Mobile Application to Improve Just-in-Time 2-Way Formative Feedback in Graduate Medical Education

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ABSTRACT

Background An easy-to-use application to facilitate direct observation and allow for 2-way feedback between residents and faculty is needed.

Objective To develop a mobile-based application (app) with the goals of (1) providing just-in-time feedback to residents; (2) improving timeliness of feedback by faculty; and (3) allowing residents to comment on the value of faculty feedback.

Methods Fifty-one of 69 (74%) internal medicine (IM) residents and 20 of 25 (80%) IM core faculty participated in the study from July 1, 2020, to December 31, 2021. An iOS app was designed by authors with expertise in medical education and application development to capture entrustable professional activities (EPAs)-based feedback (eg, informed consent) based on direct observation of residents' skills in the workplace. App utilization and narrative feedback characteristics of faculty comments were examined by exporting the data from the database server. The end user satisfaction was examined using a survey instrument.

Results Eighty-seven percent of assessments (117 of 134) initiated were fully completed by residents and faculty. Faculty narrative comments were noted in 97% (114 of 117) of completed assessments and 64% (75 of 117) of residents' feedback to the faculty contained narrative comments. Eighty-three percent (97 of 117) of comments were behaviorally specific and 71% (83 of 117) contained an actionable item. Eighty-six percent (18 of 21) of residents and 90% (9 of 10) of core faculty stated that this application promoted an educational interaction between them.

Conclusions This app facilitates the efficient completion of EPA-based formative assessments and captures bidirectional feedback in the workplace setting.

Introduction

Multiple studies have suggested that feedback is less meaningful if it does not include direct observation or guidance for performance improvement.[1-4] As clinical settings become more demanding with general lack of time, current interfaces for documenting these direct observation-based assessments remain challenging.

Traditionally, specialties in graduate medical education have used mobile applications with a milestone and competency-based framework to capture feedback and assessment data.[5-8] The Association of American Medical Colleges entrustable professional activities (EPAs) provide a framework to deliver effective formative assessment (feedback) in an individualized and setting-appropriate manner and motivation for learners to develop behaviors, skills, attitudes, and knowledge.[9-11] EPAs can also inform advancement decisions by focusing on the essential discreet professional activities a resident should be able to perform. EPA-based assessments were used in our mobile application as they provide a framework that translates competencies into clinical practice.

To our knowledge, there is a paucity of literature describing applications that allow residents to provide real-time feedback to faculty about the usefulness of their feedback. In addition, few references combining the EPA framework with a mobile platform can be retrieved in the literature.[12-14] This is the first article describing an EPA-based application (app) which delivers workplace-based assessments for internal medicine (IM) residents and also provides feedback to the faculty observers. The goals of developing this electronic, mobile-based app (qUIkcoach) were to (1) provide just-in-time feedback to residents; (2) improve timeliness of feedback offered by faculty; and (3) allow residents to comment on the value of feedback provided to them.

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Editor's Note: The online supplementary data contains the surveys used in the study and further resources.

Methods

Setting and Needs Assessment

Fifty-one IM residents and 20 IM core faculty (CF) participated in the study conducted at a large teaching hospital over an 18-month period (July 1, 2020 to December 31, 2021). The design of the app and the study were initiated in response to a needs assessment showing dissatisfaction with the current paper-based workplace-based assessment (mini-clinical evaluation exercise; mini-CEX; online supplementary data TABLE 1). Main areas of dissatisfaction included: (1) evaluation of broad skill categories rather than discrete clinical skills; (2) unavailability of paper forms at the point of care; and (3) suboptimal "just-in-time" completion rates.

Design of Mobile App

Authors with expertise in medical education (J.R., M.S.) and mobile application design (G.M.) developed the iOS app in Apple's Swift programming language using XCode, Apple's integrated development environment. The app uses Google Firebase to send real-time notifications when the assessment is created (by either resident or CF) and the feedback is completed (by either resident or CF). Assessment data is stored in the Microsoft SQL Server database, while data communication is accomplished via Web API written in C#. The user identification is authenticated by the university's single sign-on service and requires a unique user log-in. While the design of this application allows it to be available to other programs beyond our institution, financial resources (estimated cost of $4,000) to host and maintain the web and database server are required.

