Requirements for a Proposed Distributed Attention System for Supporting Awareness of Omissions in Healthcare

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Abstract. Noticing errors of omission can be challenging in complex, distributed processes. A prime example is outpatient care, where multiple distributed processes require attention. Teams must pay attention to patients currently in the clinic, to processes happening in the background, and to potential omissions in those processes. Detecting possible omissions may be supported with software, serving as a distributed attention system by guiding the team's attention to important areas. However, to ensure the software supports rather than disrupts attention, proper user requirements must be defined. This paper presents our study to identify high-level user interaction requirements for software planned to support attention to omissions in Chronic Heart Failure treatment. We interviewed outpatient clinic team members to identify information needs for addressing possible omissions, and how notifications should fit with team communication patterns. The findings are discussed in terms of high-level requirements for effective functioning of teams of humans and software agents.

Keywords: Monitoring systems, notifications, distributed attention, functional requirements, omissions, healthcare.

1 Introduction

In this paper, we present the results of a study conducted to identify functional requirements about user interaction for a proposed software program to aid with detection of specific omissions. First, we describe the problem of omissions, and the proposed software. We then present risks posed by software that attempts to guide attention, and how these risks need to be addressed via requirements informed by users' cognitive and workflow patterns. After presenting the methods and results from

our interviews, we discuss high-level requirements for how software can best facilitate attentional flow under uncertain and dynamic situations.

1.1 Background

In the US Veterans Affairs healthcare system, any patient receiving out-of-hospital care is assigned to a Patient Aligned Care Team (PACT). This team consists of: a Primary Care Provider (PCP, either a general practice or internal medicine doctor, or a community Nurse Practitioner); a Registered Nurse care manager (RN); a clinical assistant (Licensed Practical Nurse); and an administrative assistant [24]. The PACTs are supported by other healthcare workers, such as pharmacists. Except during hospitalization or treatment by a medical specialist, the PACT assumes responsibility for the ongoing healthcare of that patient.

However, there are challenges affecting the PACT's capability to deliver ongoing care to a patient. The pool of patients assigned to a PACT can be over 1000. There may be 10 to 15 patients seen in one day. Tasks must be coordinated across the PACT members. Many tasks also involve groups outside of the core team. For example, diagnostic services draw blood, conduct laboratory tests, and take x-rays. Pharmacists evaluate and fill medication prescriptions. In this system the delivery of healthcare services to a patient is distributed across several different processes.

The work is multi-threaded [33], because at any given time there are multiple patients at different points in these care delivery processes. The demands of coordinating and managing disparate tasks result in work fragmentation [19]. Under these conditions, it is easy for some steps in patient care to be missed [22].

One example is when a patient with Chronic Heart Failure (CHF) is discharged after being treated in the hospital. It is important to review and adjust the patient's CHF medications to reduce the chance that the patient will need to be re-hospitalized. However, many of these patients qualify for but are not prescribed the recommended medication doses [2].

If omissions like this are identified soon, they can be remedied. However, it is difficult to notice an omission, especially when the patient is not present, and the team is heavily occupied with other tasks. Additional support is needed.

1.2 Framework for Omission-Detection Software

In the Veterans Affairs (VA) healthcare system, all medical documentation is integrated into the VistA Electronic Health Record platform. It is possible to use software to automatically scan patient records to identify patients who have medical issues for which they may not be receiving guideline recommended care. Previous work has used this technique to identify patients who may have abnormal test results that are overdue for follow-up [21]. In that study, the medical records of those patients were reviewed by clinicians to determine if the patients likely needed follow-up. If so, the appropriate PCPs were contacted. However, because that approach requires manual review by a clinician, it will not be cost-effective at a large scale.

This limitation can be addressed by adding on a component to automatically notify the appropriate person of the potential problem. Once the software identifies a patient who has warranted a particular guideline recommended treatment but shows no evidence of having received it, the software would notify the appropriate PACT.

The study presented here was conducted for proposed software focusing on the problem of undertreatment of CHF. However, the basic strategy, and the attendant issues regarding coordination between software agents and human team members, are applicable to detection of omissions in other critical processes that are distributed across people and time [9]. This proposed software will run nightly scans of the medical records in a large network of VA outpatient clinics. It will look for patients who have been discharged after being hospitalized for CHF exacerbation, but who are not prescribed the guideline recommended levels of a particular type of medication (beta-blockers) [13]. If it finds such a patient it will inform the PACT for that patient. Based on historical data, it is expected that the average for a typical PACT will be 1-2 undertreated CHF patients per month.

