Original Article

“It closes the gap when the ball is dropped”: patient perspectives of a novel smartphone app for regional care coordination after hospital encounters

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Background: Despite the broad adoption of electronic health records (EHRs) for inpatient and outpatient care, and wide availability of EHR-linked portals, these tools are not always effective in informing primary care teams about patients’ emergency department (ED) visits or inpatient admissions, leading to persistent gaps in care coordination. The objective of this study was to understand how patients with limited patient portal use in a safety net setting engaged with a smartphone app that used location tracking to detect and notify care teams about patients’ hospital use in order to stimulate care coordination and follow-up care.

Methods: We recruited English- and Spanish-speaking adults at high risk of hospital use from a Federally Qualified Health Center (FQHC). The app detected when patients visited the hospital and asked them to confirm a hospital visit. When confirmed, the app notified the primary care team about the visit, and the care team followed up with patients according to the FQHC protocols for care coordination. We collected qualitative data on app experience from participants who used the app for four months and used a general inductive approach to identify recurring themes.

Results: Participants generally reported a positive app experience, as it helped solve the problem of poor follow-up care. “I liked the goal of the app…Ultimate goal of it was comforting”, recounted one participant when describing her app experience. Participants thought the app push notifications could be refined and the app itself could be modernized. Participants also suggested improvements to the push notifications they received from the app and the visit information they entered into the app for care teams to receive. Some participants also suggested improvements to the FQHC’s care coordination workflows facilitated by the app, like an immediate connection to the patient’s primary care team.

Conclusions: The app was well received by low-income patients at high risk of ED/inpatient visits. Future research is needed to determine feasibility of implementation in other settings.

Keywords: Care coordination; primary health care; patient-centered care; vulnerable populations; mHealth

Received: 09 November 2021; Accepted: 04 March 2022; Published: 20 April 2022.

doi: 10.21037/mhealth-21-49

View this article at: https://dx.doi.org/10.21037/mhealth-21-49

Introduction

Primary care teams often do not know when patients visit the emergency department (ED) or experience an inpatient admission. A national study found that only 55.5% of primary care physicians routinely receive discharge information for hospitalized patients (1). Furthermore, in a study describing obstacles experienced by care managers, 37% of care managers reported timely access to patient-

related information as a major barrier to care coordination for chronically ill patients (2). These information gaps impede primary care teams' ability to follow up appropriately after ED and inpatient discharge, and patients notice these gaps (3,4).

Following ED/inpatient discharge, patients often face burdensome care coordination barriers. In a multi-country study of patients with complex care needs, 29% of U.S. patients reported they had experienced discharge planning gaps, where most commonly they did not have arrangements made for follow-up visits (4). In a recent study on patient perspectives on care coordination, patient dissatisfaction often was blamed on providers not communicating about patients' medical history and treatment plan. In that same study, some patients who were forced to coordinate their own care found it to be a burden and identified a need for support due to confusion about the roles of multiple providers. Additionally, patients were relieved when they did not have to retell of the care they had received. Patients also appreciated a platform to facilitate prompt communication with their providers like the electronic health record (EHR) and patient portal (3).

Despite the broad adoption of EHRs for patient care and EHR-linked patient portals, these tools often fail to facilitate care coordination during and after ED and inpatient visits. In multiple studies, U.S. patients reported that health records were unavailable to their treating providers, leading to adverse outcomes such as misdiagnoses (3) and duplicated diagnostic testing (4). Similarly, despite wide availability, patient portals have low adoption by older patients (5) and patients from low-income backgrounds (6-8) with low health literacy (9), who have higher healthcare utilization (6), exacerbating the impact of health information transfer gaps. Low adoption of patient portals is likely related to the barriers patients tend to experience, like basic computer illiteracy (10), reading and writing barriers due to portal terms and inaccurate spelling of search terms, and medical content barriers (11). Patient portal training (12) and patient incentive programs (10) have been proposed to address these barriers, but found to be unsuccessful.

As smartphone ownership becomes universal, a mobile app for care coordination may be a practical and favored alternative to patient portals for facilitating communication between patients and their outpatient care teams (13-15). However, apps are not often developed from the underserved patient perspective (16), limiting their potential acceptability and feasibility in these high-need populations.

