STUDY PROTOCOL

Implementing a Social Knowledge Networking (SKN) system to enable meaningful use of an EHR medication reconciliation system

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Background: Despite the regulatory impetus toward meaningful use of electronic health record (EHR) Medication Reconciliation (MedRec) to prevent medication errors during care transitions, hospital adherence has lagged for one chief reason: low physician engagement, stemming from lack of consensus about which physician is responsible for managing a patient's medication list. In October 2016, Augusta University received a 2-year grant from the Agency for Healthcare Research and Quality to implement a Social Knowledge Networking (SKN) system for enabling its health system (AU Health) to progress from "limited use" of EHR MedRec technology to "meaningful use." The hypothesis is that SKN would bring together a diverse group of practitioners, to facilitate tacit knowledge exchange on issues related to EHR MedRec, which in turn is expected to increase practitioners' engagement in addressing those issues and enable meaningful use of EHR. The specific aims are to examine: 1) user-engagement in the SKN system, and 2) associations between "SKN use" and "meaningful use" of EHR.

Methods: The 2-year project uses an exploratory mixed-method design and consists of three phases: 1) development; 2) SKN implementation; and 3) analysis. Phase 1, completed in May 2017, sought to identify a comprehensive set of issues related to EHR MedRec from practitioners directly involved in the MedRec process. This process facilitated development of a "Reporting Tool" on issues related to EHR MedRec, which, along with an existing "SKN/ Discussion Tool," was integrated into the EHR at AU Health. Phase 2 (launched in June 2017) involves implementing the EHR-integrated SKN system over a 52-week period in inpatient and outpatient medicine units.

Discussion: The prospective implementation design is expected to generate context-sensitive strategies for meaningful use and successful implementation of EHR MedRec and thereby make substantial contributions to the patient safety and risk management literature. From a health care policy perspective, if the hypothesis holds, federal vendors could be encouraged to incorporate SKN features into EHR systems.

Keywords: electronic health records, medication reconciliation, meaningful use, Social Knowledge Networks, health IT implementation, patient safety, risk management

Introduction

Health care delivery and payment reform efforts are increasingly focused on improving quality and safety during transitions of care, when patients are most vulnerable to medical errors.[1] Medication errors, in particular, are common at hospital admission and discharge, and are a major contributor to adverse patient outcomes and increased spending associated with transitions of care.[2,3] The risk of medication errors is heightened during care transitions because clinicians and, in some cases, patients do not

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have access to accurate up-to-date medication lists. This can result in the inadvertent addition, omission, or duplication of medications, resulting in "unintended discrepancies" between what patients should be prescribed and what they are actually prescribed.[4–6]

To help prevent medication errors and discrepancies during transitions of care, patient safety advocates have promoted the use of Medication Reconciliation or "MedRec."[7,8] MedRec refers to the process of creating the most complete and accurate list of a patient's current medications, comparing the list to those in the patient's records, and communicating the final up-to-date list to the patient, family, caregivers, and the next providers of care. Since 2005, MedRec has been part of the Joint Commission's hospital accreditation program, and more recently, it has become part of the "electronic health record (EHR) meaningful use" requirements.[9,10]

Despite the regulatory impetus toward EHR MedRec, hospital adherence has lagged for one chief reason: low physician engagement, which, in part, stems from lack of professional consensus about which physician (e.g., hospital vs community physician) is responsible for managing a patient's medication list and the value of MedRec as a clinical tool for improving quality of care.[11–15] Moreover, within the hospital context, the assignment of MedRec responsibilities among provider subgroups – multiple physicians, nurses, and pharmacists – is often unclear, leading to inefficiency and potential for error.[16–18] Not surprisingly, therefore, a national study conducted as recently as 2014 found that although hospital EHR vendors have been enhancing MedRec functionality over time, more than a third of the hospitals still use partially paper-based processes at admission, discharge, or both.[13]

Problem of interest

The Augusta University Health System, AU Health, has invested in certified EHR technology throughout its system, which includes an academic medical center and over 80 satellite outpatient clinics. Similar to issues faced by other hospitals, there is consensus among AU Health administrators that a key challenge being encountered at the institution is that physicians who did not originally order the drugs in question are resistant to discontinuing those medications at discharge, leading to frustrated patients with incomplete medication lists. The EHR system requires clinicians to mark MedRec as "complete" with the press of a button before patients can be officially discharged from the facility. However, in 2015, AU Health leadership estimated MedRec to be accurately completed (i.e., free of discrepancies between patient's home and hospital medication lists in regard to drugs, dosages, and frequencies), for less than 20% of discharged cases. During the same period, the average monthly patient satisfaction score for medication instructions ("medications and care at home were explained to me in a way I could understand") was at the 25th percentile for outpatient visits, 40th percentile for inpatient discharges, and 2nd percentile for the Emergency Department (ED).

