Overcoming barriers to implementing patient-reported outcomes in an electronic health record: a case report

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ABSTRACT

In this case report, the authors describe the implementation of a system for collecting patient-reported outcomes and integrating results in an electronic health record. The objective was to identify lessons learned in overcoming barriers to collecting and integrating patient-reported outcomes in an electronic health record. The authors analyzed qualitative data in 42 documents collected from system development meetings, written feedback from users, and clinical observations with practice staff, providers, and patients. Guided by the Unified Theory on the Adoption and Use of Information Technology, 5 emergent themes were identified. Two barriers emerged: (i) uncertain clinical benefit and (ii) time, work flow, and effort constraints. Three facilitators emerged: (iii) process automation, (iv) usable system interfaces, and (v) collecting patient-reported outcomes for the right patient at the right time. For electronic health record-integrated patient-reported outcomes to succeed as useful clinical tools, system designers must ensure the clinical relevance of the information being collected while minimizing provider, staff, and patient burden.

Keywords: patient outcome assessment, work flow, clinical informatics, electronic health record, primary care, patient-reported outcomes

INTRODUCTION

As the US healthcare system increases its focus on accountable and patient-centered care, providers are increasingly asked to collect and use patient-reported outcomes (PROs) in patient care.^{1–3} For example, the Institute of Medicine recommended that policymakers, as part of Stage 3 Meaningful Use, require providers to collect standardized social and behavioral data in their electronic health records (EHRs).⁴ Others have proposed incorporating PROs in EHRs to achieve more standardized and efficient clinical documentation and work flow.^{5–7}

Given the importance of social and behavioral factors in health, researchers must understand barriers and facilitators related to integrating PROs in EHRs. Previously, researchers have characterized social, technical, and organizational factors related to EHR adoption and use.^{8–11} However, despite technological advances that support integrating PROs in EHRs, researchers have rarely empirically examined barriers and facilitators associated with this process.^{12–15} This research is needed to help design the systems in which PROs are collected and communicated to maximize positive impact on clinical decisions and care quality.^{3,16} Therefore, the objective of this case report is to describe our experiences and lessons learned in overcoming barriers to implementing an information system that collects PROs in an ambulatory EHR.

CASE DESCRIPTION

Setting

As part of a larger, randomized experiment to evaluate the impact of EHR-integrated PROs on chronic pain care,¹⁷ we analyzed 6 family medicine practices affiliated with the University of Florida Health System (UF Health). The practices are staffed by 39 providers, including physicians, physician assistants, and nurse practitioners. A centralized information technology (IT) department manages information systems development and customization for the health system's practice sites. Clinical and administrative champions from family medicine, pain medicine, and IT

collaborated with our team of researchers to develop and implement the system with the aim of improving patient and clinician satisfaction and quality of care for patients with chronic pain.

Information System

We modified and implemented an existing, web-based system that administers computer-adaptive PRO questionnaires, called the Collaborative Health Outcomes Information Registry (CHOIR).¹⁸ Next, we developed a messaging interface to send PRO results from CHOIR to the UF Health Epic EHR.

The CHOIR system was developed at Stanford University by a team of informaticists and physicians who provided a no-cost license for our implementation.^{18,19} CHOIR utilizes a client-server architecture with web-based clinician and patient interfaces that use open source technologies, including jQuery mobile²⁰ and Google Web Toolkit.²¹ Users can access CHOIR via web browsers on desktop or mobile devices. The primary patient user function is the completion of computer-adaptive PRO assessments using a click- or touch-based input device (Figure 1).²² Clinical user functions include registering patients to complete a PRO assessment, reviewing individual and summary PRO assessment results, longitudinal outcomes tracking, and clinical decision support through the aggregation of PRO result sets.