In collaboration with patients, our team developed a smartphone app to facilitate real-time care coordination during ED and inpatient visits, and immediately after discharge. After initial testing of the first app version (17), we updated the location tracking algorithm and app user interface for the second generation under study here (18). The goal of this study was to understand how traditionally underserved and vulnerable patients felt about the app after four months of use on their personal phone. We present the following article in accordance with the Standards for Reporting Qualitative Research (SRQR) reporting checklist (available at https://mhealth.amegroups.com/article/view/10.21037/mhealth-21-49/rc).

Methods

Study participants and setting

As part of a larger study to evaluate this care coordination intervention (18), we recruited patients from an urban federally qualified health center (FQHC) in the Midwest. To be eligible for inclusion, patients were required to be an English- or Spanish-speaking adult (age 18–94 years), enrolled in a care management program the FQHC offered to high-risk Medicaid enrollees, an owner of a smartphone that used the Android operating system version 4.4 or later, and willing to enable smartphone location tracking services. Participants installed the app onto their phones during a baseline study visit, after providing informed consent and were asked to complete interviews about their recent hospital use at baseline, two-month follow up, and at the end of the four-month follow up period.

App workflow

Information on the design of the *ER Alert* app, and incorporation of the app within a regional care coordination intervention is detailed elsewhere (18), but outlined briefly here. We conducted interviews with patients, clinicians, and care managers about app acceptance and integration into the FQHC clinical workflows (17), which gave us valuable insight on how to integrate the app into the health practice in reality. For example, care managers elected to receive notification of their patients' ED/inpatient visits via an electronic fax automatically integrated into the patients' EHR. The app used location tracking to identify when a patient visited the hospital. Specifically, the app used radial geofences up to 350 meters for 41 Chicago-area hospitals with EDs placed at the center of the geofences. The app

tracked all location, but only stored location information on the study server when the phone was near a geofenced hospital. First, the app used location tracking to identify a hospital visit after the phone was inside a hospital geofence for approximately 45 minutes. Next, the participant was prompted by a push notification asking, "Are you a patient in the ER/hospital now?" If the participant did not respond to the push notification, the notification repeated every five minutes while the patient remained inside the geofence. Participants often referred to this notification workflow as an alert (for each hospital visit identified by location tracking) due to the name of the app, *ER Alert*. After the patient confirmed receipt of emergency or inpatient care, their FQHC was notified via an electronic fax automatically integrated into the patient's EHR, as preferred by the FQHC. Finally, a member of the FQHC's care management team (typically a nurse) followed up with the patient according to organizational protocols. The app language, English or Spanish, was dependent on the phone's language setting. And due to budget constraints, technical functionality of the app was prioritized, potentially to the detriment of graphic design.

Data collection and analyses

After participants provided informed consent and installed *ER Alert* on their phones at baseline, we collected data on demographics, health literacy (19), and prior use of the FQHC's patient portal. After the four-month study period, participants completed a 30-minute phone interview that followed an interview guide with open- and closed-ended items for participants to provide feedback on their overall experience with the app, how the app looked, and any changes they would recommend. Participants were contacted up to three times using primary and secondary contact information they provided to the study team at baseline and were given a $20 honorarium after each interview to support completion rates. All telephone interviews were conducted and audio recorded by an English- and Spanish-speaking study team member (AG). English interviews were transcribed by an English-speaking study team member (TB), and Spanish interviews were interpreted and transcribed in English by the bilingual study coordinator who conducted the interviews. The English translation of any Spanish quotes are presented below in the results. Two authors (DTL and AG) used a general inductive approach to identify possible themes (20). Both coders reviewed the same 15 (29%) interviews to identify an initial list of codes. Then, together they decided on the full list of codes that reflected recurring themes. Each coder then independently reviewed transcribed responses and assigned applicable codes. Responses could have multiple assigned codes, and discrepancies were discussed until consensus was reached. At study conclusion, an FQHC staff member conducted chart reviews for all study participants to obtain data on chronic illnesses and confirm participant characteristics and ED/hospital visits.

Ethical statement

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of Northwestern University (IRB #STU00203990) and the FQHC's Research Evaluation Committee and informed consent was taken from all individual participants.