Specific aims

In October 2016, Augusta University received a 2-year research grant from the Agency for Healthcare Research and Quality (AHRQ) to implement a "Social Knowledge Networking (SKN) system" for enabling AU Health to progress from "limited use" of EHR MedRec technology to "meaningful use." The 2-year project involves collaboration with both the medical leadership and health IT Division at AU Health to develop an EHR-integrated SKN system on MedRec and implement it over a 1-year/52-week period in select inpatient and outpatient units.

The specific aims of the project are twofold:

1. To evaluate user-engagement in the SKN system;
2. To examine associations between "SKN use" and "EHR meaningful use."

Rationale and hypothesis

The aforementioned EHR-integrated SKN system on MedRec was launched at AU Health in June 2017, following Augusta University Institutional Review Board (IRB) approval for the overall funded project. It will be implemented over a 1-year/52-week period through June 2018. The rationale for an EHR-integrated SKN system on MedRec is that it would bring together a diverse group of practitioners (physicians, nurses, pharmacists) across inpatient and outpatient settings, to facilitate the exchange of tacit (practice-based) knowledge on issues related to MedRec and to enable engagement, learning, and practice change (i.e., EHR meaningful use).

The SKN system consists of two tools: 1) a "Reporting Tool" on issues related to EHR MedRec, and 2) an "SKN/Discussion Tool" (Microsoft Yammer). Both tools have been embedded (as links) within the EHR (Cerner PowerChart™, London, UK) at AU Health. Approximately, 60 practitioners (physicians, nurses, and pharmacists), who have signed on to participate as "SKN Users," will report issues related to MedRec on a regular basis (over the 52-week SKN period) using the "Reporting Tool." Concurrently, a group of five "SKN Moderators" (i.e., senior administrators, including the Chief Medical Officer (CMO), Chief Medical Information Officer (CMIO), and physician champions) at AU Health will bring reported issues up for discussion via the "Discussion

Tool." Correspondingly, SKN Moderators will play a key role in facilitating tacit knowledge exchange across a diverse group of practitioners, to enable engagement, learning, and practice change (EHR meaningful use).

The hypothesis, based on the integrated Technology-in-Practice and Knowledge-in-Practice framework, is that implementing an SKN system alongside an existing EHR system could serve to transform the technology-in-practice from "limited use" to "meaningful use" by enabling engagement, tacit knowledge exchange, learning, and practice change among a diverse group of practitioners (physicians, nurses, and pharmacists) from inpatient and outpatient settings of care.[19–21] An example of tacit knowledge exchange in the context of MedRec would be, "how not discontinuing a formulary beta-blocker at discharge (when a home version was present) resulted in the patient taking both home and formulary versions at home, leading to patient readmission." Tacit knowledge exchange, in turn, has potential to: 1) highlight adverse consequences of gaps in practice for patient outcomes, and 2) emphasize the value of adhering to best practices in EHR MedRec, which in turn is expected to increase practitioner "engagement" in addressing issues related to EHR MedRec and provide a foundation for collective "learning" and practice "change", leading to EHR meaningful use.[22–24]

Methods

The study will use an exploratory and developmental design, with a mixed-method approach to data collection and analysis. The 2-year project consists of three phases: 1) Development Phase (first 6 months), 2) SKN Implementation Phase (next 12 months), and 3) Analysis Phase (last 6 months).

Study setting

Based in Augusta, Georgia, AU Health is a health care network offering comprehensive primary, specialty, and sub-specialty care in the region. The health system's region has been reported to have high rates of cardiometabolic disease, hypertension, stroke, heart failure, and kidney disease.[25] Facilities include a 478-bed AU Medical Center, more than 80 outpatient practice sites, a Critical Care Center housing a regional trauma center, and a 154-bed Children's Hospital. AU Health uses certified EHR technology throughout its health system, powered by Cerner Inc. By definition, the level of EHR implementation at AU Health is "comprehensive" (Health Information and Management Systems Society Level 6). As part of the EHR, providers can electronically prescribe medications through SureScripts™ (Arlington, VA, USA), which enables them to view patients' medication history, including prescriptions filled at participating pharmacies.

