The Implementation of an Integrated Information System for Substance Use Screening in General Medical Settings

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Summary

The Massachusetts Screening, Brief Intervention and Referral to Treatment (MASBIRT) Program, a substance use screening program in general medical settings, created a web-based, point-of-care (POC), application – the MASBIRT Portal (the "Portal") to meet program goals.

Objectives: We report on development and implementation of the Portal.

Methods: Five year program process outcomes recorded by an independent evaluator and an anonymous survey of Health Educator's (HEs) adoption, perceptions and Portal use with a modified version of the Technology Readiness Index are described. [8] Specific management team members, selected based on their roles in program leadership, development and implementation of the Portal and supervision of HEs, participated in semi-structured, qualitative interviews.

Results: At the conclusion of the program 73% (24/33) of the HEs completed a survey on their experience using the Portal. HEs reported that the Portal made recording screening information easy (96%); improved planning their workday (83%); facilitated POC data collection (84%); decreased time dedicated to data entry (100%); and improved job satisfaction (59%). The top two barriers to use were "no or limited wireless connectivity" (46%) and "the tablet was too heavy/bulky to carry" (29%). Qualitative management team interviews identified strategies for successful HIT implementation: importance of engaging HEs in outlining specifications and workflow needs, collaborative testing prior to implementation and clear agreement on data collection purpose, quality requirements and staff roles.

Discussion: Overall, HEs perceived the Portal favorably with regard to time saving ability and improved workflow. Lessons learned included identifying core requirements early during system development and need for managers to institute and enforce consistent behavioral work norms.

Conclusion: Barriers and HEs' views of technology impacted the utilization of the MASBIRT Portal. Further research is needed to determine best approaches for HIT system implementation in general medical settings.

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1. Background

Health Information Technology (HIT) is fueling the transformation of the United States (US) healthcare system [1–3]. A core component of this change is the use of technology to improve the acquisition, management and reporting of health information, including screening and assessment, patient behavior modification and disease management [4-10]. The Institute of Medicine asserts that a strong information technology infrastructure is vital to quality care for mental health and substance use (alcohol and other drugs) conditions [1, 11].

The spectrum of unhealthy substance use, from risky use to substance use disorders (SUD), is a major cause of preventable morbidity and death [12, 13]. In the US, from 2012, the prevalence of unhealthy substance use in the adult population is 29.2% for alcohol and 7.0% (adults aged 26 years or older) and 21.3% (young adults aged 18 to 25) for illicit drugs. For SUD, prevalence rates are 8.5% for alcohol and 2% for illicit drugs [14-16].

To address this public health problem, the Substance Abuse and Mental Health Services Administration (SAMHSA) funded through a cooperative agreement for Screening, Brief Intervention and Referral to Treatment (SBIRT) programs to implement universal SBIRT to address unhealthy substance use in general medical settings. The Massachusetts Department of Public Health Bureau of Substance Abuse Services (MDPH-BSAS) was awarded funding for the Massachusetts SBIRT (MASBIRT) program and contracted with Boston Medical Center (BMC) for implementation in from 2006 to 2012. Eight clinical sites were served by the MASBIRT Program including: Three Hospitals: 1. Boston (BMC), Quincy and St Elizabeth's Medical Centers clinical settings at these institutions included (Inpatient Medicine and Emergency Room – ED) and Six Outpatient Clinics: BMC (Internal Medicine – IM, Family Medicine – FM, Adolescent Medicine – AM, OB/GYN, Geriatrics, Renal, Pre-operative Clinic, Ophthalmology, Orthopedics, &Urgent Care – UC); South Boston Community Health Center (IM, FM, Dental & UC); Whittier Street Health Center (IM, UC), East Boston Neighborhood Health Center (IM, FM, UC-ED); Dorchester House Multi-service Center (IM, FM, AD, UC), and Codman Square Community Health Center (IM, FM, UC). During the 5 year program, 33 Health Educators (HEs) were trained to screen patients for unhealthy substance use when presenting for general healthcare, provide brief counseling and, when appropriate, facilitate referral to specialty addiction treatment. HEs were hired based on the following criteria:
1. had a bachelor's degree or equivalent experience,
2. had experience working in healthcare, mental health, or public health, and
3. had computer competency inclusive of the ability to enter and access data.

