

Research and Applications

Workflow analysis for design of an electronic health record-based tobacco cessation intervention in community health centers

Bryan Gibson,¹ Heidi Kramer,¹ Charlene Weir,¹ Guilherme Del Fiol,¹
Damian Borbolla,¹ Chelsey R. Schlechter,^{2,3} Cho Lam,^{2,3} Marci Nelson,⁴
Claudia Bohner,⁴ Sandra Schulthies,⁴ Tracey Sieperas,⁵ Alan Pruhs,⁵
Inbal Nahum-Shani,⁶ Maria E. Fernandez ,⁷ and David W. Wetter^{2,3}

¹Department of Biomedical Informatics, University of Utah, Salt Lake City, Utah, USA, ²Center for Health Outcomes and Population Equity, Huntsman Cancer Institute, Salt Lake City, Utah, USA, ³Department of Population Health Sciences, University of Utah, Salt Lake City, Utah, USA, ⁴Tobacco Prevention and Control Program Utah, Department of Health, Salt Lake City, Utah, USA, ⁵Association for Utah Community Health, Salt Lake City, Utah, USA, ⁶Institute for Social Research, University of Michigan, Ann Arbor, Michigan, USA ⁷Center for Health Promotion and Prevention Research, University of Texas Health science Center at Houston, Houston, Texas, USA

Corresponding Author: Bryan Gibson, DPT, PhD, Department of Biomedical Informatics, 421 Wakara Way, Salt Lake City, UT 84132, USA (Bryan.Gibson@utah.edu)

Received 14 July 2020; Revised 9 October 2020; Editorial Decision 18 November 2020; Accepted 22 December 2020

ABSTRACT

Objective: Tobacco use is the leading cause of preventable morbidity and mortality in the United States. Quitlines are effective telephone-based tobacco cessation services but are underutilized. The goal of this project was to describe current clinical workflows for Quitline referral and design an optimal electronic health record (EHR)-based workflow for Ask-Advice-Connect (AAC), an evidence-based intervention to increase Quitline referrals.

Materials and methods: Ten Community Health Center systems (CHC), which use three different EHRs, participated in this study. Methods included: 9 group discussions with CHC leaders; 33 observations/interviews of clinical teams' workflow; surveys with 57 clinical staff; and assessment of the EHR ecosystem in each CHC. Data across these methods were integrated and coded according to the Fit between Individual, Task, Technology and Environment (FITTE) framework. The current and optimal workflow were notated using Business Process Modelling Notation. We compared the requirements of the optimal workflow with EHR capabilities.

Results: Current workflows are inefficient in data collection, variable in who, how, and when tobacco cessation advice and referral are enacted, and lack communication between referring clinics and the Quitline. In the optimal workflow, medical assistants deliver a standardized AAC intervention during the visit intake. Referrals are submitted electronically, and there is bidirectional communication between the clinic and Quitline. We implemented AAC within all three EHRs; however, deviations from the optimal workflow were necessary.

Conclusion: Current workflows for Quitline referral are inefficient and ineffective. We propose an optimal workflow and discuss improvements in EHR capabilities that would improve the implementation of AAC.

Key words: tobacco use cessation, electronic health records, community health centers, reminder systems

LAY SUMMARY

Tobacco use is the leading cause of preventable illness and death in the United States. Quitlines provide telephone-based tobacco cessation services but are underused. The goal of this project was to describe current clinical workflows for Quitline referral, and design an optimal workflow for Ask-Advice-Connect (AAC), an intervention to increase Quitline referrals.

Ten Community Health Center systems (CHC), participated in this study. We conducted: 9 group discussions with CHC leaders; 33 observations/interviews of clinical teams' workflow; surveys with 57 clinical staff; and assessment of the Electronic Health Record capabilities in each CHC. Data across these methods were coded and used to notate the current and optimal workflows. We compared the requirements of the optimal workflow with Electronic Health Record capabilities.