CHOIR is Health Insurance Portability and Accountability Act (HIPAA) compliant for storing patient information. Moreover, the CHOIR web server interfaces with a computer adaptive testing engine for administering questionnaires and scoring results. Through computer adaptive testing, patient response burden is reduced by ~71%.¹⁹ The implementation described in this case was designed to administer 13 PRO questionnaires that were selected by local family and pain physicians as relevant to the assessment and management of chronic pain. The measures include the following from the Patient Reported Outcome Measurement Information System (PROMIS): pain

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interference, pain behavior, fatigue, physical function, sleep disturbance, sleep-related impairment, anger, depression, and anxiety.^{23,24} Each PROMIS measure is assessed via a series of text-based items that are administered computer adaptively for increased efficiency and validity.²⁵ Each PROMIS measure is resulted on a 0–100 scale, where 10 points represent a one standard deviation change based on a healthy population distribution. In addition, CHOIR computes a population percentage score and attaches a nominal result (e.g., “mild,”

“moderate,” or “severe”). In addition to the PROMIS measures, our implementation assesses pain location using a body map and pain intensity (0–10 scale), pain catastrophizing,²⁶ and risk of opioid-related aberrant behavior.²⁷

Beyond choosing PRO assessments for our local implementation, we developed an interface between CHOIR and the UF Health Epic ambulatory EHR. Through this interface, CHOIR loads patient and visit information from the EHR. Then, patients can complete PRO assessments when they arrive for a visit but before they see their provider. After a patient completes the assessment, the server creates a Health Level Seven (HL7) message containing discrete PRO results, a static document summarizing all results (Figure 2), and a patient identifier. CHOIR immediately and securely sends this message to the EHR where results records store the PROs for potential provider review during the visit. Through these results and additional EHR customization, clinicians can view PRO scores in their standard results review interface, graphically trend results over time alongside prescribed medications, and use pre-built templates to insert the PRO results into clinical notes.

Figure 1: Screenshot of the CHOIR patient interface for completing PRO assessments. This item is from the PROMIS Pain Behavior scale's item bank.

METHODS

We conducted a qualitative observational study over a 15-month period encompassing the system design and early implementation. The study was approved by the University of Florida Institutional Review Board.

Research team members collected notes by hand and computer based on observations and conversations during IT development meetings, clinical practice observations, system demonstrations, and facilitated discussions with providers and staff. Between 1 and 3 research team members scheduled and attended each session. The primary goal in the sessions was to understand user and other stakeholders'

Figure 2: PRO results document generated by CHOIR. This document is stored in the EHR as are discrete results for each PRO.

Collaborative Health Outcomes Information Registry (CHOIR)

Page 1

Test Patient

DOB 09/18/1990 Age 24

MRN 7654321

Gender N/A

6 areas selected on the most recent body map

PROMIS Outcomes Measures	Score	%ile
Pain Interference Bank	63	90
Fatigue	42	21
Sleep Disturbance	30	2
Anxiety	67	96
Depression	53	62
Pain Behavior	55	69
Physical Function *	43	24
Sleep-Related Impairment	54	66
Anger	60	84

** Scores and percentiles have been inverted*

Pain Intensity: 0=No Pain, 10=Worst Pain Imaginable

Worst	Average	Now	Least
9	6	4	2
Severe	Moderate	Mild	Mild

needs and preferences for the system design and implementation. The system demonstrations involved 8 patients and 4 providers. The clinical practice observations and facilitated discussions involved a total of 23 providers; 4 IT developers; 4 health system, or IT administrators; and approximately 15 practice staff members. Some of these stakeholders participated in multiple sessions.

During the design phase, our interactions focused on understanding how to design the technology to be maximally usable and useful in the context of clinical practice. During the implementation phase, our interactions had a similar focus but also involved demonstrations and observations of the technology via screen shots, mock-ups, or actual use. Our notes contained a mix of direct quotes and researcher's interpretation of the interactions. Also, we obtained verbatim written feedback from practice managers during a facilitated group discussion and from some providers and practice staff via email and/or electronic survey. The electronic survey was administered to assess provider experiences for the larger experimental study, but it also yielded some feedback on the PRO system. In total, the data collection generated 42 documents containing approximately 90 pages of text. Table 1 provides an overview of the data.