HEs collected data electronically using an automated, web-based, point-of-care (POC) database application, the MASBIRT Portal, (the "Portal") which communicated screening results to the patient's medical providers and provided data to SAMHSA and MDPH-BSAS in an aggregate, de-identified format.

There were several requirements to the Portal design process. MASBIRT productivity requirements (e.g., providing efficient SBIRT clinical services and ensuring consistent, automated electronic aggregate data reporting to SAMHSA) determined how the Portal was developed and implemented. The system had to be easy to use, facilitate rapid, accurate patient identification and tracking and provide POC data collection, while ensuring adequate privacy and security.

The MASBIRT IT system, that is, the MASBIRT program database, data feeds, and web-based application, was developed at BMC as a software layer utilizing the hospital network's existing IT infrastructure. It was a non-EHR-based, secure, HIPPA-compliant, web-based system primarily accessed via combination tablet/laptop PCs that required authorized access and was modeled on the actual screening workflow of HEs.

1.1 Objectives

The primary aims of this paper are to assess adoption, perceptions and use of the Portal and report implementation challenges and lessons learned.

1.2 Description of the MASBIRT IT System

The MASBIRT IT System was first developed and implemented in 2007 and continued to evolve through 2012. It was based on the HEs' screening workflow, including challenges such as frequent interruptions, space limitations and data calculation, collection and storage. It was designed to mitigate these challenges, permitting the HEs to focus on clinical interactions. Pilot testing of the Portal was performed by HEs over two months in various inpatient and outpatient settings. BMC's IT department managed wireless connectivity issues and provided secure access to internal patient data (e.g., inpatient admission, discharge, bed-transfers). HEs gathered data which was merged and stored in the hospital's central data repository. After nine months of development, application testing and staff training, the Portal "went live" with a fully automated clinical workflow in mid-November 2007.

The Portal was the electronic interface that HEs and management staff used to interact with the MASBIRT IT System to fulfill three key operational requirements:
1. locate and identify patients,
2. efficiently record screening and assessment data for unhealthy substance use (tobacco, alcohol and other drugs), and
3. transmit the screening and assessment data and clinical decision support recommendations to both the general healthcare team/provider and the funding agency.

The MASBIRT management team, composed of medical informaticians, clinicians (including the HE Supervisor), IT developers, and administrators from BMC, met weekly regarding the creation and implementation of the MASBIRT IT System, including the Portal, by leveraging existing HIT infrastructure. Data from the patient appointment registration system at each MASBIRT site was sent to the operational data store, which then sent data to pre-populate the Portal with site-specific patient information (e.g., demographics, prior MASBIRT screening history) and created individualized, patient screening questionnaires. This obviated the need for manual collection and entry of key data elements while ensuring integrity (▶ Figure 1 and ▶ Figure 2). HEs entered screening data into web-based questionnaires, which were validated in real time according to established rules (▶ Figure 3). This data was then stored in the MASBIRT central data repository (DataMart) (▶ Figure 4).

1.3 System Core Capabilities

The MASBIRT IT System ensured the following capabilities:
1. Central Data Repository: Clinical data storage for the program using multiple relational tables built on an Oracle 10/11G database platform.
2. Operational Data Store: Temporarily stored patient appointment and logistical process data (appointment dates, screening locations, patient registration and contact information) acquired from the hospital's IT registration and inpatient management systems on all patients screened by MASBIRT. MASBIRT program data (e.g., for patient follow-up) were stored in additional tables.
3. Data exchange: Electronic interface components facilitated cross-institutional data exchange through automated, secure systems integration. Automated daily data feeds from all institutional sources provided patient information to the tables in the Operational Data Store.
4. Web-based application (the Portal): Provided near real-time, POC data entry to permit efficient, secure, authorized and accurate data collection. The Portal was equipped with authorization-only, secure web access and idle-session time-outs to prevent unauthorized data access or theft. Data could not be downloaded or stored on remote devices or PCs in any clinical setting to prevent inadvertent data releases.
5. Automated electronic data reporting: A secure and fully automated web services server ran weekly batch uploads of all aggregate screening data to SAMHSA. Industry-standard data-mart backup and recovery protocols were implemented as part of the System's maintenance infrastructure.
6. Productivity reporting: The Portal contained self-service, ad hoc reports (e.g., mini-dashboards) accessed only with authenticated permissions. The configurable reports included productivity by

HE, site, date range and screening results and allowed the management team to monitor screening productivity. HEs could also monitor their own productivity and compare it to the average overall productivity of other HEs.