Current workflows are inefficient in data collection, variable in enactment, and lack communication between referring clinics and the Quitline. In the optimal workflow, medical assistants deliver a standardized AAC intervention during the visit intake. Referrals are submitted electronically, and there is bidirectional communication between the clinic and Quitline.

We implemented AAC within all clinics; however, deviations from the optimal workflow were necessary. We propose an optimal workflow and discuss improvements in EHR capabilities that would improve the implementation of AAC.

INTRODUCTION

Tobacco use is the leading cause of death and disability in the United States and is disproportionately concentrated among underserved populations.^{1,2} Low-income smokers are less likely to quit, in part due to lack of access to evidence-based tobacco cessation treatment.³ Community Health Centers (CHCs) provide comprehensive primary care to underserved populations and are optimal settings to reach populations most in need of tobacco cessation services.⁴ In this project, we worked with CHCs to increase referrals to telephone-based tobacco cessation counseling (Quitlines).

Quitlines offer telephone-based tobacco cessation services. They have been consistently found to provide cost-effective tobacco cessation treatments,⁵⁻⁸ yet are grossly underutilized, reaching less than 2% of smokers annually.⁹ To increase the utilization of Quitlines, the Centers for Disease Control (CDC) and the North American Quitline Consortium (NAQC) recommend electronic referral from medical clinics to Quitlines (e-Referral).¹⁰⁻¹⁴ Ask-Advice-Connect (AAC) is an intervention that includes e-Referral. In AAC, the EHR prompts the clinic practice team to *ask* every patient about tobacco use at every visit, *advise* tobacco users to quit, and electronically *connect* (e-Referral) patients to the Quitline. Tobacco users who agree to be connected are called by the Quitline within 48 h. Several studies have demonstrated that AAC can dramatically increase the reach (the number or proportion of individuals willing to participate in a program) of Quitlines, without compromising effectiveness in tobacco cessation.^{13,15}

Despite its effectiveness, AAC has not been widely adopted and implemented in primary care settings.¹⁶ Barriers to large scale implementation of e-Referral/AAC include lack of information technology (IT) capacity within healthcare organizations, lack of vendor flexibility in modifying the EHR, and concerns over ongoing costs and staffing required to maintain the intervention over time from both a clinical and technical perspective.¹⁷ The low adoption of AAC suggests the need for further work to understand both how AAC can be integrated into existing clinical workflows and how the IT ecosystem may be adapted to support the implementation of this evidence-based practice.

Recent research on gaps in adoption of advanced health IT functionality between high and low-resource settings suggests that implementing AAC in community health centers may be particularly challenging.^{18,19} For example, small rural hospitals, compared with large urban hospitals, are almost 40% less likely to have implemented advanced IT functions such as the ability to identify care

gaps for specific patient populations.²⁰ In addition, there may be a significant difference in the IT ecosystem of community health centers versus higher resource systems. High resource settings are equipped with highly customizable EHR systems and staffed with specialized IT personnel. These organizations are continuously optimizing their systems and leveraging their health IT platforms to innovate.²¹⁻²³ In contrast, rural and low-income settings typically rely on out-of-the-box EHR systems, with the very little customization, non-local IT administration, and small IT staff, leading to suboptimal EHR implementation.²⁴

This project is part of a pragmatic cluster-randomized, Sequential Multiple Assignment Randomized Trial (SMART) entitled "QuitSMART Utah." The overall objective of the trial is to increase the reach and impact of evidence-based tobacco cessation treatment in order to reduce the prevalence of tobacco use among underserved populations. A detailed description of the study protocol has been published elsewhere.²⁵ In the first randomization of the trial, clinics will be randomized to receive one of two versions of AAC. The procedures outlined in this report are one component of a systematic process to optimize the sequencing and adaption of the implementation strategies for QuitSMART Utah.