Given resource and logistical constraints, we chose only 4 of the 6 practices to initially participate in the randomized experiment.¹⁷ One practice was excluded because it is a residency teaching practice,

which created additional logistics challenges to implementation. The second practice was excluded because it is located in an outlying geographic area, which posed challenges for conducting regular data collection. Next, consistent with the larger experimental study design, we used a random number generator to select 2 practices to actually implement the system. Therefore, 6 practices provided data during the design phase, and 2 practices provided data during implementation.

Conceptually, our analysis was guided by the Unified Theory on the Adoption and Use of Information Technology (UTAUT) and its core constructs: performance expectancy, effort expectancy, facilitating conditions, and social influence.²⁸ These constructs predict adoption and use of IT. Three analysts independently read and scrutinized all data by hand, labeling text and using constant comparison across documents from different data sources (Table 1). Analysts looked for repetition and factors relevant to overcoming barriers to using the PRO system.^{29,30} Next, the analysts met among themselves and identified a single set of themes via consensus. In this process, some preliminary themes from individual analysts were dropped due to a lack of general representation in the data. In other cases, preliminary themes from individual analysts were judged to be similar and thus combined. Next, to increase validity and comprehensiveness of the themes, each analyst independently reviewed the themes while scrutinizing the original data. Last, the analysts met again to discuss and arrive at a single

Table 1: Description of data source types and example data generated

Type of data sources	Example data
On-site observations of practice work flows and staff interviews	<i>[Office manager] stated that Epic would have to alert the check-in staff of a pain patient, then a staff member could administer the pain survey [PROs]. . . . There is typically a 5-10 minute wait</i>
Facilitated group discussion with practice managers ^a	<i>"Nurses already have a lot of things to do for each patient/check-in already preps forms for patients based on appointment."</i>
Facilitated group discussion with practice medical directors	<i>She [medical director] said that they were planning on giving the patients the iPads in the exam room and asked if that was okay.</i>
Facilitated discussions with providers	<i>Can we email the patients the survey to complete at home before their appointment? Concern about burden and time required for survey.</i>
IT planning meetings with IT administrators and developers	<i>Also discussed implications as other PROs are requested, there was a general belief from [assistant dean for clinical informatics] and the group that more PROs are coming.</i>
Facilitated discussions and emails with practice schedulers	<i>The [schedulers] would not want it to be that the patient only comes in to discuss pain when they were actually calling to make an appointment about something else. . . . (So there is a concern that asking the pain question could be leading and result in additional questions the agent was not qualified to answer.)</i>
Facilitated group meetings with providers	<i>They [providers] don't want to know about a patient's depression if they are coming in for a sore throat. If it is chronic pain, then they are okay with knowing about their depression.</i>
Patient demonstrations of PRO assessment	<i>Patient did not feel well enough to complete survey, but was receptive to me reading the questions aloud and recording answers.</i>
Provider demonstrations and discussions of PRO assessment and EHR results	<i>They [providers] value specific practical information about how to deal with patients with pain, such as what would a pain specialist do in a given scenario.</i>
Provider open-ended survey comments ^b	<i>I find that patients with chronic pain require alot of time in the office to discuss the issues and they want to be heard. It is important to get the entire context in which they exist and oftentimes it is not possible to get that information because of time constraints.</i>
Email feedback from providers, staff, and administrators	<i>About half my patients are still filling out forms in the room when I get there. If they have to complete the tablet in the waiting room, this could significantly affect work flow.</i>

Notes: ^aIn this session, practice managers completed a questionnaire on potential work flow challenges. ^bFor the larger experimental study, providers completed a monthly survey on experiences with pain care in which they also sometimes commented about assessing or using PROs and related work flows.

set of themes via consensus. Throughout this iterative process, the analysts interpreted the themes in the context of the four core UTAUT constructs, labeling themes with these constructs as they judged appropriate. The analysis lasted ~5 weeks, and the analysts met as a group 3 times during that period.