1.4 System Clinical Data Exchange – Portal to the Electronic Health Record (EHR)

The requirement to communicate the screening results obtained by HEs with the medical team was accomplished using a Provider Communication Form (PCF). The PCF extracted relevant information from the data entered into the Portal and sent it to the EHR via an electronic health interface engine. The PCF was only provided for outpatient screening encounters at BMC because of technical and resource limitations that precluded this additional development. At all other sites, provider communication was accomplished through manual processes.

1.5 Implementation

Amongst the authors, the implementation team included (CWS) Associate Medical Director for Information Technology, (AS-A) Program Coordinator, (BLC) Administrative Assistant, (IP) IT Architect and Developer), (AC) Program Manager, (MB) Evaluator, and (DP A) PI-BMC.

The Portal enabled HEs to collect POC screening data and implement real-time assessment with decision support via a dynamic daily work list. This list, known as the "Hotlist" represented patients who were likely present at the clinical site based on current inpatient census and outpatient scheduled appointments (▶Figure 1). After their identities were verified (▶Figure 2), HEs could then click through to the "Prescreening" questionnaire (▶Figure 3). The Portal also enabled HEs to "search and screen" non-scheduled patients (e.g. walk-ins, urgent care).The "Prescreening" questionnaire contained five questions on tobacco, alcohol and other drug use. The questionnaire could be marked "negative" by HEs with a single click to complete screening. This feature was included because it was anticipated that approximately 80% of the patient population would screen negative and would not be required to answer additional questions to assess unhealthy substance use. For patients answering "yes" on one or more of the questions (i.e., screened positive for unhealthy substance use), the system automatically activated validated substance-specific clinical assessment instruments: the Alcohol, Smoking, Substance Involvement Screening Test (ASSIST) for adults [17-19], or the CRAFFT (Car, Relax, Alone, Forget, Friends, Trouble) [20] for individuals under the age of 23. Based on immediate results of these assessments, the Portal triggered additional forms for required data collection elements. In addition, The Hotlist had a flag mechanism to alert HEs when patients enrolled in the follow-up sample were due for a 6-month follow-up interview and presented for care at a MASBIRT site. This feature helped staff locate patients who were difficult to contact due to transient housing, unreliable contact information, or other barriers.

1.6 Implementation of the MASBIRT Program IT System

As part of orientation, HEs received standard training by IT and management staff on effective and secure use of the Portal which covered the key components of the system outlined above. Ongoing feedback on system functionality, ease of use and efficiency was solicited in staff meetings and individual supervision sessions as part of a continual IT-System change management process. IT System changes were carefully tested by HE "super-users," individuals who were identified as innovators and early adopters [7], and MASBIRT supervisors before implementation in the live Portal. "Regular periodic enhancements and updates were made based on end-user feedback. When the project was implemented in a new clinical site local requests were incorporated when possible".

2. Methods

2.1 Portal Development and Implementation Process Evaluation

The MASBIRT management team partnered with an independent evaluator to conduct a process evaluation on Portal implementation. The Portal was evaluated and modified on an ongoing basis in response to programmatic, clinical site and end-user feedback and needs. Additionally an end-user survey of HEs and semi-structured interviews with key management staff were conducted at the end of the program to understand how the Portal was perceived and utilized. An anonymous, 15-minute, web-based survey, REDCap [21], was administered to all 33 HEs to

1. assess how Portal end-users employed the system to meet grant goals,
2. measure technology acceptance to determine and evaluate system adoption [8], and
3. gain an understanding of how the portal facilitated SBIRT service integration in a general health-care setting. We report our observations with this real-world experience.

All participants provided passive, informed consent. HE technology acceptance was assessed based on questions adapted from the Technology Readiness Index (TRI) [9]. The components of the TRI include optimism, innovativeness, discomfort and insecurity using technology. The independent MASBIRT Program Evaluator (MB) administered the survey and retrieved all data from REDCap. REDCap was used only for the HE Survey and was not linked to patient or EHR data. All authors, except the evaluator were blinded to all survey and interview data.