The software will be able to monitor the whole population of patients in the network of clinics, and it will be able to identify delays spanning across long time frames. It will identify patients that would otherwise not cross the mind of any PACT member. In principle, the proposed software will expand the ability of the PACT to detect omissions. It can help team members shift perspective [33]—between a narrow but deep focus on the rich complexities of the small set of patients at hand, and a broad but shallow focus on which patients among the 1000+ assigned to the PACT might have omissions (in this case, beta-blocker titration). More specifically, this software will be sensitive to omissions that happen in the time after a patient event (in this case, discharge from hospital and standard follow-up), when PACT members have finished performing their routinized tasks. A PACT with a software agent monitoring for problems is an example of a distributed attention system, in which multiple agents (human and/or software) serve to facilitate the flow of a member's attention to where it is currently most warranted [34].

1.3 Automation as Help or Hindrance

Often the introduction of automation software into a work system causes problems [5, 33]. Many of these problems come from a poor fit between the software and the larger work system [7]. To prevent these problems, the software design should take into account such factors as the workflow, the existing software, and the communication and organizational patterns [26]. For example, the notification software tools under development should fit with the technical and organizational communication channels.

Another factor that affects the impact of the software on the work of practitioners is how data on patients, medical conditions, and care processes are organized and presented. In complex domains like healthcare, data displays can support cognitive work if the design takes into account the meaningful properties of the relevant system and its functions [6, 14, 29, 32]. The meaningful properties involved in managing care for these sorts of medical issues in the outpatient setting include: the goals of the team members, the patient's condition, the status of the care processes, possible courses of

action, applicable criteria, etc. These can be integrated into a frame of reference which can be used to portray relationships, trends, and other important patterns [31].

Organizing and presenting information along these lines can be helpful for detecting patterns [31] and interpreting and making predictions about the status of a situation [11]. These cognitive processes are especially important for the tasks of understanding and responding to an anomaly (the possible omission of care) while simultaneously managing other work under the difficult conditions that led to the anomaly [33].

Another potential automation-related problem is how messages from a software agent to a human team member may cause unnecessary disruption. This is especially true of push notifications like pop-ups or alarms. However, in re-directing a person's attention, any notification can incur a re-orientation cost. This cost is dependent upon the interaction between the workflow and communication channels, and the patterns of activation of knowledge structures. When a team member is engaged in a particular area of their work, their attention is focused in that area, and relevant knowledge structures are activated (enabling the interpretations and expectations necessary for the process of situation awareness) [34]. If an external stimuli pulls the team member's attention towards an arbitrarily different area of their work, any newly relevant knowledge structures are not instantly activated [4]. The process of situation awareness does not plateau instantly [5]. A notification that initiates a shift across (rather than within) "working spheres" will present more disruption [19].

1.4 Requirements Elicitation

The success of the proposed software tool at expanding the attention of the PACT members depends on: a) the fit with the current workflow and communication channels; b) the fit with the basic functions and meaningful properties of the task domain; and c) the fit with the attention flow of the team members (as their knowledge structures are dynamically activated in response to workflow and communication events). It is important that the functional design requirements for the software incorporate information on these aspects of the system and the work. Therefore we conducted research to elicit information about these aspects from relevant primary care professionals (PACT members and supporting healthcare workers).

2 Methods

2.1 Participants and Setting

Our settings were three different Veterans Affairs outpatient clinics: one in a large city, one in a medium city, and one in a rural area. All sites were part of the same regional VA network.

Participants were recruited from all PACT PCPs, RNs, and all pharmacists at those outpatient clinics. There were a total of 16 participants: 7 Primary Care Providers (2 doctors, 5 nurse practitioners), 5 Registered Nurse care managers, and 4 pharmacists.

2.2 Procedure and Data Collection

We conducted semi-structured interviews with each participant individually on site. The interviews were audio-recorded, and notes were taken. One research team member led the interview (MS) and another took notes (CB).