Identifying context-specific factors is critical to improving implementation outcomes of EHR-based interventions, such as AAC. Previous studies that have implemented AAC have not reported on any analysis of clinical workflow or barriers to implementation in specific clinical settings.^{15,26} We believe this gap in the literature is important because understanding the context of how clinicians communicate, negotiate work responsibilities, and document activities (both within and outside the EHR) is critical to ensuring the effectiveness and replicability of interventions.^{27,28}

To help guide the implementation and future dissemination of AAC, we sought to describe current Quitline referral workflows, design an optimal workflow for AAC, notate those workflows in a formal non-ambiguous language, and assess the capacity of the IT ecosystem of participating CHCs to implement the proposed workflow.

METHODS

Overview

This multimethods study was determined exempt by the University of Utah Institutional Review Board. Our approach had four components: group interviews, workflow observations, brief workflow

interviews, surveys, and a structured review of the IT ecosystem at each CHC.

Recruitment and settings

All data collection was conducted in partnership with the Association for Utah Community Health (AUCH), the federally designated Primary Care Association (PCA) in Utah, and 10 participating CHC systems which are members of AUCH. These systems serve both urban and rural populations and provide healthcare to individuals regardless of insurance status or ability to pay. CHCs in Utah serve a diverse patient population, including 48% Latino, 53% uninsured, and 64% living under the federal poverty level.²⁹

Procedures

Orientation meetings with a stakeholder group discussion

We conducted orientation meetings with the leadership of each of the participating CHCs to review the study aims and procedures. Next, we conducted brief group discussions to elicit information and ideas on the current and optimal workflow related to tobacco cessation. (see [Supplementary File S1](#) for the semistructured interview guide).

Observations of clinical workflow

We conducted observations at a random sample of 1–2 clinics per CHC system. Observations consisted of the following 1–3 patients per clinical team from the time they entered the clinic until they left using a structured observation form. We observed about how patients are assessed upon arrival, the information gathered at each step and by which individuals, and the content and form (verbal, paper, or EHR) of information exchanged between different roles. We made particular note of how specific phases of AAC might be enacted and any variations in practice within and across clinics. The observations were supplemented by short follow-up interviews of both medical assistants (MAs) and medical providers regarding variations in their workflow (eg when might you not “ask”) and desired features of an intervention for improving their tobacco cessation workflow. (see [Supplementary File S2](#) for the observation guide).

Surveys of clinical staff

During each clinic visit, we conducted paper-based surveys of clinical staff to assess current access to data related to tobacco use and treatment (eg “do you currently have access to information on the patient’s current tobacco use, and when the patient was last advised to quit” in a yes/no format); roles and responsibilities in tobacco cessation (eg “to what extent are you currently involved in assessing current use, advising the patient to quit” in a Likert scale format); and desired features of an optimal AAC intervention (open-ended). (see [Supplementary File S3](#) for survey).

Reviews of CHC IT ecosystems

One of our team members met with the local IT staff at each CHC to learn more about the clinic’s EHR, IT support available, EHR vendor contact information, procedures for requesting EHR configuration changes, and any other relevant information for the project. We also reviewed EHR technical manuals and video tutorials about the systems used by the clinics; and held conference calls with the vendors.

Analysis

Aggregation of orientation meeting, observation/interviews, and survey data

The data from the transcripts of interviews and from observations and surveys were analyzed collectively. Group discussions, workflow data, and open-ended survey comments were parsed into single topic units and entered into an excel sheet. These units were inferentially coded to identify emergent codes. No theoretical framework was used, although our work was guided by the Fit between Individual, Task, Technology and Environment Framework,³⁰ an extension of the Fit between Individual, Task, and Technology Framework,³¹ and integrated with a typology derived from the activities at the core of AAC (ie assessing tobacco use, advising to quit, referring to the quit line), clinical role of the individual performing the task (MA, provider), where and when each task is addressed, how each task is addressed, and why a subtask might not be addressed in a given clinical encounter.