2.2 Management Interviews

The Program Evaluator conducted individual, semi-structured interviews with the MASBIRT Program Director, the IT Database Architect and the HE Clinical Supervisor. Interviewees were involved in developing the Portal and overseeing HE implementation. These participants provided verbal consent and reported on

1. what was most and least helpful in the MASBIRT IT System development process,
2. unanticipated development or implementation challenges, and
3. what they would change if asked to develop the MASBIRT Portal again.

The evaluator collected detailed notes during the management interviews and compiled the results as aggregate reports.

2.3 Analysis

Descriptive statistics were used to report quantitative HE survey results using SPSS Version 18 [22]. In-depth management interviews were digitally recorded. Interview debriefing notes were written within 24 hours after each interview was conducted, and the interviews were transcribed and coded to summarize, synthesize and sort the information for analysis. An iterative process was used to identify and assess existing theories and grounded theories that arose from the data throughout the analysis [23-25]. These reports provided representative quotations to highlight emerging themes.

3. Results

Overall, the 33 MASBIRT Program HEs conducted 173,758 screens with 132,818 unique patients (76.4%). HEs were predominated male; 51.5% (16/33). Additionally the HEs the racial distribution was 46% (15/33) White, 42% (14/33) Black and 11.5% (4/33) Hispanic. Overall 21.4% (7/33) of HEs spoke fluent Spanish.

3.1 HE Survey Results

Seventy-three percent (24 of 33) of HEs completed the anonymous, web-based REDCap survey. Because the survey was conducted at the conclusion of the five-year funding period, nine HEs had moved on from their positions and were unreachable. Demographic and worksite data were intentionally not collected in the survey to protect the anonymity of all HEs. Because the survey was anonymous, data on possible differences between the 24 HEs who completed the survey and the 9 HEs that did not was not available. All 24 HEs reported using the Portal for a minimum of three months, with 71% (17/24) reporting 18 months or more of use.

3.2 MASBIRT Portal Adoption

When HEs were asked about their general acceptance of technology using composite subscales from the TRI [9], 74% expressed optimism and 48% innovativeness, while 21% expressed discomfort and 50% insecurity.

When asked how they utilized the Portal during a typical workday, 84% (20/24) reported having used a computer to collect at least some screening data at the POC, however, 96% (23/24) reported collecting screening data on paper and entering it into the Portal after the patient encounter (▶Table 1).

3.3 Impact on Ease of Use

When asked about the overall ease of use of the Portal, 96% (23/24) reported they agreed that "it made recording screening information easy", 100% (24/24) agreed that the Portal was "is/was useful in recording screening information", 92% (22/24) reported they "Sometimes" or "Never" had difficulty accessing the Portal site and 92% (22/24) reported that the information on the Portal was "Always" or "Usually" presented in a useful format (▶Table 2).

3.4 Impact on Workflow

When asked how the Portal affected planning during a typical workday, 71% (17/24) reported they agreed the Portal helped plan their workday, 88% (21/24) agreed it made locating patients easy and 79% (19/24) agreed it made confirming patient identity easy. One hundred percent agreed that the Portal was useful for recording screening information and made it less time consuming to record screening information, while 92% (22/24) agreed the Portal was reliable in recording screening information (▶Table 1). Based on anecdotes and informal observations from clinical management and HEs, we estimate that the Portal saved approximately one and one-half (1.5) hours of work time per HE daily when compared to the original paper-based system.

3.5 Portal Adoption and Screening in a General Healthcare Setting

Seventy one percent (17/24) reported that during patient encounters, they had the Portal available for immediate use. When asked how the Portal facilitated collecting screening data, a majority of HEs (63%) agreed the Portal improved their ability to impact the quality of patient care. In addition, 59% of HEs agreed that it did not depersonalize patient care, 59% agreed the Portal increased job satisfaction and 88% agreed it improved ability to work independently (▶Table 3).

When HEs were asked how the Portal helped patient encounters, 58% reported that it "prompted them when asking screening questions," 33% said it "prompted them to provide health information to patients," and 42% agreed it "helped them decide which screening questions to ask" (▶Table 4).

3.6 Reported Barriers to Portal Use

HEs were asked to identify the most significant barriers to using the Portal. The two top barriers were "no or limited" wireless connectivity (46%) and that the tablet was too "bulky/big to carry all day" (38%) (▶Table 5).