The interviews were loosely based on two approaches to cognitive task analysis: ACTA (Applied Cognitive Task Analysis) [20] and GDTA (Goal Directed Task Analysis) [11, 15]. We asked participants about which communication channels they used, when, and for what types of information. We asked about how notifications are handled in their PACT, and for examples of helpful and unhelpful notifications. We also asked questions about clinical activities (such as the timing and processes for medication review, and for post-discharge follow-up). We asked what factors they considered when making treatment decisions for CHF patients, and especially when considering titration of a beta-blocker. Afterward we asked what information they think would be important to present on a notification about possible omission of beta blockers, and what they thought they would do if they received such a notification. The specific set of questions varied depending on the role of the participant (PCP, RN, or pharmacist). Institutional review board approval was obtained for this study.

2.3 Analysis

We conducted a framework analysis [23] on the interview data. This incorporates both a "top-down" framework-driven approach and a "bottom-up" data-driven approach. In our analysis, some aspects of the interview topics were analyzed with particular use of frameworks: the different communication channels used in the VA, and general models of CHF treatment and beta-blocker use.

The analysis was conducted by the two research team members who were present at the interviews. One performed iterative reviews, coding the data and identifying patterns (MS). The other critically evaluated this initial analysis to establish independent confirmation (CB). The results reflect the consensus of the two research team members.

3 Results

The items and issues raised by the participants are presented below, structured by themes. When necessary the types of participant(s) who expressed the specific item or issue are identified afterward: PCP (Primary Care Provider); RN (Registered Nurse care manager); and Pharm (pharmacist).

3.1 Communication Channels

Among the several electronic communication channels mentioned, three were brought up most frequently: View Alerts, Secure Messaging, and Message Manager. Other channels are used, but were not mentioned as frequently. Different channels are used by different roles, and for messages of different urgency.

View Alerts. These notifications appear in a list on the user's home screen of the VistA Electronic Health Record software. Each is linked to new information entered into a patient's medical record (e.g., lab results, notes from specialists). Among our participants, PCPs used View Alerts the most, followed by RNs and pharmacists. View Alerts are for actions that need to be acted on within a short time (PCP), but not for highly urgent tasks. If it can be done anytime throughout the day then it should be sent via View Alerts (RN).

Especially for PCPs, "processing" alerts involves reading the new information, and performing any EHR-based tasks required (such as prescribing new medication, ordering new labs, etc.). In general, checking View Alerts is done when time is available: throughout the day (RN), or whenever they can (PCP). The challenge of finding time to process alerts is exacerbated by the high rate of incoming View Alerts, a known problem [25].

A View Alerts notification serves to inform the recipient of new information added to the patient's record. Thus, the information provided can include a brief narrative on what was done, preferably including an assessment and plan (Pharm). It allows clinical staff to communicate with one another (RN, Pharm). View Alerts are one mechanism that directs the attention of the PCP to a patient's record. Another mechanism that directs attention to the record is an upcoming appointment with that patient (PCP).

Secure Messaging. Secure Messaging is a system for the patient to send a message to the PACT using a secure patient web-portal. Once received, messages can be assigned to specific team members to take care of. They sometimes consist of lengthy and detailed feedback requests from the patient (RN). The fact that it is a direct message from the patient is valued (RN). It can be easily added into the patient's record in the VistA EMR (RN). However, it is not a good channel for reporting medical symptoms or other more urgent issues (RN). Recipients have three days to address a secure message before the director of the clinic is alerted.

PCPs and their PACTs may allocate different team members to check Secure Messaging, based on what works best for them. Some teams have multiple members check the messages (RN). Messages are checked multiple times per day (2 RNs).

Message Manager. Message Manager is a system for delivery of telephone messages from the patient. Staff at the regional call center receive the patient's telephone call, type up the patient's message in Message Manager, and send it to the patient's PACT. The notification is then listed in the Message Manager web-tool, to be accessed by a PACT member. The item can be assigned to specific team members. An email is also sent to the team members indicating that a new Message Manager item has been delivered. There is an optional function to receive a pop-up notification on the computer as well.

Most users check Message Manager periodically, such as once in the morning and once in the afternoon (2 RNs). Messages are often patient requests for medication refills or to find out the results of laboratory test (RN). This channel is not good for urgent issues or those regarding medical symptoms, which should go through triage (RN). Recipients have two days to address these messages (RN).