Four investigators (B.G., H.K., C.W., and D.B.) reviewed the aggregated, coded data, and collaboratively developed key findings related to the current and optimal workflow. Disagreements amongst analysts were adjudicated in group meetings until consensus was reached.

Clinical workflow modeling

A formal process of workflow modeling was conducted through iterative group discussion where decision points, roles, and information needs were identified through review of the coding results. Five coauthors (B.G., H.K., C.W., D.B., and G.D.F.) collaboratively developed the models of the current and optimal workflows through a consensus process. Business Process Model and Notation (BPMN) was used to formally represent these models.³²

Two workflow diagrams were created: a current workflow diagram ([Figure 1](#)) that represents the current workflow within and across clinics. The second separate workflow was designed to represent the optimal workflow for AAC ([Figure 2](#)). Key features of the optimal workflow were later validated with the Study Advisory Committee, which is advising the research team on all important aspects of the larger QuitSMART project.

RESULTS

Participation in group discussions

Ten orientation meetings and nine group discussions were conducted with the different CHC systems. All group meetings consisted of 2–20 participants depending on the size of the CHC system and lasted up to 15 min. We did not collect individual demographic information in these meetings but ensured that participants represented clinical staff (eg MAs, providers) and clinic administration (eg CEOs, medical directors, and clinic managers) at each meeting.

Participation in workflow observations

We conducted a total of 33 observations of clinical teams at 13 clinical sites. All clinical teams consisted of a medical assistant and a midlevel provider (Nurse practitioner or PA). In the smallest clinics, there was only one clinic team to observe. In the larger clinics, a sample of two to five teams were observed until the observers felt that they had reached saturation.

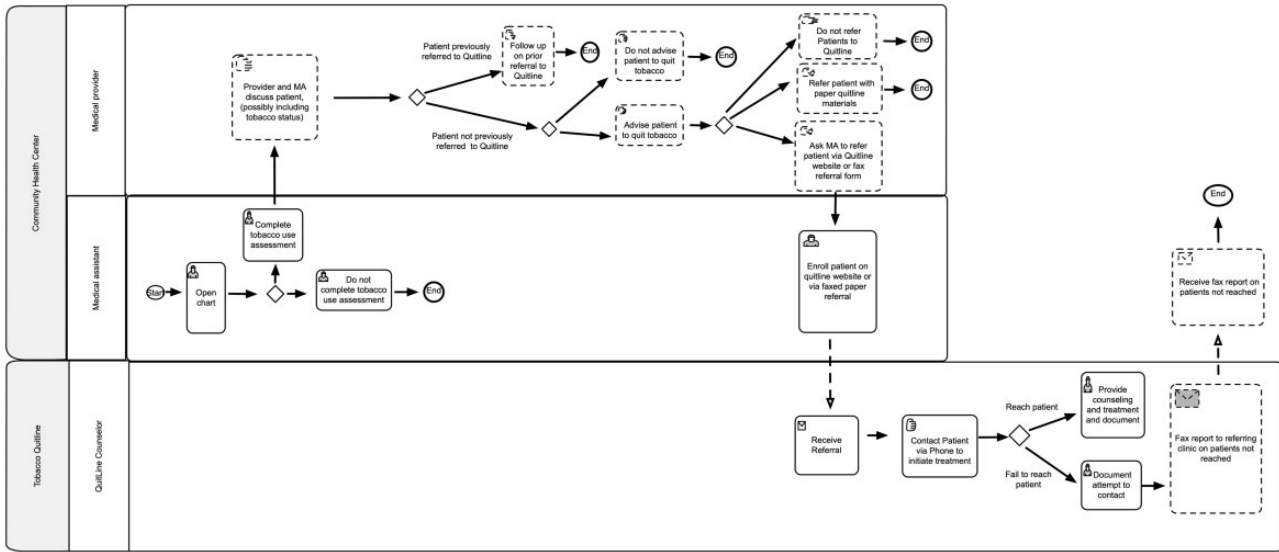


Figure 1. Current tobacco cessation workflow in community health centers.