Phase 1: Development Phase

Phase 1 (Development Phase) was completed in May 2017 at AU Health and provided a foundation for launching Phase 2 (SKN Implementation Phase) in June 2017. Phase 1 involved "developing" a simple "EHR MedRec Issue Reporting Tool" ("Reporting Tool") to enhance the capability of an existing "SKN/Discussion Tool" (Microsoft Yammer), to facilitate knowledge exchange related to EHR MedRec and "integrating" both the Reporting Tool and the SKN/Discussion tool into the EHR workflow at AU Health. Therefore, the EHR-integrated SKN System on MedRec consists of two components: 1) Reporting Tool, and 2) SKN/Discussion Tool (Microsoft Yammer).

Yammer is a "freemium" enterprise social networking tool that was sold to Microsoft in 2012. It is available free of charge, but a premium is charged for proprietary features and additional functionality. Yammer is used for private communication and knowledge exchange within organizations, and is an example of an enterprise SKN system. Our study uses the basic version of Yammer, which is already available to AU Health as part of its Microsoft Office 365 package. Only study participants, including five SKN Moderators and 60 SKN users, have access to Yammer. All study participants are employees of the Augusta University/AU Health enterprise and have a working e-mail address from the enterprise's domain.

Identify a comprehensive set of issues related to EHR MedRec to build a "Reporting Tool"

The first step in Phase 1 was to identify a comprehensive set of issues related to EHR MedRec from multiple practitioner subgroups involved in the MedRec process, i.e., physicians, nurses, and pharmacists, based in the inpatient and outpatient medicine service at AU Health. This, in turn, involved using a two-round mixed-method approach: 1) individual interviews with practitioners (Round 1), followed by 2) a survey of a larger group of practitioners at AU Health (Round 2).

Round 1 of the mixed-method approach included 15 individual semi-structured interviews with physicians, nurses, and pharmacists at AU Health, to identify issues related to EHR MedRec. Thematic analysis helped identify 55 issue items grouped under nine issue categories.[26,27] These results, in turn, were used to conduct a survey of a larger group of physicians, nurses, and pharmacists at AU Health (Round 2). The survey sought practitioners' importance rating of all 55 issue items, identified from interviews on a 7-point Likert scale. A total of 127 responses were received (out of 200 recipients), with a 63% response rate.

On average, the issue items under each of the nine issue categories were rated as "Important" or "Extremely Important" by 70%–90% of all survey respondents: 1) care-coordination issues – CCI (89%); 2) patient education issues – PEI (84%); 3) workflow issues – WI (83%); 4) resource issues – RI (82%); 5) ownership and accountability issues – OAI (81%); 6) process of care issues – PCI (81%); 7) workforce training issues – WTI (79%); 8) IT-related issues – ITRI (78%); and 9) documentation issues – DI (74%). The significance testing or *t*-test analysis revealed no statistically significant differences (at the 5% significance level) in the importance rating of issues by professional or unit affiliation.

Develop a simple "Reporting Tool" for SKN users

The "Reporting Tool" was intended to enable Phase 2 SKN participants to report issues encountered with EHR MedRec on a regular basis over a 1-year/52-week SKN Phase. It included five simple questions that participants would need to complete, before submitting a report: 1) Pick the issue category; 2) Indicate the patient diagnoses the issue applies to (e.g., heart failure, atrial fibrillation, risk for thromboembolic events, etc); 3) Indicate the care setting the issue applies to (e.g., ED, inpatient, outpatient, primary care, etc.); 4) Describe the issue; and 5) Identify possible solutions to the issue. The page automatically records the date, time, and name of the participant submitting the report, and contains a prominent reminder that use of Protected Health Information (PHI) is prohibited. Users would click a button to submit the form.

Submitted reports would be accessible "only" to SKN Moderators, who would review reported issues on a regular basis (during the SKN Phase) to select issues of interest for further discussion on the SKN tool (Yammer). SKN Moderators would consult each other twice a month to decide which issues must be prioritized for SKN discussion. They would also take turns creating discussion groups on selected topics and inviting SKN Users to join the discussions. Nobody outside of the enterprise would be given access to the "Reporting Tool" or "SKN/Discussion Tool" (Yammer) during the study.

An example of a discussion topic on Yammer may be "Using External Rx History to update the home medications of patients at discharge." This topic may have been prompted by a report initiated by a pharmacy participant. The "Issue Description" may have been that many practitioners are not aware of "External Rx History" option which is now completely available for 80% of patients. The "Issue Resolution Idea" may be to educate and train all discharging clinicians regarding this option. The discussion group on Yammer, in turn, may be moderated by the CMIO (SKN Moderator) who may include pharmacists, nurses, hospitalists, and attending faculty from internal medicine and cardiology in the discussion.