3.7 Clinical Administrator and IT Management Interviews

Semi-structured key informant interviews were conducted with MASBIRT administrative, clinical and IT management staff. Common themes identified included:
1. importance of engaging and cultivating relationships with stakeholders,
2. collaborative testing prior to implementation,
3. availability of a "well-designed HIT system" does not assure operators will utilize it as intended, and
4. the observation that clear agreement on the purpose of data collection and quality requirements is essential to ensure efficient workflow, operational roles and reliable data.

Two members of the three members of the management team who were interviewed felt more strongly about uniform data collection, whereas one reported being more interested in the patient care aspects of the program. Key informants described the Portal reporting data as "*accurate and up-to-date*," and noted that it "*helped the management staff make day-to-day staff assignment decisions*." Additionally, two MASBIRT management staff raised the need to consider HE candidate's prior experience with IT. One respondent who came to value project data more over time, stated [the need for] "*good data should be emphasized when hiring and managing people in future projects*."

4. Discussion

We report our experiences developing and implementing the Portal, an innovative point of care (POC) tool used to assist health educators with screening large numbers of patients for unhealthy substance use in general healthcare settings. While we were not able to conduct a large-scale IT tool effectiveness study to support substance use screening programs, we believe this study provides an important understanding on the perceptions of "end users" of such a tool. Although purely descriptive, our analysis may provide insights that may be useful for benchmarking future HIT adoptions and guiding development of effective workflow practices. Within the context of the HITECH 2009 and ACA 2010 Acts, which have expanded healthcare IT systems, this knowledge may impact information systems incorporating unhealthy substance use (tobacco, alcohol and other drugs) screening and assessment as components of integrated, patient-centered care [26].

Designing, building and implementing an electronic web-based data collection and reporting system for unhealthy substance use screening in general clinical settings is feasible and can be successfully implemented. However it requires skill, careful planning and continual adaptation to develop and deploy an integrated HIT system. The HE surveys, coupled with feedback from the independent program's evaluator, suggest that the Portal adequately met the operational requirements:
1. ease of access,
2. rapid and accurate patient identification, patient tracking and data collection at the POC, and
3. timely and reliable automated electronic data reporting.

However, despite substantial effort expended to make the Portal acceptable and easy to use, not all health educators (HEs) accepted or adopted the IT system for POC screening. Use of the Portal was not required of HEs for screening at the POC; however its use was mandatory for recording of screening data gathered. Generally, HEs saw MASBIRT first as a clinical program focused on patient interactions despite data collection expectations during patient encounters; HEs often did not prioritize using the Portal to do so at the POC.

To gauge general acceptance of technology, we used questions from the Technology Readiness Index (TRI) which indicated that while most HEs appeared moderately optimistic and innovative, some expressed discomfort and insecurity with the use of technology in clinical care. This may have had a moderate negative impact on adoption and ongoing use of the Portal. This reinforced our qualitative findings that highlight the importance of hiring, staffing, training and program policy that appear to impact perceptions of application utility and technology adoption.

Other studies have found that optimism as measured by the TRI appeared to have the greatest impact on user perceptions of service quality and explained behavior best, whereas innovativeness

only did so marginally [27]. When confronted with obstacles to using technology during screening, users who were most successful at problem solving were those who reported higher levels of optimism and innovativeness. [28] In our study it appears that technology readiness may have also influenced end-user perceptions of the quality and utility of the Portal, which would have positively impacted HE satisfaction and utilization of the Portal.

Although the Portal was designed to help HEs optimize their workload, variability of clinical workflow often made this difficult and may have led a minority of HEs to be disenchanted with the Portal as a whole. Despite this, clinical and administrative leadership relied on the Portal's timely and accurate data reports, which enabled quick problem identification and facilitated staffing adjustments (e.g., relocation to busier clinical sites).

In retrospect, the MASBIRT Program could have introduced the use of the Portal in a more prescriptive and comprehensive manner to delineate its intended use. Technology acceptance and use could have been better integrated into HE hiring and training. The clinical management team did not specifically identify and include prior experience and comfort level with IT applications as desirable traits for HE candidates. Rather, the hiring process focused on candidate qualities such as, human service experience, interest in and/or concern about substance use, flexibility and collaboration and an ability to work independently. These are all desirable characteristics for HEs, however, since IT played a major role in the daily workflow of HEs, based on our findings it may have been appropriate to emphasize the expectations for IT use as an essential component from the beginning. Moreover, it would have been advantageous to feature IT in HE training and ongoing supervision more prominently, which was instead focused primarily on its clinical aspects.