The feedback cycle begins with the initiation of feedback by either the resident or the CF and ends with delivery of feedback to both the resident and CF (FIGURE). Radio buttons allow for efficient recording of the assessments for each of the EPA-based discrete skills on the checklist. In addition, a level of entrustment (global assessment) is also chosen by the CF for every observation. Screenshots of 2 EPA-based assessments (verbal handoff and informed consent) are included as examples in online supplementary data FIGURES 1 and 2. Narrative comments are made using the voice-to-text feature. The app is designed to allow assessments to be submitted only when all fields are completed. After the assessment is submitted by the CF, a notification is sent to the resident. The resident can then view the submitted assessment and enter feedback on the utility and quality of the feedback provided by the CF. To assure anonymity, the CF can only view aggregate feedback (minimum of 5 entries) from the residents.

The user interface of the app is divided into 3 tabs: Create, Pending, and Completed. These tabs make the interface intuitive and easy to follow and allow users to quickly navigate the app. The resident or CF may initiate an assessment for an individual resident by clicking the Create tab. Once an assessment is created, the notification feature of the app delivers the request to the CF (online supplementary data FIGURE 3) and moves the assessment to the

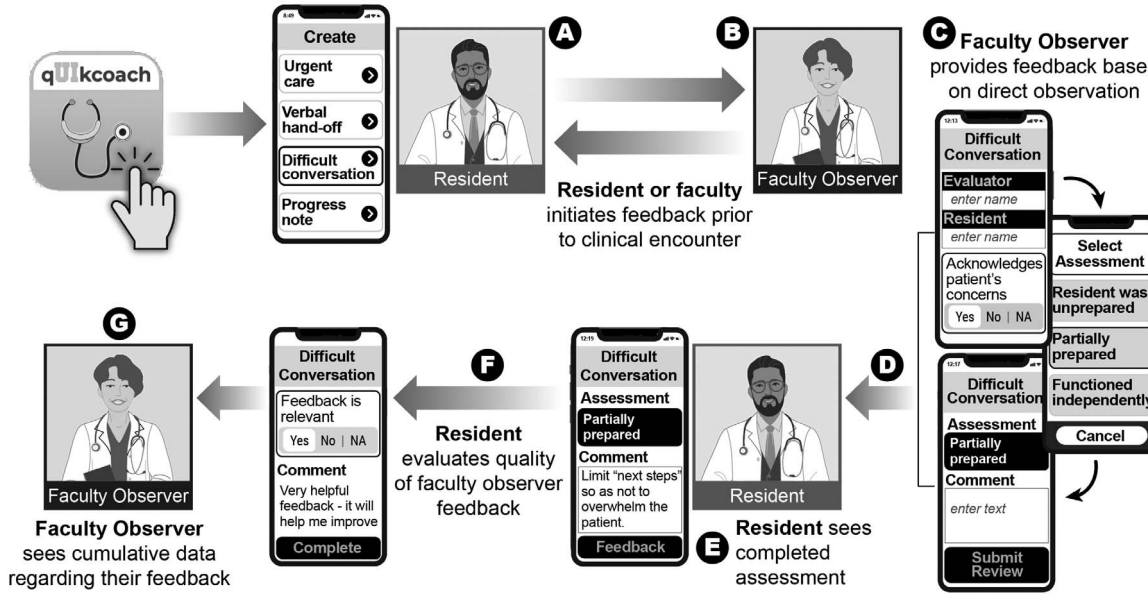

FIGURE
Illustration of Bidirectional Feedback Cycle Used in the Mobile Application

Pending tab. The list of assessments is color-coded, so assessments that need to be completed are easily identifiable. The number included in the red circle indicates the number of pending assessments and implies that action is needed (online supplementary data FIGURE 4). The assessment moves to the Completed tab once the resident has reviewed the CF feedback and provided feedback back to the CF. Following completion of the faculty feedback, an email containing the feedback and entrustment rating is automatically generated and sent to the resident, faculty, and residency program. All data are automatically uploaded and available to the residency program leadership via the dashboard.