Integrate the "Reporting Tool" and the "SKN Tool" into the EHR workflow

The final step in the Development Phase was to integrate the SKN system into the EHR workflow at AU Health. Correspondingly, upon completion of Phase 1 in May 2017, the newly developed "Reporting Tool" and existing "Discussion Tool" (Microsoft Yammer) were embedded as links within the EHR (Cerner PowerChart™) at AU Health, to facilitate launch of Phase 2 in June 2017. The links were labeled "SKN Reporting Tool" and "SKN Yammer." The two links were made available alongside each other on the EHR system, and were accessible to study participants through both mobile devices and desktop computers.

Phase 2: SKN Implementation Phase

SKN participant recruitment and informed consent

Study participants (for the SKN Phase) were recruited using an IRB-approved informed consent process. Eligible participants from the outpatient and inpatient medicine service, including physicians (residents, fellows, and attending belonging to Cardiology, Internal Medicine, Family Medicine, and Hospitalist Services), nurses, and clinical pharmacists at AU Health, were approached in groups for recruitment through informed consent. At each informed consent session, the Principal Investigator provided a comprehensive presentation related to the study purpose, methodology, timeline, and risks and benefits of participation.

The presentation included examples of appropriate and inappropriate uses of both the "Reporting Tool" and the "SKN/Discussion Tool" (Yammer), and stressed that the use of PHI during the study was strictly prohibited. Individuals interested in participating were requested to sign: 1) IRB-approved Informed Consent Document, 2) SKN Privacy and Confidentiality Agreement, 3) Expectations of Ethical and Professional Conduct on the SKN System, 4) Responsibilities of SKN Users, and 5) Custom Usage Policy for the "Reporting Tool" and "SKN/Discussion Tool."

In keeping with the study design, we capped the total number of participants (SKN users) at 60. We recruited 30 physician participants (including residents, fellows, and attending) and ~30 participants from among nurses and pharmacists. Among medical residents, we recruited only first-year and second-year residents so that they were in a position to complete the SKN-user surveys before and after the 1-year SKN Implementation Phase.

All consenting participants (SKN Users) received comprehensive orientation to the "Reporting Tool" and the "SKN/Discussion Tool." The five SKN Moderators also received training to serve as administrative users of both tools. The study team has undertaken proactive efforts to ensure ongoing participation in the SKN system during Phase 2. SKN Users receive reminder e-mails every week, alerting them to any new content on the SKN. Gift card incentives (US$25 each, to restaurants) are being regularly used to encourage participation throughout the SKN Phase. Additionally, SKN participants are invited to a lunch-and-learn session every quarter during the SKN Phase to share their experiences with the SKN system.

Privacy and security protections

In addition to prohibiting participants from using PHI during the informed consent process, the study includes "numerous safeguards against incidental disclosure of PHI." The submission page of the "Reporting Tool" includes a prominent reminder that PHI use is prohibited, along with a comprehensive set of examples of PHI. SKN users would only be able to use the tool to submit/report issues. They will not be able to view other submissions. All reported issues would be accessible only to the SKN Moderators. Similarly, the study team has implemented several administration and security controls on "Yammer" to provide protection against incidental reporting of PHI. In addition to these safeguards, the study team has developed a Custom Usage Policy to restrict the ability of creating discussion groups on Yammer by SKN Moderators. Only SKN Moderators have the ability to create private groups, while SKN Users (end-users) do not. This in turn enables all interactive exchanges by SKN users on "Yammer" to be screened and moderated by SKN Moderators. To this effect, the five SKN Moderators play a key role in ensuring privacy protections by closely monitoring all forms of communication on SKN regularly. Any sensitive information or PHI detected during these regular scans would be deleted from the system by SKN Moderators. Participants who do not adhere to the terms of the "SKN Privacy and Confidentiality Agreement" would risk permanent loss of access to the SKN system, in addition to losing their eligibility for participant incentives.

SKN Moderators' and SKN Users' roles and responsibilities

The 1-year/52-week SKN Implementation Phase (Phase 2) of the study was launched in June 2017 at AU Health, after the Development Phase (Phase 1), was concluded. Correspondingly, the five SKN Moderators have begun playing a key role in facilitating knowledge exchange related to EHR MedRec on the SKN system at AU Health. They have four main responsibilities:

1. Review submissions on the "Reporting Tool" on a regular basis to identify pressing issues related to EHR MedRec for bringing to discussion on the SKN Tool (Yammer).
2. Facilitate discussions on selected issues of interest on Yammer. This entails sending regular invitations to SKN users and guest experts (as applicable) for participation in private groups on the SKN tool and moderating discussions on Yammer.
3. Proactively and periodically, initiate interventions on Yammer on a regular (e.g., monthly) basis to promote EHR MedRec, e.g., soliciting ideas from participants regarding their experiences with recent upgrades to the EHR MedRec system, and suggesting a lunch-and-learn session on the topic.
4. Identify key aspects of SKN discussions for bringing to monthly meetings of the Quality and Safety Steering Committee (highest level quality committee), chaired by the CMO, for further discussion and action.