RESULTS

We identified 5 themes reflecting barriers to and facilitators of system adoption and use (Table 2). Two barriers emerged: (i) uncertain clinical benefit and (ii) time, work flow, and effort constraints. Respectively, these 2 barriers relate primarily to the UTAUT constructs of performance expectancy and effort expectancy. Similarly, 3 facilitators emerged: (iii) process automation, (iv) usable system interfaces, and (v) the need to administer and communicate PRO results for the right patient at the right time. In the context of the UTAUT, each facilitator exemplifies a facilitating condition, which is organizational or technical infrastructure to support the system's use.²⁸ We did not identify any themes exemplifying the fourth UTAUT core construct, social influence.

Barrier 1: Uncertain clinical benefit

Uncertain clinical benefit of the PRO system relates to performance expectancy, which defines the importance of user-perceived benefits to job performance when considering a system. Providers described concern that systematically collecting PRO information, in particular psychological data on depression and anxiety, could open “Pandora’s Box” during visits. For example, some said discussing these issues could harm care quality by diverting their attention away from acute problems that they judged to be more relevant at a given visit or more aligned

with their clinical expertise. However, as the primary facilitating condition to help overcome uncertain clinical benefit, providers and practice staff overwhelmingly described a need to collect PRO data from the right patient at the right time. Along those lines, administrators, practice staff, and providers desired processes to pre-identify specific patient visits for which collecting PRO information would be clearly useful. Moreover, administrators, practice staff, and providers mostly rejected a suggestion that PROs be collected at all visits, despite the potential general relevance to patients’ overall health. Finally, some providers suggested the system have a mechanism to defer discussing problems identified by the PROs to a subsequent visit or specialist referral to ensure their ethical and legal obligations to address PRO results were satisfied.

Barrier 2: Time, work flow, and effort constraints

Time, work flow, and effort constraints represented a barrier that cut across nearly all stakeholders’ feedback on concerns about implementing the system. Essentially all stakeholders expressed that system use must fit within existing work flow slack (e.g., patient wait times) or otherwise reduce clinician, staff, or patient time and effort. This barrier fits with the UTAUT principle that increasing expected effort in using a system lowers intended use. Therefore, clinicians and practice staff strongly supported facilitating conditions, namely process automation and collecting PROs from the right patient at the right time, to enhance system adoption and use. Their desire for automation encompassed multiple tasks, including identification of relevant patients, display of PRO results in the EHR, and administration of the PRO questionnaires. For example, after considering multiple approaches, administration, providers, and staff favored an automated

Table 2: Barriers and facilitators to implementing patient-reported outcomes in an electronic health record

	Barriers		Facilitators		
	Uncertain clinical benefit	Time, work flow, and effort constraints	Process automation	Usable system interfaces	Right patient at the right time
UTAUT construct	<i>Performance expectancy</i>	<i>Effort Expectancy</i>	<i>Facilitating conditions</i>	<i>Facilitating conditions</i>	<i>Facilitating conditions</i>
Example Data 1	Practice medical director: <i>wants providers to know that patients can return for a follow-up appointment if they are not able to address the “open can of worms” (created by the PROs)</i>	<i>The group practice leadership want to make sure that work flows aren’t interrupted</i>	Practice manager wrote: <i>patients will need to register themselves; consensus for patients to be pre-registered into the study software prior to their visit</i>	Physicians requested: <i>that the [data] be provided as smart phrases so that they could easily integrate into their clinic notes (not have to toggle back and forth between screens)</i>	Provider wrote: <i>“It has been said that the [PRO] questionnaire may identify issues that would have not otherwise been addressed. I can appreciate that in the-ory, but only if the patient is coming in to the office specifically to have their chronic pain addressed.”</i>
Example Data 2	Practice staff said: <i>Concern that it [PROs] will open Pandora’s box and they will decide to talk to their doctor about pain AND their chief complaint; they will “hate us” if all of their patients suddenly want to start talking about their pain</i>	<i>During busy times, we (nurse or check-in staff) would not have time to do this [administer PRO assessments]</i>	<i>Multiple doctors were emphatic about the value of “dot” phrases [an Epic short-cut], so they can [automatically] drop results into their notes</i>	Patient said: <i>difficult to undo a click on the body map, had to zoom in and tap. Zooming in function can get tricky. Patient suggested labeling “left” and “right” side of the body map</i>	<i>One provider asked about one of his patients for whom he does not manage their pain. . . . That provider was also concerned about whether he could refer his patients to pain specialists because he did not want to treat them</i>

