' care. No health information technology can address these needs on its own. If we are to build more effective and patient centered reminders and notifications that help patients achieve better health, we must invest in better staffing and models of primary care.

List of Publications and Products

Publications:
1. O'Leary KO, Liu L, McClure JB, Ralston JD, & Pratt W. Persuasive reminders for health self-management. Proceedings of the American Medical Information Association, Nov 12-16, 2016. Chicago, IL.
2. Eschler J, Meas PL, Lozano P, McClure JB, Ralston JD, and Pratt W. Integrating the patient portal into the health management work ecosystem: user acceptance of a novel prototype. Proceedings of the American Medical Information Association, Nov 12-16, 2016. Chicago, IL.
3. O'Leary K, Vizer L, Eschler J, Ralston J, Pratt W. Understanding patients' health and technology attitudes for tailoring self-management interventions. AMIA Annu Symp Proc. 2015 Nov 5;2015:991-1000. PMC4765611.
4. Eschler J, Liu LS, Vizer L, McClure J, Lozano P, Pratt W, Ralston J. Designing asynchronous communication tools for optimization of patient-clinician coordination. AMIA Annu Symp Proc. 2015 Nov 5;2015:543-52. PMC4765629.
5. O'Leary K, Eschler J, Vizer LM, Ralston JD, Pratt W. Understanding design tradeoffs for health technologies: a mixed-methods approach. Proceedings of CHI (Human Computer Interaction). April 2015.

6.   Eschler J, O'Leary K, Kendall L, Ralston JD, Pratt W. Systematic inquiry for design of health care information systems: an example of elicitation of the patient stakeholder perspective. In Proceedings of the Hawaii International Conference on System Sciences. January, 2015.
7.   Kendall L, Eschler J, Lozano P, McClure JB, Vizer LM, Ralston JD, Pratt W. Engineering for reliability in at-home chronic disease management. AMIA Annu Symp Proc. 2014 Nov 14;2014:777-86. PMC4419963.
8.   Eschler J, Kendall L, O'Leary K, Vizer LM, Lozano P, McClure JB, Pratt W, Ralston JD. Shared calendars for home health management. In Proceedings of the 18th ACM conference on Computer-Supported Cooperative Work and Social Computing. March, 2015.

Posters and Presentations:
1. Designing Reminders and Notifications for Patients: AHRQ National Webinar. May 7th, 2015

Manuscripts in Preparation:
1. Liu L, O'Leary K, Pratt W, Ralston JD. Opportunistic Reminders in the World: How Older Adults Design Everyday Reminders to Manage their Chronic Illness.
2. O'Leary K, Tenghe D, Pratt W, Ralston JD. Designing Reminders for Socialable Use.

References:
1.   Eschler J, Meas PL, Lozano P, McClure JB, Ralston JD, Pratt W. Integrating the patient portal into the health management work ecosystem: user acceptance of a novel prototype. AMIA Annu Symp Proc. 2016;2016:541-50. PMCID: PMC5333335.
2.   O'Leary K, Vizer L, Eschler J, Ralston J, Pratt W. Understanding patients' health and technology attitudes for tailoring self-management interventions. AMIA Annu Symp Proc. 2015;2015:991-1000. PMCID: PMC4765611.
3.   Davis F. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly. 1989;13:319-39.
4.   Glasgow RE, Wagner EH, Schaefer J, Mahoney LD, Reid RJ, Greene SM. Development and validation of the Patient Assessment of Chronic Illness Care (PACIC). Med Care. 2005;43:436-44. Epub 2005/04/20.
5.   Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. Am Psychol. 2000;55:68-78.
6.   Eschler J, O'Leary K, Kendall L, Ralston JD, Pratt W. Systematic inquiry for design of health care information systems: an example of elicitation of the patient stakeholder perspective. In Proceedings of the Hawaii International Conference on System Sciences. 2015.
7.   Eschler J, Ralston J. Opportunities for Empathetic Responses in Field Interview Scenarios Investigating Home Health Routines. 2014.
8.   O'Leary K, Eschler J, Kendall L, Vizer LM, Ralston JD, Pratt W. Understanding Design Tradeoffs for Health Technologies: A Mixed-Methods Approach. Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems; Seoul, Republic of Korea. 2702576: ACM; 2015. p. 4151-60.
9.   Eschler J, Kendall L, O'Leary K, Vizer LM, Lozano P, McClure JB, Pratt W, Ralston JD. Shared calendars for home health management. In Proceedings of the 18th ACM conference on Computer-Supported Cooperative Work and Social Computing. 2015.
10.   Kendall L, Eschler J, Lozano P, McClure JB, Vizer LM, Ralston JD, Pratt W. Engineering for reliability in at-home chronic disease management. AMIA Annu Symp Proc. 2014;2014:777-86. PMCID: PMC4419963.
11.   Liu L. Finding Reminders in the World: How Individuals Support Motivation and Tasks in Managing Chronic Illness. 2017.
12.   O'Leary K, Liu L, McClure JB, Ralston J, Pratt W. Persuasive Reminders for Health Self-Management. AMIA Annu Symp Proc. 2016;2016:994-1003. PMCID: PMC5333289.