On the other hand, the main responsibility of SKN Users is to report issues encountered with EHR MedRec on the "Reporting Tool," on an ongoing basis, during the 1-year SKN Phase. SKN users are "not" expected to initiate exchanges on "Yammer;" they only need to respond to invitations from SKN Moderators to join and participate in discussion groups on Yammer. The only other expectation of SKN users would be to participate in recurring SKN-user surveys.

Therefore, the theoretically informed SKN implementation design enables a clear separation of responsibilities between the two levels of users: SKN Moderators and SKN Users. This upfront clarification of roles and responsibilities serves to greatly mitigate the risk of incidental disclosure of PHI by SKN users. A comprehensive participant engagement and incentive plan has been implemented to ensure that both the "Reporting Tool" and the "SKN/Discussion Tool" are being used for their intended purpose.

SKN-user surveys

To address Aim #1 of the study, i.e., evaluate user-engagement in the SKN system, three types of SKN-user surveys will be conducted before, during, and after the SKN Phase. To begin with, we will conduct a recurring brief electronic survey of SKN users, every 2 months, to capture "user-engagement with the SKN system." For example, users will be asked: On a 5-point scale: 1) How satisfied are you with the information

you have exchanged on the SKN system? 2) How likely are you to return to the SKN system within the next 2 weeks? 3) Have you learned anything new on the SKN system? 4) Please rate the ease of use of the reporting and SKN tool; and 5) Please provide your comments or suggestions. Items #1 and #2 would serve as a proxy for user-engagement; item #3 would serve as a proxy for user-learning; and items #4 and #5 would serve to assess SKN usability over time. Data from these surveys will be used to implement real-time improvements to the SKN implementation process. The first survey instance would provide a baseline, the final instance would serve as a direct comparison point, and intervening instances would help capture user-reported engagement with the SKN system during the SKN Phase.

We will also conduct a pre/post-survey of SKN Users to capture communication networks related to EHR MedRec before and after the SKN Phase. This survey would be designed to obtain data on the specific individual SKN users communicated with in regard to EHR MedRec at the study institution, before and after the SKN Phase, which in turn would enable Social Network Analysis of changes in communication networks related to EHR MedRec.

Lastly, we will conduct a comprehensive survey to obtain user feedback on SKN usability at the "end" of the SKN period, to obtain input on the value and utility of the SKN tool, and areas for improvement. In addition to capturing essential "usability metrics" informed by the literature, this survey will request SKN Users to rate their overall experience with the SKN system and provide an assessment of SKN Moderators' roles and effectiveness.[28] Examples of questions include: On a 5-point scale: "Did your use of SKN change the way you use EHR MedRec?"; "Did the use of SKN improve your care of patients?"; "As an SKN study participant, will you continue to use SKN in your day-to-day work?"; "How much did you engage in the SKN system: i) during direct patient care, ii) in between patients, iii) outside of direct patient care?"

Phase 3: Analysis Phase
The study is expected to generate measures on: 1) SKN user-engagement; 2) SKN usability; 3) SKN usage; and 4) EHR meaningful use. All measures would be calculated at the "SKN user" level. While the "first three" would provide the "independent variables (IVs)" for the study, the "fourth", i.e., EHR meaningful use measures would provide the "dependent variables (DVs)" or outcome measures. Together, these measures would serve to address Aim #2 of the study, i.e., examine associations between "SKN Use" and "EHR meaningful use."

SKN user-engagement and SKN usability
As discussed earlier, three types of SKN-user surveys would help capture a variety of measures (IVs) related to SKN user-engagement and SKN usability.

SKN usage
Every individual instance of SKN use (interactive or non-interactive) would constitute a unique record. The SKN tool (Yammer) provides an Application Programming Interface (API) that makes data extraction possible. A variety of data elements pertaining to each unique record (e.g., participant name, date, content of communication, etc) would be extracted from the Yammer API into a FileMaker Pro database. This weekly database would enable a variety of analyses related to the structure and content of communication on the SKN system, to test the study hypothesis, i.e., that the ongoing exchange of tacit knowledge across diverse professional subgroups (enabled by proactive periodic "top-down" SKN interventions) can promote practice change (EHR meaningful use).