Results

Among 57 enrolled participants who met inclusion criteria and installed the app on their phone, 52 (91.2%) completed the 4-month follow-up interview within two weeks of study conclusion and provided qualitative data for analysis. Among participants who completed follow-up, the mean age was 44.3 years (range: 19–73) (*Table 1*). Our study sample was representative of the population served by the FQHC in 2018 (21), with a large Hispanic community and more than half of the patients insured by Medicaid. Our sample was racially and ethnically diverse, with 30.8% Black and 55.8% Hispanic participants. Seven participants were primarily Spanish-speaking and used the Spanish app. Nearly all (92.3%) participants had less than a four-year college degree, 30.8% of participants had limited health literacy, and only 5.8% had ever sent a secure message to their care team via the FQHC's patient portal. There were high rates of chronic illness, with 59.7% having two or more illnesses.

As observed previously (18), participants received several alerts (i.e., push notifications) from the app during study follow-up. Many of these alerts (82.5%) were ultimately deemed 'false positives' due to reasons such as being near the hospital (within a hospital geofence) for 45 minutes or longer, or visiting a hospitalized loved one. The app identified seven hospital encounters from six hospitals and seven participants.

Themes from qualitative data are reported here in

Table 1 Patient characteristics

Characteristics	N (%)
Total	52
Age, mean [range]	44.3 [19–73]
Female	38 (73.1)
Race/ethnicity	
Black/African American	16 (30.8)
Hispanic	29 (55.8)
White	4 (7.7)
Other	3 (5.8)
Primarily Spanish-speaking	7 (13.5)
Education	
High school or less	21 (40.4)
Some college or 2-year degree	27 (51.9)
College graduate	4 (7.7)
Limited health literacy	16 (30.8)
None/limited patient portal use[†]	49 (94.2)
Number of chronic illnesses[‡]	
0	10 (19.2)
1	11 (21.2)
2	15 (28.9)
3–5	16 (30.8)

[†], either never registered for patient portal or registered but never used secure messaging; [‡], chronic illnesses include: diabetes, chronic obstructive pulmonary disease, chronic bronchitis, emphysema, asthma, hypertension, congestive heart failure, depression, anxiety disorder, substance use disorder, rheumatoid arthritis.

three distinct categories: (I) perceived benefits and utility of the app, (II) perceived challenges encountered during the study period, and (III) participant suggestions on app improvement.

Perceived benefits and utility: solution to existing care coordination barriers

Several participants said the app was appealing or a good approach to overcoming barriers they had experienced with care coordination.

In the following quotes, participants explicitly mentioned liking the app and its intended purpose. They described the app as providing a sense of security, since they knew that their care team would be informed about their hospital visits.

"I had a great experience. I liked the goal of the app… Ultimate goal of it was comforting." (Female, three alerts).

"Easy to understand. Pretty simple and I would say the thought of it is really good. It's accessible. Pretty much self-explanatory." (Female).

Some participants found the app to be a helpful, reliable communication tool for care coordination during and after hospital visits, and a timesaver during follow-up visits with their primary care team.

"…lots of times the ball gets dropped between the emergency room and the doctor's office. I like that it closes the gap when the ball is dropped." (Female).

"It's efficient…in my follow-up visit I won't have to explain what happened because they'll already have the report." (Male, four alerts).

Participants appreciated that the app was non-intrusive while it worked in the background, and that it did not constantly send unnecessary notifications, particularly during ED visits, which were already hectic.

"Emergency department can be crazy town-the app doesn't do anything crazy. It's perfect." (Female, five alerts).

Additionally, there appeared to be minimal effect on phone performance, with participants reporting that the app did not negatively affect battery life or data processing speed.

"I like that it doesn't take up a lot of battery. It was a worry early on." (Female, one alert).

"I found it doesn't disturb my phone or services. My only worry was my data plan or my phone working a little slower, but I had no problems." (Female).

Perceived challenges: push notifications and graphic design

Some potential barriers to acceptability of the app that were noted included push notifications that were received too slowly or too often and the app's graphic design.

In the following quotes, participants reported differing concerns about the app's push notifications, which began after the phone had been inside a geofence for 45 minutes, and repeated every 5 minutes until the patient responded to the prompt.

"I was in the emergency room and it took longer than I expected for the alert to come through—I was eager to see how it worked. While I was in the waiting room, it never went off, but when I went in the back, it went off right

away. Once I entered, I thought it would go off. I prefer for app to alert me immediately." (Male, four alerts).