Lastly, POC adoption of the Portal might have been increased if the computer application had provided even greater functionality and ease-of-use (▶ Table 5). In anticipation of the tablet weight/size burden, state-of-the art (at that time) convertible tablet/laptops (ThinkPad X60 Tablet with battery; Weight: 4.8 – 5.8 lbs.) were deployed to all HEs. However, tablet weight and size remained a major issue for many HEs. With the rapid changes in technology, this may no longer be an issue given the small, thin, lightweight tablet computers currently available.

Despite these barriers, nearly half of HEs reported always using the Portal via the tablet at the bedside for at least some portion of POC data collection, another quarter reported always entering screening data shortly after the actual encounter. Although the Portal was not used by all HEs for immediate POC data entry, all HEs were required to use the Portal for data entry by day's end. Only a minority reported always entering all screening data into the Portal from interim paper-based notes as part of a batch at the end of the day. In addition, most HEs used the Portal to locate (88%) patients for screening.

Time saved by use of the portal (e.g. locating patients) that eliminated time spent in non-clinical activities may have enabled HEs to screen, counsel and refer more patients. In addition to improved POC data collection efficiency, we believe, but cannot claim, that the resources invested to develop the Portal were justified based on the time savings associated automation of weekly aggregation and upload of screening data to SAMHSA. It is possible that justification of this investment of resources hinges on a balance of several factors including: data quality improvement, time savings, development and implementation expense, project scope, screening volume and the feasibility and sustainability of various staffing models.

Our greatest implementation challenges involved developing consensus on the role of data acquisition in the setting of the clinical encounter. This challenge appears to be part of a larger debate within healthcare that is focused on balancing new documentation and accountability requirements against increasing clinician work burden within the context of increasing EHR use.

5. Limitations

This evaluation of MASBIRT implementation has several limitations. First, the Portal was developed in early 2007 and ran until 2012. During that time many technological improvements in the HIT occurred, which if applied to this project would have had direct bearing on the Portal's usability, efficiency and adoption. Specifically, tablet technology is now robust, more secure, less expensive and widely accepted by both technical and non-technical users. Similarly, wireless technology is now

ubiquitous and easier to use. These technological advancements may have addressed barriers reported by the HEs and ultimately had a large impact on utilization and adoption. Lastly, while the primary HE supervisor was on the development team and represented the perspective and needs of HEs, having an HE on the management team could have provided ongoing, first-hand input from HEs. This could have ensured greater HE engagement in the application development process and consequently directly impact adoption by HEs. As technology continues to improve, it is likely any study on IT will be outdated by the time the data is analyzed; however, we believe that the lessons learned herein are applicable to any IT implementation with regards to end user adoption and system integration.

6. Conclusions

The intersection of clinical care and technology is an exciting dimension of modern healthcare, yet challenges of perception and user adoption remain. This is especially true with the patient and clinician relationship that develops during health screening [29]. An ideal system should unobtrusively facilitate acquisition and transmission of screening data from patient to clinicians and incorporate this information into clinical decision making and care. The development and implementation of the Portal serves as an attempt to facilitate POC screening in an unobtrusive manner.

The two largest barriers to use reported by HE's have been at least partially addressed by technological advances now available. HE's reports of utility and ease of use, suggest that the Portal was insufficiently facile to induce busy clinical users to adopt the devices for real-time POC data collection. While use may have been enforceable by work requirements, it is clear that the interface still did not draw the majority of users to use it as designed. Potential ways to improve POC data collection capabilities by incorporating the following technologies:
1. voice recognition [30],
2. radio frequency Identification (RFID) patient identification [31],
3. embodied conversational agents (ECA) that directly interact with patients [32], and
4. enhanced interfaces to facilitate self-administration [33].

Management played a key role in setting behavioral and collaborative work norms as well as maintaining balance between program productivity targets and clinical priorities. A tension developed from mismatched expectations concerning data collection versus workflow. This added to the stress of multidisciplinary collaboration within a program bound by contractual service and productivity obligations. Alignment of incentives to use the Portal as the sole point-of-care tool might have enhanced technology and system adoption.