EHR meaningful use (outcome) measures
DV-1: EHR medication reconciliation rate
The EHR MedRec rate would include: 1) EHR admission reconciliation rate, i.e., proportion of encounters that had medication history intake upon admission; 2) EHR discharge reconciliation rate, i.e., proportion of encounters that had MedRec performed at discharge; and 3) EHR medication instructions rate, i.e., proportion of encounters in which instructions were provided. All sub-measures would be obtained from the EHR system, and calculated weekly at the physician level, for physician SKN participants and non-participants across the health system.

DV-2: Proportion of "Not-Taking" medications discontinued at discharge
We will calculate the proportion of medications that are documented (in the medical record) as "Not Taking" by patients (and that should be discontinued), which are in turn discontinued at discharge. This would serve as a measure of MedRec accuracy. Since the study includes physician participants from Cardiology, Internal Medicine, Family Medicine, and Hospitalist Services, these data would be calculated for patients shared among these specialties in the inpatient, outpatient, and primary care settings, i.e., ~300 patients per quarter. The medical leadership (CMO and CMIO) and Cerner Health IT division at AU Health have collaborated to develop algorithms to capture this measure, while excluding

as needed (PRN) and short-term medications. All physicians (attending, residents, and fellows) associated with each chart will be noted, thereby enabling a comparison between physician SKN participants and non-participants (in the General Medicine Service at AU Health).

DV-3: Proportion of formulary beta-blockers discontinued at discharge

We will calculate the proportion of the formulary version of beta-blocker drugs that are discontinued at discharge, when a home version is present (i.e., discontinuation of duplicate therapy). This would serve as an additional measure of MedRec accuracy. Since the study includes physician participants from Cardiology, Internal Medicine, Family Medicine, and Hospitalist Services, these data would be calculated for patients shared among these specialties in the inpatient, outpatient, and primary care settings, i.e., ~300 patients per quarter. The medical leadership (CMO and CMIO) and Cerner Health IT division at AU Health have collaborated to develop algorithms to capture this measure. All physicians (attending, residents, and fellows) associated with each chart will be noted, thereby enabling a comparison between physician SKN participants and non-participants (in the General Medicine Service at AU Health).

DV-4: Concordance between discharge medication list and Rx history

The medical leadership (CMO and CMIO) and Cerner Health IT division at AU Health have collaborated to develop algorithms to capture the concordance between the patients' discharge medication list and the patient's "External Rx History," i.e., medications that the patient orders from the pharmacy, to identify if the patient is taking any medications that are not on the institution's active list. This would serve as a measure of completeness of the patient's medication list. Since the study includes physician participants from Cardiology, Internal Medicine, Family Medicine, and Hospitalist Services, these data would be calculated for patients shared among these specialties in the inpatient, outpatient, and primary care settings, i.e., ~300 patients per quarter. All physicians associated with each chart will be noted, thereby enabling a comparison between physician SKN participants and non-participants (in the General Medicine Service at AU Health).

DV-5: Patient-centered outcome measure: readmission for heart failure

An additional outcome measure, i.e., the number of readmissions for heart failure "associated with medication management provision of care," as a proportion of all readmissions for heart failure, will be obtained quarterly, using the EHR system, at the physician level. All charts for heart failure readmissions during pre-SKN, SKN, and post-SKN periods will be reviewed by quarter, to understand if the reason for readmission was associated with provision of care associated with medication management for heart failure. This measure would be generated for physician SKN participants and non-participants across AU Health.

Discussion

Results from Phase 1 of this project directly contribute to the literature on EHR MedRec implementation in health care organizations, by identifying a comprehensive set of issues related to MedRec across multiple practitioner (stakeholder) groups involved in the process. While other studies have helped to identify barriers and drivers for MedRec from a planner's and/or a physician's perspective, the results from Phase 1 have helped identify a comprehensive set of issues encountered in performing EHR MedRec from the perspective of multiple practitioner (stakeholder) groups directly involved in the MedRec process (physicians, nurses, and pharmacists), to create a foundation for conducting an intervention, i.e., an EHR-integrated SKN system on MedRec.[12,18]

A central theme that emerged from Phase 1 was the absence of shared understanding across multiple practitioner groups, including:

1. Absence of shared understanding of what the responsibilities are of each practitioner group in the MedRec process. For example, admitting providers are not clear on who does what in in the medication history and admission process.
2. Absence of shared understanding of how the EHR MedRec system is being used by other clinicians. For example, outpatient subspecialists are not convinced that MedRec marked as complete in the system at the time of hospital discharge translates to a complete and accurate medication list.
3. Absence of shared understanding of the why, i.e., the value of EHR MedRec in preventing discrepancies and promoting patient safety. For example, outpatient providers expressed the concern that inpatient clinicians may not realize the importance of ensuring a medication list that is free of discrepancies at discharge, to enable patients to effectively transition into the community.