For the study we created a web-based version of qUIkcoach for Android users. This web-based application design is identical to the iOS app, allowing Android users a similar experience.

Resident and Faculty Development

All IM residents and CFs were trained to use the app during 20-minute sessions that were repeated 3 times prior to the start date. All participants were also trained on the feedback framework proposed by Gigante et al.[15] This framework was also included in the app for reference (online supplementary data FIGURE 5). Residents and CFs received monthly informational e-mail reminders following the training sessions.

Intervention

CFs and residents were encouraged to use the mobile app, but no expectations for numbers of assessments to be completed were set for the study. Automated reminders were sent if there were incomplete assessments.

Outcomes

To assess the feasibility, utility, and validity of the intervention, 3 outcomes were examined: (1) utilization; (2) characteristics of faculty narrative comments (content and polarity, specificity and actionability); and (3) end-user satisfaction. Application utilization and characteristics of faculty narrative comments were examined by exporting the data from the database server. End-user satisfaction data was gathered using an electronic survey (online supplementary data TABLE 2) delivered to CFs and residents following the 18-month study period. Using a previously published method for describing the comments, we characterized each CF comment defined as a grouping of words focused on a unique concept or behavior, in 3 dimensions: (1) content and polarity (ie, reinforcing/corrective); (2) specificity (ie, general comment vs behaviorally specific); and (3) actionability.[16] Two authors (J.R. and M.S.) independently coded each comment and then compared assigned codes. Differences were resolved through consensus. Resident feedback on the quality of CF feedback was not examined in this study.

This project was deemed nonhuman subjects research by the Institutional Review Board of the University of Iowa.

Results

Utilization

A total of 134 assessments were initiated during the study period. Of 134 initiated assessments, 117 (87%) were fully completed by both residents and faculty. Thirty-nine percent (46 of 117) of completed assessments were performed in the inpatient and 61% (71 of 117) in the outpatient setting. Narrative comments by CFs were noted in 97% (114 of 117) of the completed assessments whereas 64% (75 of 117) of the residents' provided narrative feedback to CFs.

Feedback Characteristics

Forty percent (47 of 117) of the completed CF assessments generated a single narrative comment, 15% (18 of 117) contained 2 comments, and 44% (52 of 117) included 3 or more comments. Eighty-three percent (97 of 117) of comments were behaviorally specific (eg, *"Do recommend you ask one more time to make sure no other questions. Also consider checking in after each chunk"*) and 17% (20 of 117) were general (eg, *"Overall great job. You made the patient feel very comfortable with the procedure")*. Additionally, 71% (83 of 117) of comments had an actionable item as part of the narrative feedback. In terms of valence, 83% (97 of 117) of assessments contained reinforcing comments, 71% (83 of 117) contained corrective feedback, and 65% (77 of 117) contained both reinforcing and corrective feedback.

End-User Satisfaction

The post-study survey was completed by 50% (10 of 20) of CFs and 41% (21 of 51) of residents (TABLE 1A & B). All (10 of 10) CFs reported that they were able to complete the assessment in less than 10 minutes (30% completed within 5 minutes). In addition, 100% (10 of 10) of CFs reported that they either finished the assessment immediately after the observation or at some point during the observation day. Ninety percent (9 of 10) of CF responders thought that the application was easy to use and rating forms were easy to

TABLE 1
Post-Study Surveys Completed by Residents (1A) and Core Faculty Observers (1B)