algorithmic approach to reviewing patients' history and electronically flagging upcoming visits as appropriate for PRO collection. Also, clinicians preferred automated approaches to displaying the PRO results in the EHR, specifically templates or other shortcuts for inserting PRO results in their clinical notes. Similarly, some providers responded positively to the idea that capturing structured PROs could save time normally spent eliciting similar data during face-to-face patient encounters. Practices varied in their preferences for efficiently administering computerized PRO questionnaires. Some practices preferred PROs be collected in a waiting room while others preferred the exam room. These preferences were based on work flow constraints but also reflected concerns about privacy and security of the devices used to administer the surveys.

As an additional facilitating condition to overcome time, work flow and effort constraints, patients and providers requested highly usable system interfaces for efficiently collecting PRO data and reviewing results. For example, some patients expressed frustration with unfamiliar touchscreen interfaces and insufficient interface feedback when they tried to skip required questions. As discussed above, providers were particularly interested in EHR interfaces that allowed them to easily document PRO results in their notes and interpret PRO summary scores. In response to this feedback, we developed and continue to improve interfaces for easily inserting PRO results into clinical notes, trending results over time, and text-based results that appear alongside numeric PRO scores to indicate their clinical decision making relevance.

DISCUSSION

In this case report, we described the design and implementation of a novel information system for computer-adaptive PRO collection and EHR integration along with related lessons learned. While administrators, practice staff, providers, and patients generally supported this system, our experience produced many lessons learned in terms of how to overcome barriers to system adoption and use. Therefore, this study provides timely and practical insights into system- and practice-level barriers and facilitators to integrating PROs in EHRs. Indeed, our findings align with existing theory on antecedents of IT adoption and use, including effort expectancy, performance expectancy, and facilitating conditions.²⁸ Also, our findings coincide with recent research and policy recommendations, including the importance of efficient and feasible data collection and clear clinical usefulness.^{4,31–33} Furthermore, our findings provide new, management and policy-relevant insights into stakeholders' perceptions of incorporating PROs in EHRs, such as the desire for process automation and to carefully select which patients report PROs.

This study has limitations. First, the study was limited to one institution and embedded in a larger study on chronic pain. Therefore, future research should explore these findings in more general settings. Second, much of the data collected and the analysis results represent the researcher's perspectives, which may have introduced bias into the findings. Third, the data collection did not continue long into the system implementation, therefore themes may not represent longer-term stakeholder perspectives. Finally, it is important to point out that the barriers and facilitators identified were not universally reported by each provider, staff member, or patient. Our analysis focused on identifying themes that tended to recur across settings and people, which we judged to provide the most generalizable lessons learned.

In conclusion, for EHR-integrated PROs to succeed as useful clinical tools, system designers must ensure the clinical relevance of the information being collected while minimizing provider, staff, and patient burden. Designers should focus on easy-to-use interfaces,

automated PRO collection, and communicating PROs only when directly relevant to a given patient visit. Finally, policymakers and clinical leaders may need to better demonstrate clear clinical usefulness or provide other incentives for practices to routinely incorporate PROs in EHRs.

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COMPETING INTERESTS

The authors have no competing interests to declare.

CONTRIBUTORS

C.A.H. was responsible for the study concept and design, data collection, analysis and interpretation of the data, and initial drafting of the manuscript. A.L. and C.M.C. were responsible for the collection, analysis, and interpretation of data and initial drafting of the manuscript. S.M. was responsible for the system design and development and study concept and design. P.J.C. was responsible for study concept and design and system implementation coordination. R.B.F. was responsible for study concept and design. R.W.H. was responsible for data collection and study concept and design. S.O.F.S. was responsible for study concept and design and system implementation coordination. All authors contributed to revising the manuscript, approval of the data interpretation and approval of the final manuscript.

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