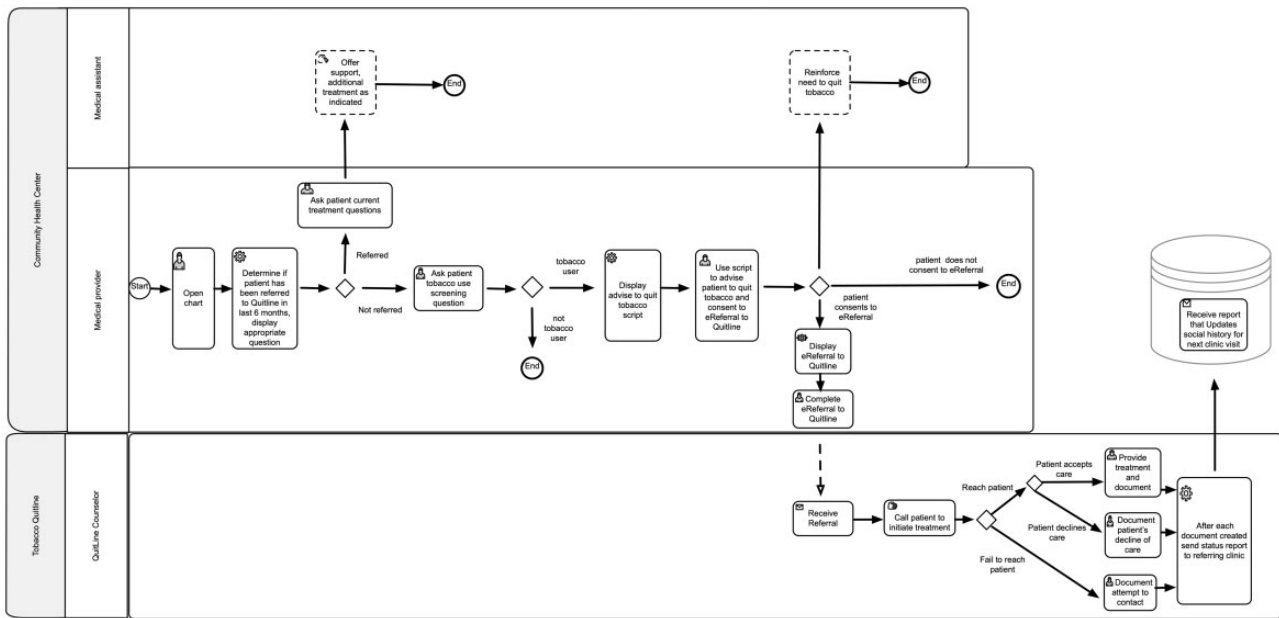


Figure 2. Optimal workflow for tobacco cessation.

Participation in clinical staff surveys

Fifty-six paper-based surveys were completed. Thirty-three MAs, 14 midlevel providers, 2 registered nurses, 2 community health workers, 1 physician, 1 clinic manager, 1 front office worker, and 1 chief operating officer completed the survey. Respondents reported a median of 3.5 years working in the clinic (range 1–20 years) and 2.75 years working with their current EHR (range 1–11 years). We report median and ranges since none of these measures were normally distributed.

Figure 1 depicts the current workflow for tobacco use assessment, cessation counseling, and referral. Solid boxes indicate processes that occur consistently and the dotted boxes indicate processes that vary within or across clinics.

Current workflow related to ask

The process begins when the MA weighs and rooms the patients, takes vital signs, and completes the intake questionnaire, which includes tobacco use history. Reasons for not asking included: time pressure, patient acuity, patients who were believed to not want to be asked again, or patients for whom asking would be inappropriate (eg pediatric patients). Providers learned of the patient’s tobacco use from the MA’s recording in the social history section of the EHR or sometimes from a verbal handoff. In one participating clinic, they had recently implemented previsit phone calls to collect social history information (which includes tobacco use). Clinicians at this clinic suggested that this shift in workflow resulted in a more efficient clinic visit with the patient more of their in clinic time with the provider.