This central issue, in turn, contributed to a sense of skepticism regarding the value of EHR MedRec (among practitioners), leading to workarounds, and "limited use" of the EHR MedRec functionality. Results of Phase 1 provide insights into best practices for meaningful use and successful implementation of EHR MedRec. In effect, the results suggest that meaningful use of EHR MedRec could be facilitated by creating shared understanding of the process for MedRec and responsibilities for each step of the process among all practitioner (stakeholder) groups involved in the EHR MedRec process. Additionally, it would be important to create shared understanding among practitioner groups, of the value of EHR MedRec in preventing medication errors and discrepancies during care transitions and promoting patient safety.

Importantly, results from Phase 1, have helped create a foundation for Phase 2, by enabling the development of a "Reporting Tool" on issues related to EHR MedRec, one of the two key IT components of the SKN system. Insights gained from the results of Phase 1 suggest that an EHR-integrated SKN system may have considerable potential to facilitate the implementation of best practices for enabling meaningful use of EHR MedRec. An SKN system moderated by senior administrators to facilitate tacit knowledge exchange across diverse groups of practitioners and solve problems related to EHR MedRec, may have potential to create shared understanding of responsibilities in the MedRec process, as well as the value of EHR MedRec for preventing errors during transitions of care. Over time, these types of discussions may have potential to enable practitioner engagement and learning, to facilitate practice change (EHR meaningful use). In summary, forthcoming results from Phase 2 have potential to provide a foundation for generating context-sensitive "evidence-based management strategies" for meaningful use and successful implementation of EHR MedRec in health care organizations.

Conclusion

This study protocol describes a 2-year research project currently underway to implement an SKN system to enable meaningful use of EHR MedRec technology. Results from Phase 1 of the project have provided the foundation for implementing an EHR-integrated SKN system at an academic health center. A key gleaning from the ongoing study is that there is an absence of shared understanding among practitioners of the value of EHR MedRec in preventing medication discrepancies and errors during transitions of care, which in turn leads to workarounds and "limited use" of the EHR

MedRec functionality. Lessons learned from Phase 1 have provided insights into best practices for the meaningful use and successful implementation of EHR MedRec. Importantly, these gleanings also indicate considerable potential for an SKN system on MedRec to enable tacit knowledge exchange across practitioner subgroups, to address these issues, and to in turn foster engagement, learning, and change (i.e., EHR meaningful use). If the hypothesis holds, the study would serve to highlight the potential of moderated SKN in enabling tacit knowledge exchange across multiple clinician subgroups to facilitate meaningful practice change. To this effect, federal EHR vendors could also be encouraged to incorporate SKN features into EHR systems.

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Disclosure

The author reports no conflicts of interest in this work.

References

1. AHRQ, Agency for Healthcare Research and Quality. Patient safety primer: medication reconciliation. Available from: https://psnet.ahrq.gov/primers/primer/1/medication-reconciliation; Accessed October 15, 2016.
2. IOM, Institute of Medicine Committee on Identifying and Preventing Medication Errors, Aspden P, WolcottJ, Bootman JL, Cronenwett LR, editors. *Preventing Medication Errors: Quality Chasm Series*. 2007; Washington, DC: The National Academies Press.
3. Mueller S, Sponsler KC, Kripalani S, Schnipper JL. Hospital-based medication reconciliation practices: a systematic review. *Arch Int Med*. 2012;172:1057–1069.
4. Burton R. Health policy brief: improving care transitions. *Health Affairs*. 2012; Available from: http://www.healthaffairs.org/healthpolicybriefs/brief.php?brief_id=76. Accessed October 31, 2015.

5. Coleman EA. Falling through the cracks: challenges and opportunities for improving transitional care for persons with continuous complex care needs. *J Am Geriatr Soc*. 2003;51(4):549–555.

6. Pronovost P, Weast B, Schwarz M, et al. Medication reconciliation: a practical tool to reduce the risk of medication errors. *J Crit Care*. 2003;18(4): 201–205.

7. Barnsteiner JH. Medication reconciliation. In: Hughes RG, editor. *Patient Safety and Quality: An Evidence-Based Handbook for Clinicians*. Rockville, MD: Agency for Healthcare Research and Quality (US); 2008; Chapter 38. Available from: http://www.ncbi.nlm.nih.gov/books/NBK2648/. Accessed October 31, 2015.