"What I did not like is that it often alerted me again and again, too many notifications [per visit]." (Female, seven alerts on Spanish app).

Although some participants liked the simple look of the app, others felt it looked outdated.

"…like that it's low profile—it's not a big obnoxious thing." (Female, five alerts).

"[Regarding the look,] I was like, 'ewww,' when it first popped up." (Female, three alerts).

Additionally, a few participants who used the Spanish language app thought that some aspects of the app were too wordy or lengthy.

"…a lot to read. Since my eyes get tired, there were times where half way through my eyes would get exhausted, and I would stop reading, but I did like looking at the app information." (Female, three alerts on Spanish app).

Although privacy concerns were a potential barrier to acceptability, very few participants were hesitant about information security or enabling location tracking.

Suggestions for app improvements

Most participant suggestions for improving the app were focused on the push notifications, with participants wanting faster notifications with a distinct sound, and in response to the notifications, there was interest for an option to specify the reason for visiting the hospital (i.e., being seen as a patient in the ED versus visiting a loved one).

"Maybe the notifications could be more prominent—special sound—sound a little more alerting. The first time I received a notification I didn't hear it. One of my kids hit 'No'. I didn't even know it happened—more of an alerting sound I would have noticed." (Female, three alerts).

"There's an ATM in a hospital that I use frequently, and I didn't always get alerts. I'd like to receive alerts sooner. Or give the option to say you're there for someone else. You don't want to alert your care team if you're there to visit someone else." (Female, two alerts).

Some participants wanted the ability to share additional patient information with their care team about their hospital visit, such as symptoms and the reason for their visit. Participants also wanted to be able to manually report a hospital visit, rather than waiting for the app to automatically detect the hospital visit with location tracking.

"Some type of space so I could send a message to my doctor to tell him 'I'm being seen for this reason.'" (Male, four alerts).

"…give the option of saying 'I'm in the hospital' instead of [the app] asking you." (Female).

A few participants suggested changes beyond the app that would likely involve new care management workflows, such as establishing an immediate connection to the patient's primary care team or the app providing the primary care team with full details of the patient's hospital care.

"…would like to be able to automatically connect with [FQHC] triage. More communication between the app and the clinic. I would want to make [FQHC] nurses aware of the symptoms I'm having." (Female, one alert).

"I think that it should send the primary care doctor the whole report so they see what happened the whole visit so they don't have to ask questions because the [patient] might not remember. I'm not going to remember exactly what happened to tell the care team." (Male, four alerts).

Conclusions

We obtained qualitative feedback from a diverse, high-risk sample of 52 FQHC patients, who had very limited patient portal use, about a smartphone app that used location-based alerts to facilitate care coordination during and after ED/inpatient visits. Although many participants did not visit the hospital or receive alerts during the study period, participants reported many benefits. Participants liked the purpose of the app and found it comforting to know that their primary care team would automatically be informed about their hospital visit with little effort from the patient. Patients found the app to be a helpful communication tool for care coordination, regardless of how often the app was used during the short study period, and with minimal effect on battery life and phone services. A few challenges presented by participants were not receiving push notifications fast enough, while others reported they received too many notifications per hospital visit. Also, some participants disliked the app's graphic design. Interestingly, the wordiness of the app that was noted was only from participants that used the Spanish app. When describing potential improvements to the app, participants suggested faster, distinct notifications and new features to specify the reason for the hospital visit and self-initiate the hospital visit alert. Participants also suggested changes beyond the app itself, like an immediate connection with an FQHC nurse and transmission of hospital encounter notes.

A smartphone app-based approach to care coordination like the ER Alert app has the potential to be an alternative

to existing patient portals or other personal health records that patients rarely access. A 2020 HINTS survey (22) found that 73.7% of respondents reported accessing their online medical record two times or fewer in the previous 12 months. Previous work by Atienza and colleagues also found that online personal health records are sparingly used, with only 18% of mHealth privacy and security focus group participants reporting using an online personal health record. Additionally, patient portals are best accessed on desktop computers, which are not always easily accessible to underserved patient populations (10,23). When accessible, the barriers of a new technology and a new platform likely exist (10,11). Since traditionally underserved patient populations are more smartphone dependent for online access (24), it is reasonable that mobile apps designed appropriately could be more intuitive for these patient populations. Our app mainly worked in the background with automated alerts where, after onboarding, patients only had to respond to a push notification to alert their care team about hospital use. With location tracking enabled, patients did not need to initiate the communication workflow, making it as simple as possible for patients.