Patient Almanac and Data Warehouse. These are two similar tools that provide reports on patients assigned to the PACT who may have medical issues to be addressed. The Data Warehouse lists patients who have high "critical need" scores, indicating a high risk for hospitalization (2 RNs). The almanac provides information on patients with chronic diseases, and on patients who have been admitted to the emergency department or discharged from the hospital (RN). These tools are used primarily by the RNs, and not by PCPs (RN, PCP). The Patient Almanac is checked throughout the day (RN). The Data Warehouse is checked first thing each morning (RN), or once a week (RN).

Instant Messaging. Instant Messaging is a real-time chat system. It is used for urgent issues (2 RNs). It is used to communicate with PCPs (Pharm), and used by PCPs to request help in the middle of a patient visit (PCP). Some use Instant Messaging frequently (RN, PCP), while others don't use it at all (RN).

Email. Email is not used consistently. One RN checks email throughout the day. Others don't use it at all (2 RNs). For PCPs, it is one of the communication channels they look at the least (RN).

3.2 Events and Factors Affecting Assessment and Care

Doctors and nurses need to take many elements into consideration when evaluating a patient for potential treatment with beta-blockers. Factors mentioned by participants included: age, blood pressure, heart rate, kidney function, symptoms, medication history and adherence, patient's goals, and co-morbidities (such as kidney disease). In addition to these clinical factors, they must be aware of the status of relevant care processes (i.e., what steps or events have or have not taken place). Events mentioned by participants included: pre-discharge medication review, discharge, post-discharge call with RN, stabilization, and each titration event.

3.3 Attributes Related to the Usefulness of Notifications

Participants gave examples of useful and non-useful notifications. The set of examples reflects attributes of the needs of clinical users regarding notifications. These attributes are listed below, with positive (+) and negative (-) examples provided under each attribute.

Aiding Re-orientation of Attention.
+ The items in the Message Manager web-tool list show the subject of the message (Pharm).
+ Using markers (such as "ATTENTION") in a long note in a patient record to indicate which part the recipient should focus on (Pharm).
+ Pop-up notifications indicate the arrival of a new Message Manager item (PCP).
- The Message Manager web-tool does not refresh automatically, so the displayed list is not up to date (Pharm).
- The VistA EMR View Alerts system does not support prioritization (Pharm).

Providing Clear Information and Instructions.
+ Some discharge summary notes in VistA contain specific information on what needs to be attended to (PCP).
+ E-consults (responses to requests from specialists in VistA) are good because they explain what to do (PCP).
+ Patients' records often contain brief narratives where the doctor or other clinical team member explains what they did, what the assessment is, and what the plan is (Pharm).
+ Consult notes from specialists often explain why they are using a particular medication (PCP).
- Message Manager items that address a clinical issue but are written by a non-clinical clerical assistant can contain inaccuracies or be missing information (RN).
- Some notifications are for tasks that are out of the recipient's scope of work (RN), or could just as easily be performed by the clinical or clerical assistants (RN).

Notifications Directly from Originating Person.
+ Secure Messages are most helpful because they are directly from the patient (PCP, RN).
- Calls being routed through the call center can cause problems and make it hard for the patient to reach the PACTs (RN).
- Some calls through triage are not routed properly (PCP, RN).

Easy Access to Relevant Information.
+ The Patient Almanac provides information on multiple patients, and includes relevant data (e.g., dates the patient was hospitalized and discharged, deadline for post-discharge call) (RN).
+ A reminder at each stage in the processing of diagnostic imagery (e.g. echocardiograms, mammograms) would be useful (PCP).

- Message Manager items lack background information, and are not specific or descriptive (Pharm).

Relevance.
+ Getting an Instant Message about an urgent issue is appropriate (RN).
- View Alerts that are simply "For Your Information" are not helpful (PCP, Pharm).

3.4 Participants' Thoughts on Responding to a Notification

To elicit potential factors concerning the role of notifications, participants were asked about how they might respond to a hypothetical notification about a possible omission of appropriate beta-blocker titration. Participants said they would try to determine what happened that caused the omission of the beta-blocker titration (3 PCPs). They would look to see who was involved (PCP). One PCP said they would go ahead and order beta-blockers upon receiving the proposed notification. Another PCP said they would try to find out more about the guideline being applied in the software, to see if it was applicable to that particular patient.

Note that when a PACT member is responding to one of these notifications, they will be in a different situation compared to when they have been following a pre-planned process to address an anticipated task (i.e., evaluation for beta-blocker titration). For example, less time and less planning means that it will be more difficult to coordinate follow-up activities with the patient's previously scheduled appointments (PCP).