1A		
Resident Post-Study Survey		**Somewhat Agree & Strongly Agree, n (%) (N=21)**
Workplace-based observation of my clinical skills during patient care is an important component of resident training		21 (100)
The qUIkcoach app promotes an educational interaction between the observer and the resident		18 (86)
Feedback the observer provides to me through the qUIkcoach app is useful for my skill development		15 (71)
I find that the qUIkcoach app is easy to use		16 (76)
The qUIkcoach rating form for providing feedback to the observer is easy to understand		19 (91)
Approximately how many minutes does it take you to complete your portion of a qUIkcoach workplace-based assessment form?	0-5 min	13 (62)
	6-10 min	7 (33)
	11-15 min	1 (5)
	16-20 min	0 (0)
	>20 min	0 (0)
Identify when you most generally fill out your portions of the qUIkcoach workplace-based assessment which is sent back to the faculty observer:		
Immediately upon receiving electronic feedback from the faculty observer		3 (14)
At some point in time during the day of the encounter		9 (43)
One day after the encounter		1 (5)
More than one day following the encounter		8 (38)

1B		
Faculty Post-Study Survey		**Somewhat Agree & Strongly Agree, n (%) (N=10)**
Workplace-based observation of residents' skills during patient care is an important component of resident training		10 (100)
The qUIkcoach app promotes an educational interaction between the observer and the resident		9 (90)
Completing a clinical observation using the qUIkcoach app during a patient encounter is an efficient way to provide feedback to the resident		8 (80)
qUIkcoach rating forms are easy to understand		9 (90)
The qUIkcoach app is easy to use		9 (90)
Approximately how many minutes does it take you to complete your portion of a qUIkcoach workplace-based assessment form?	0-5 min	3 (30)
	6-10 min	7 (70)
	11-15 min	0 (0)
	16-20 min	0 (0)
	>20 min	0 (0)
Identify when you most generally fill out your portions of the qUIkcoach workplace-based assessment which is sent back to the faculty observer:		
During the patient encounter		0 (0)
Immediately following the patient encounter		3 (30)
After I have had a chance to provide in-person feedback to the resident		3 (30)
At some point in time during the day of the encounter		4 (40)
One day after the encounter		0 (0)
More than one day following the encounter		0 (0)

understand. One hundred percent of CFs (10 of 10) and residents (21 of 21) surveyed responded that workplace-based assessment is an important part of training.

Discussion

This mobile application offers the possibility of efficiently completing and capturing WBAs based on direct observation. The characteristics of the CF narrative feedback included a high proportion of behaviorally specific comments and actionable items. In addition to providing feedback to residents, this is the first platform to offer a bidirectional feature to the feedback (CF to resident and resident to CF) and to allow residents to assess the usefulness of the feedback they receive.

Medical educators who have implemented WBAs have encountered significant challenges. Common barriers include lack of time and competing demands that interfere with the faculty member's ability to complete these assessments. Design of our app addresses some of these barriers by making the user interface easy to use and time efficient. Multiple specialties (pediatrics, surgical specialties, family medicine) have employed different frameworks (milestones, competencies) using mobile applications to facilitate more efficient capture, delivery, and aggregation of assessment data.[5-8,17-19] Initial outcomes of these reports have supported the feasibility and utility of mobile platforms. At the same time, concerns have been raised that competencies and milestones used in assessments are too numerous, too granular, and/or too abstract for frontline faculty to use. We used EPA-based assessments in our mobile app as they provided a framework that translates competencies into clinical practice. The EPA-based assessments used were refined from the assessments used in our previous study.[20]

The outcomes of this study indicate that, when designed with user interface principles in mind, assessments can be completed quickly and generate bidirectional feedback. The app's efficiency supports feasibility of its use within a training environment, and the narrative comment analysis supports its utility. While there was a high completion rate of the narrative comment section by CFs, the resident narrative comment completion rate indicates room for improvement. More faculty development will be needed to increase the number of specific actionable items included in the feedback. The completion rate of the post-study survey was below expectations, thereby hindering us from drawing conclusive results. In the future, time stamps for evaluation creation and completion will be added so that we can more accurately measure the time needed to complete an assessment.

Currently we are developing an integrated dashboard to allow for residents and CFs to view their cumulative data, which will allow us to gather additional evidence of the app's validity and usability, both for coaching and for judging competence.

Conclusions

This mobile application facilitates the efficient completion of EPA-based formative assessments and captures bidirectional feedback in the workplace setting. The application also combines EPA-based formative assessments and bidirectional feedback into a single package.

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