An essential lesson learned over the 6 year course of the project was that despite the changes in technology and expectations for IT system functionality, there was a consistent ongoing need for a trained workforce who were clinically competent and willing and motivated to adopt, implement and engage with an evolving computer based screening and assessment system. Program leadership should emphasize the importance of accurate, consistent and efficient data collection while also ensuring that HE's possess a clear understanding of how and why the electronic tools are being used. One way to further emphasize the importance of process, in addition to productivity, is to provide empirically based feedback to HEs to enforce approved data collection methods. An analysis of auto-generated data collection time stamps could be used to determine if data was entered at the POC or in a batch at the end of the day.

Another lesson was that specific, core requirements must be identified early in an IT system's design and development. For example, a vital tenant of the Portal was to make it error-free to reduce the need for data cleaning and to ensure data uploads to the funding agency were efficient and consistent. This principle was fully realized throughout the program and eventually paid dividends in terms of efficiency, apparently helping avoid many hours of manual, repetitive work. Another lesson learned is that it is challenging to build and implement a customized system (staffing model and IT infrastructure) that will both meet specialized programmatic requirements and yet be sustained after the cession of grant funding.

The manner that users and patients accept advanced HIT continues to evolve and may reflect the varying perspectives of the role of technology in patient interactions. Additional research is needed to elucidate optimal approaches to meet user-requirements in the context of programmatic requirements.

Clinical Relevance Statement
Health educator (HE) perceptions and acceptance of point of care (POC) HIT tools may reflect views on the role of technology in human interactions. Development of an electronic, web-based data collection and reporting system for screening in the general healthcare setting is feasible, but requires attention to technological and clinical staffing perspectives to ensure that HIT tools are implemented as intended. Providing opportunities to enhance user ownership in the IT system might strengthen adoption and facilitate improvements in functionality and increase the likelihood of meeting users' needs.

Conflicts Of Interest
The authors declare that they have no conflicts of interest.

Human Subjects Protections
The study was performed in compliance with the World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects and was reviewed and approved by the Boston University Medical Campus Institutional Review Board.

Acknowledgments

Fig. 1   MASBIRT IT Implementation Portal Hot-List

Fig. 2   MASBIRT IT Implementation Portal Identity Confirmation.

Fig. 3   MASBIRT IT Implementation Prescreening Form

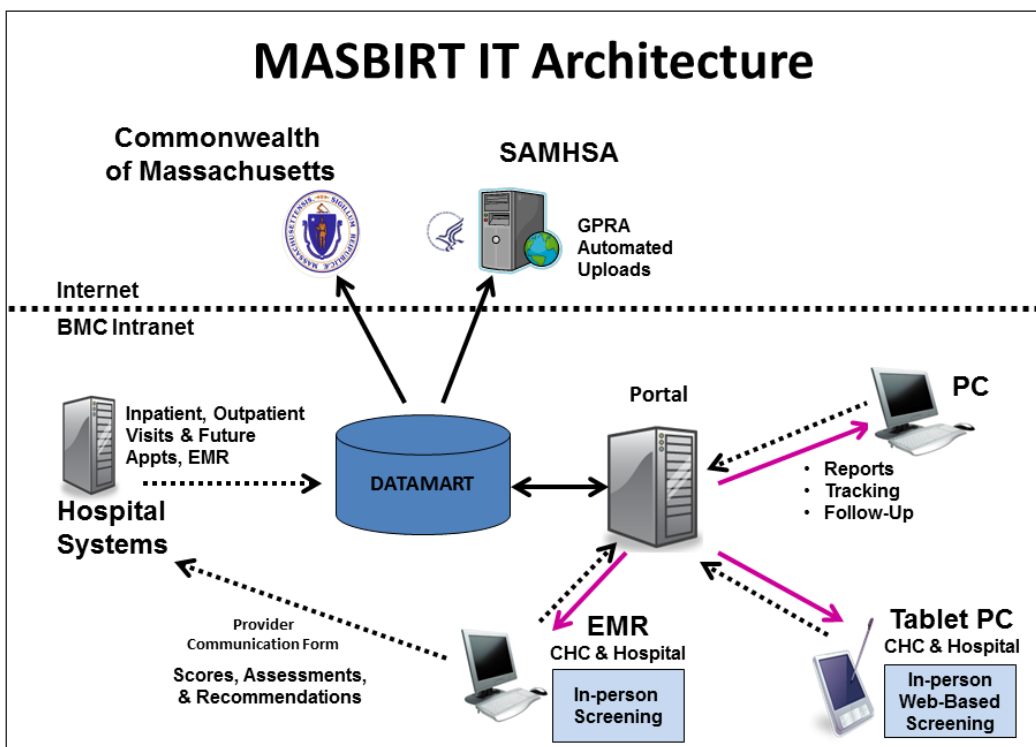**Fig. 4**   MASBIRT IT Implementation Architecture