8. Greenwald JL, Halasyamani L, Greene J, et al. Making inpatient medication reconciliation patient centered, clinically relevant and implementable: a consensus statement on key principles and necessary first steps. *J Hosp Med*. 2010;5(8):477–485.

9. CMS Centers for Medicare and Medicaid Services. Stage 2 Eligible Professional Meaningful Use Core Measures. Measure 14 of 17; 2012. Available from: https://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/downloads/Stage2_EPCore_14_MedicationReconciliation.pdf. Accessed October 31, 2015.

10. HealthIT.Gov. Achieving Meaningful Use Stage 2: Medication Reconciliation; 2014. Available from: https://www.healthit.gov/providers-professionals/achieve-meaningful-use/core-measures-2/medication-reconciliation. Accessed October 31, 2015.

11. Boockvar KS, Santos SL, Kushniruk A, Johnson C, Nebeker JR. Medication reconciliation: barriers and facilitators from the perspectives of physicians and pharmacists. *J Hosp Med*. 2011;6:329–337.

12. Sanchez HS, Sadie SS, Santos SL, Boockvar K. Implementing medication reconciliation from the planner's perspective: a qualitative study. *BMC Health Serv Res*. 2014;14(1):290.

13. Agency for Healthcare Research and Quality. [webpage on the Internet]. Grossman J, Gourevitch R, Cross DA. Hospital experiences using electronic health records to support medication reconciliation. *National Institute for Healthcare Reform (NIHCR)* Research Brief Number 17; 2014. Accessed October 31, 2015.

14. Rangachari P. Overcoming the unintended adverse consequences of implementing health IT through human resource and knowledge management. In Blair JD, Fottler MD, Savage GT, editors. *Strategic Human Resource Management in Health Care. Advances in Health Care Management*, Vol 9. Bingley, UK: Emarald; 2010: 163–194.

15. Barrett M. Information technology, organizational change, and new modes of organizing. In Salazar A, Sawyer S, editors. *Handbook of Information Technology in Organizations and Electronic Markets*. Singapore: World Scientific Publishing; 2007.

16. Clay BJ, Halasyamani L, Stucky ER, Greenwald JL, Williams MV. Results of a medication reconciliation survey from the 2006 Society of Hospital Medicine National Meeting. *J Hosp Med*. 2008;3(6):465–472.

17. Rose AJ, Fischer SH, Pasche-Orlow MK. Beyond medication reconciliation: the correct medication list. *JAMA*. 2017;317(20):2057–2058.

18. Van Sluisveld N, Zegers M, Natsch S, Wollersheim H. Medication reconciliation at hospital admission and discharge: insufficient knowledge, unclear task reallocation and lack of collaboration as major barriers to medication safety. *BMC Health Serv Res*. 2012;12:170.

19. Orlikowski W. Using technology and constituting structures: a practice lens for studying technology in organizations. *Organ Sci*. 2000;11(4):404–428.

20. Orlikowski W, Barley S. Technology and institutions: what can research on information technology and research on organizations learn from each other? *MIS Quarterly*. 2001;25(2):145–165.

21. Rangachari P. Knowledge sharing networks related to hospital quality measurement and reporting. *Health Care Manage Rev*. 2008;33(3): 253–263.

22. Harrison M, Koppel R, Bar-Lev S. Unintended consequences of information technologies in health care – an interactive sociotechnical analysis. *JAMA*. 2007;14(5):542–549.

23. Rangachari P, Madaio M, Rethemeyer RK, et al. The evolution of knowledge exchanges enabling successful practice change in two intensive care units. *Health Care Manage Rev*. 2015;40(1):65–78.

24. Rangachari P, Madaio M, Rethemeyer RK, et al. Cumulative impact of periodic top-down quality improvement communications on infection prevention practices & outcomes in two units. *Health Care Manage Rev*. 2015; 40(4):324–336.

25. Augusta University CSRA Community Health Needs Assessment. Available from: https://www.augustahealth.org/media/file/Community%20Health%20Needs%20Assessment/community-health-needs-assessment-6-2016.pdf. Accessed October 31, 2015.

26. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. 2006;3(2):77–101.

27. Pope C, Ziebland S, Mays N. Qualitative research in health care: analyzing qualitative data. *BMJ*. 2000;320:114Y116.

28. Sauro J. *Measuring Usability with the System Usability Scale*. Available from: www.measuringusability.com. Accessed October 31, 2015.