4 Discussion

4.1 Coordination of Attention Flow

In dynamic domains, it is important for all team members to be able to direct attention to the important signals in the world. These signals can pertain to expected changes, deviations from a prescribed plan, or critical unanticipated events. This study provides further evidence for the necessity of good attention management within a notification system. We found that notification mechanisms correlate with different levels of urgency, and are checked with different frequencies. Accessing different channels with different frequencies is a way that team members can control when and how they permit the system to re-direct their attention. Instant Messaging is for immediate issues. Message Manager, View Alerts, and Secure Messaging are for issues with a time frame of a couple of days. Email, and the Patient Almanac and Data Warehouse, are for less urgent issues. When the nature of the channel itself conveys information about the urgency of the notification, the team member is able to direct their attention flow at a pace that corresponds to the urgency of the notification, before knowing the content of the notification.

This mechanism for managing attention functions at both the individual and team levels. For instance, PCPs do not attend to the low urgency channels. They primarily use View Alerts, with some use of Instant Messaging. PCPs primarily focus on individual patients and their time-sensitive, medically important issues. PCPs need to be able to easily re-orient to new patients and new urgent tasks as they arise.

In contrast, RNs attend to information about patients in less urgent states. They manage messages from patients regarding care maintenance issues. They access the Patient Almanac and the Data Warehouse tools which are designed to identify sets of patients at risk, before problems become more critical. Thus, they are focusing on a somewhat different scale and different time frame than the PCPs. By accessing other more urgent channels (Secure Messaging, Message Manager) at specific times, they are able to reduce the frequency of re-orienting to more acute issues.

In principle, the way the software selects the channel and the recipient should be based on the type of response required, and the time frame required. For example, relatively urgent medical issues might be directed to PCPs using View Alerts, while non-urgent issues that pertain to nursing care management functions might be directed to RNs using Data Warehouse. If the software is sensitive to the different levels of risk experienced by patients with omissions, it can be more nuanced in its interaction with the PACT. The PACT can be kept informed of issues at various stages, instead of simply receiving a uniform alert at one particular threshold.

Note that there are challenges to implementing an elaborate algorithm to determine who should be notified and how. Much of the data in the Electronic Health Records are not structured or standardized sufficiently to support automated inference. A human team member must play a primary role in evaluating the nature of the problem and the type of response required. A fully automated approach, without a human there to evaluate situations, will be brittle in a domain like healthcare, where variation is high and deviations from plans can involve many interacting factors.

4.2 Making the Omission Observable

To support the human team member in evaluating the nature of the problem and the response required, the software should make the relevant clinical processes and care management procedures observable [17, 33]. It should reveal the factors related to the event (e.g., the omission of beta-blocker titration) and to the possible courses of action. To do this requires a clear understanding of how these clinical practitioners make sense of meaningful events and assess possible risks to the patient [10, 16]. The knowledge structures involved in these processes relate to a meaningful frame of reference which can be used to make supportive data representations. Our study shows the way practitioners use significant aspects of a clinical situation to make sense of possible omissions.

One significant aspect was the applicability of the clinical guideline to a hypothetical patient with a notification. The practitioners needed to know if there were reasons why the patient should not be given higher doses of beta-blockers. This included information like clinical contra-indications or patient preferences.

A second significant aspect concerned the status of the patient's care activities. They wanted to know about where the patient was in the sequence of steps, and what

else may have been omitted. Associated with an assessment of progress along the prescribed plan was the need to know if care was being provided by a doctor outside of the VA but not documented in the VA EHR.

A third significant aspect was the causal factors related to the omissions. They wanted to understand what led to the CHF patient not being prescribed the correct medication and/or dose. For example, did an order from the doctor not get sent, or was there a follow-up appointment that got canceled?

The complexity of these significant aspects cannot be easily accounted for in a software algorithm, which is why a human team member is required to make sense of these aspects. However, this sense-making process can be facilitated by the software making these significant aspects more observable by presenting the relevant information in meaningful frames-of-reference. Our findings in this study suggest that the care plan and associated guidelines is one potential frame-of-reference. Within this care plan frame-of-reference it is possible to organize information like diagnostic data, appointments, tests, and plan progress. These types of integrated displays leverage the benefit of the human-machine team [18].