Table 1   Impact of Portal on Workflow

Survey Domain	The Portal…	Response N/24 (%)
Use at point of care	"…used a computer (either a tablet/laptop or desktop) to collect screening data at the point of care."	Always 11 (46) Sometimes 9 (38) **Combined 20 (84)**
Initial paper data collection for data entry into Portal later	"…collected screening data on paper and entering it into the portal after the patient encounter."	Always 7 (29) Sometimes 16 (67) **Combined 23 (96)**
Planning workday	"…helped workday logistics planning."	Agreed 17 (71)
Eases of patient location	"…made locating patients easy."	Agreed 21 (88)
Confirming patient identity	"…made confirming patient identity easy."	Agreed 19 (79)
Data entry time efficiency	"…makes/maderecording screening information less time consuming."	Agreed 24 (100)
Reliable	"…is/was reliable inrecording in screening information."	Agreed 22 (92)

* Agree includes "Strongly Agree" and "Agree"

Table 2   Ease of Use of Portal for Recording Screening Information

Survey Domain	The Portal…	Response N/24 (%)
Overall ease of use	"…it made recording screening information easy."	Agreed 23 (96)
Usefulness	"…is/was useful in recording screening information."	Agreed 24 (100)
Difficulty accessing portal site	"I had difficulty accessing the Portal site."	Sometimes 17 (71) Never 5 (21) **Combined 22 (92)**
Format of information presentation	"The information on Portal was presented in a useful format."	Always 7 (29) Usually 15 (63) **Combined 22 (92)**

* Agreed includes "Strongly Agree" and "Agree"

Table 3 Portal Helped Patient Adoption

Survey Domain	The Portal…	Response N/24 (%)
Immediately available	"…was kept available for immediate use."	Agreed 17 (71)
Improved ability to impact patient care quality	"…improved their ability to impact the quality of patient care."	Agreed 15 (63)
Did not depersonalize patient care	"…did not depersonalize patient care."	Agreed 14 (59)
Increased job satisfaction	"…increased job satisfaction."	Agreed 14 (59)
Improved ability to work independently	"…improved ability to work independently."	Agreed 21 (88)
Able to meet patient needs	"I was satisfied with ability to meet needs and demand of patients."	Always 8 (33) Usually 12 (50) **Combined 20 (83)**
Able to meet colleague needs	"I was satisfied with ability to meet needs and demand of colleagues."	Always 5 (21) Usually 15 (63) **Combined 20 (84)**

* Agreed includes "Strongly Agree" and "Agree"

Fig. 4 Portal Helped Patient Encounters

Survey Domain	The Portal…	Response N/24 (%)
Screening question prompts	"…prompted them when asking screening questions."	Agreed 14 (58)
Providing patient health information prompts	"…prompted them to provide health information to patients."	Agreed 8 (33)
Helped decide screening questions to ask	"…helped them decide which screening questions to ask."	Agreed 10 (42)

* Agreed includes "Strongly Agree" and "Agree"

Table 5 Barriers Reported

Barrier Type	N (%)
No or limited wireless connectivity	11 (46)
The tablet was too heavy/bulky/big to carry all day	9 (38)
Lack of space to setup the tablet/computer	7 (29)
No significant barriers	5 (21)
Lack of IT system support (at clinical sites)	5 (21)
Other	5 (21)
No time to log in and access the Portal	3 (13)
Lack of computer/tablet availability	2 (8)
Lack of accuracy of data (patient, site) in Portal	2 (8)
Lack of support from MASBIRT supervisors/management	1 (4)
Lack of training on Portal use	0 (0)

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