In addition to the app serving as an alternative to existing patient portals or personal health records, participants' approval of the app confirmed patients' enthusiasm for apps that improve communication with their primary care teams (13,17). Furthermore, our app connected patients to their primary care teams, which aligns with patients' preference for primary care physicians being their source of support and information when coordinating their care (3). The very few information security and location tracking concerns were consistent with previous studies where patients seldom reported privacy concerns (25) and where patients were willing to have their location tracked for mHealth purposes or perceived benefits and convenience (17,26).

This study had several limitations. First, although we had a moderate sample size with high retention, our sample was limited to one urban FQHC. Future app versions should be tested in other FQHC populations to ensure broad acceptability and feasibility of the app. Second, app installation and onboarding was facilitated with a study staff member in person. It is likely that in the future patients may continue to need app onboarding support. If implemented in other populations, some users may be able to follow onboarding instructions independently, while others may be unable to do so due to lower uptake of activities like internet browsing and app use among older smartphone owners (27). Third, there were limited opportunities for alerts. The study follow-up period was four months, so participants that did not visit the hospital during that timeframe had minimal app use. Additionally, some hospital encounters were not identified by the app due to phone manufacturers implementing new battery-saving updates that hindered our location-based algorithm and push notifications that were later addressed. Fourth, there may be patients actively using existing patient portals in which case our app can complement existing portal functions. However, for patients who still do not use portals, as was the case in our sample that had limited or no patient portal use (see *Table 1*), this app may be a preferable alternative to portals. Fifth, it is possible that participants may have selectively reported positive or negative experiences only. Finally, due to selection bias, the participants under study here—who agreed to use the app and were willing to share feedback—may be different from other FQHC patient populations.

Feedback from participants directly informed subsequent modifications to the app. For patients to self-report hospital visits, we added a distinct button for users to manually initiate the app workflow, allowing patients to report a hospital visit at any time during their ED/inpatient care without having to wait for location tracking to detect a geofenced hospital. This also gives users the option to deny app location-tracking to reduce 'false positives'. Although the initial push notification specifically asked "Are you a patient in the ER/hospital now?", there appeared to still be confusion amongst participants about times when they entered a hospital building but did not receive medical care—such as visiting a hospitalized family member—that should not be reported to participants' primary care teams. To address this issue, we added a confirmation screen for patients to confirm whether they were the patient in the ED/hospital or at the hospital for another reason. The confirmation screen was built using a 'select only one' response (e.g., "I'm at an outpatient appointment/testing" *vs.* "I'm the patient in the ER/hospital") to also reduce 'false positives'. Finally, to address interest in sharing additional patient information with care teams, we added free-text sections for patients to expand on the reason for their hospital visit and to add other notes. This free text could then be transferred securely to the primary care team at the time of care team notification of the patient's hospital visit.

In conclusion, a smartphone app that used location tracking to detect hospital visits and stimulate subsequent care coordination activities was well received by low-income patients who did not regularly use a patient portal and

were at high risk of ED/inpatient visits. Future research is needed to determine whether these results are generalizable to other high-need patient populations and to determine the feasibility of implementing this app at a larger scale in other real-world settings.

Acknowledgments

We would like to thank Shira Dunn and Geoyia Nightengale for recruitment and chart review support.
Funding: This work was supported by the Agency for Healthcare and Research Quality (No. #R21 HS025000).

Footnote

Reporting Checklist: The authors have completed the Standards for Reporting Qualitative Research (SRQR) reporting checklist. Available at https://mhealth.amegroups.com/article/view/10.21037/mhealth-21-49/rc

Data Sharing Statement: Available at https://mhealth.amegroups.com/article/view/10.21037/mhealth-21-49/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://mhealth.amegroups.com/article/view/10.21037/mhealth-21-49/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of Northwestern University (IRB #STU00203990) and informed consent was taken from all individual participants.

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doi: 10.21037/mhealth-21-49
Cite this article as: Guzman A, Brown T, Liss DT. "It closes the gap when the ball is dropped": patient perspectives of a novel smartphone app for regional care coordination after hospital encounters. mHealth 2022;8:13.