4.3 Directing towards Courses of Action

For effective coordination to happen in the human-machine team, the members of the team need to be able to direct the application of resources, and the synchronization and prioritization of activities [33]. One aspect is how the notification should not only help human team members notice and interpret possible omissions, but also support them in recognizing and assessing possible courses of action.

Our findings stress the importance of notifications that provide actionable information. By incorporating representations of guideline recommended courses of action (e.g., time frames, treatment options and dose levels) into the frame-of-reference, this will facilitate practitioners in responding to the potential omissions. By presenting this information in the context of other factors (patient history, clinical status, etc.), we can mitigate the risk of the human team member focusing only on the computer's reference to guidelines and neglecting these other important factors [28].

4.4 Accommodating the Limits of Automation

One fundamental limit of notifications or alerts within a team of humans and automated monitoring agents is the information value of the alerts [30]. The information value of an alert is related to the positive predictive value. The positive predictive value of the software algorithm is projected to be 80%, meaning that 1 out of 5 notifications will be false positives. False positives may be from: the beta blocker being prescribed but not documented in the VA record (i.e., from a non-VA physician); from exclusion criteria or contra-indications documented in a way that is not machine-readable; or from the PCP determining that the guideline is not applicable in that specific situation.

However, the notification can make the decision process of the software observable by presenting information on how the software came to its conclusion. It can show the

way in which the patient meets the algorithm's criteria for inclusion, and what contra-indications it checked for but did not find, and what data it had access to. In so doing, the notification can support easier recognition of false positives by the recipients. They will be able to directly check a few things to verify that the software missed something. Listing the factors will also help remind the recipient of what should be checked as part of assessing for beta blocker use. This will not decrease the number of false positives, but it will decrease the cognitive burden from them.

One way to help manage the rate of false positives is to enable human team members to continue to direct the focus and priorities of the software agent as part of human-machine coordination [17, 33]. The ongoing maintenance and updating of the software must involve mechanisms for the users to easily provide input and guidance to the software as part of normal use. Because healthcare is a dynamic system, and even clinical documentation practices change over time [1], the algorithms will become out of date without fresh feedback from the PACT members. Ensuring the end user has a role in the control of the software evolution will help the software stay resilient [8, 27], potentially reduce the rate of false positives, and addresses some of the political concerns raised by software that monitors workers [3].

4.5 Proposed High-Level Requirements

The system shall select the delivery channel based on the urgency of the notification. E.g., if the patient has an appointment scheduled within 60 days, or is being treated by a cardiologist, it is less urgent, and the notification should be delivered via Data Warehouse. Otherwise, it is more urgent, and the notification should be delivered via View Alert.

The software will scan the structured data in the chart for the following clinical factors: previous use of beta-blockers; current use of heart and kidney medications; current lung, kidney, and heart diagnoses; and presence of documentation from any cardiologist in the past 6 months. The notification will list all of these factors and the results of the scan (positive or negative/inconclusive).

The software will extract the date and the name of the healthcare provider responsible for the following care delivery events: CHF diagnosis; hospital admission and discharge; medication reconciliation; post-discharge follow-up call; pending orders for heart medications; and pending appointments with PCP, cardiologist or pharmacist. The notification will list each of these items with either the dates and names, or an indicator that the event was not found.

The above clinical factors and care delivery events will be displayed in the notification using the format of a care plan, chronologically ordered and structured by functional area.

4.6 Study Limitations

This study has relied on interviews to collect data on how the PACT members use communication channels, how their knowledge about particular tasks is structured, and their patterns of attention flow. With interviews there is a risk of inaccurate recall

and reporting about such issues. However, our general findings reflect accounts from a wide range of participants, but do not reflect any systematic self-serving or social desirability biases. This strengthens the validity of our findings.

Because many of the relevant communication activities occur infrequently (e.g., using the Data Warehouse, receiving discharge reports), observations of communication and attention flow patterns were impractical. Computerized monitoring to detect work activities has been shown to work in hospital settings [12]. However, for this study we did not have enough information at the beginning to operationalize a sufficient set of indicators of communication and attention flow patterns.

4.7 Next Steps

Working with clinical subject matter experts, we plan to develop notification designs which incorporate the meaningful clinical factors and care process events. Prototype designs will be used in usability testing with PACT members. Throughout the design and implementation process, representatives from the clinics will be involved.

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