Current workflow related to advise

Some MAs reported not asking the patient about their smoking status. Only a minority of MAs reported consistently advising patients to quit, with several reporting that it was the provider's job to advise. Providers more consistently reported advising their patients who use tobacco to quit. Limited time, patients not wanting to quit, and the need to address more pressing medical issues often prevented them from doing so at every visit. Some providers commented that having MAs advise patients to quit might be better because they are perceived as more personable by patients.

Current workflow related to connect

We found that very few MAs are involved with referring patients to the Quitline. In most cases, the provider gave the patient a handout and expected to contact the Quitline on their own. In a minority of cases, the provider would ask the MA to submit a referral through the Quitline website, but MAs reported that this is a time-consuming process. In one CHC, MAs and providers were able to complete a referral within the EHR, but the referral was still printed and faxed (not actual e-referral). Most MAs reported they would be comfortable with placing the referral in the future, particularly if the provider asked them to. Likewise, most providers reported being comfortable with the MAs sending the referral. Providers and MAs reported that a current barrier to effective referrals to the Quitline is a lack of knowledge about the services the Quitline offers. A second and nearly ubiquitous barrier is the lack of feedback from the Quitline to the practice team on the patient's current status (eg patient reached, started treatment). In a few cases, CHCs receive a faxed report outside the EHR indicating if a patient was reached or not, but with no details about the patient's treatment and status.

The current workflow has several features that likely decrease its effectiveness and efficiency. First, data collection on tobacco use is inefficient and not patient specific; intake forms include the same questions regardless of the patient's prior tobacco history. Second, the responsibility for enacting the workflow is distributed across roles and over time, increasing the likelihood that a step in the workflow will be "dropped." Third, the substantial variability in how patients are advised and referred may reduce the effectiveness of promoting Quitline enrollment. Fourth, the most common referral process, that is, suggesting to patients that they contact the Quitline, has been shown to yield very low enrollment in Quitline services and very low cessation rates.³³ Finally, the absence of communication and feedback between referring clinics and the Quitline may reduce providers' perceived value of referring patients.³⁴

Figure 2 depicts the optimal workflow for tobacco use assessment, cessation counseling, and referral. The proposed workflow attempts to address the issues with the current workflow noted above as well as to implement suggestions raised by participants. To eliminate the problem of diffusion of responsibility across roles and time, a single person (the MA) is responsible for implementing all three AAC steps (ie asking about tobacco use, advising tobacco users to quit, and sending the electronic referral to the Quitline) and does so in three steps performed without interruption during the intake. We have chosen the MA for this role because they are already engaged in assessing tobacco use and can complete the remaining steps of advise and connect immediately following that assessment.

Optimal workflow for ask

We propose two features of the ask phase of the optimal workflow to improve efficiency. First, much of the burden of patient intake

could be reduced by capturing social history (including tobacco use) via a previsit questionnaire delivered via the personal health record. This functionality would allow patients to spend more time with the provider in the clinical encounter and was suggested by the clinic that had implemented previsit phone calls for this purpose. Second, as suggested by participants, the intake questions would be tailored based on the patient's tobacco status. The questions would start with a single mandatory screening question. For patients who are not tobacco users, the intake would continue reducing unnecessary questions. For patients who report tobacco use, an additional set of questions would inquire about the types of tobacco, frequency of use, and readiness to quit. The intake questions for an individual who is currently being treated for tobacco cessation (eg has been referred to the Quitline) would include questions about the individual's response to that treatment. These data would help clinicians support patients in their quit attempt.

Optimal workflow for advise

To reduce the variability in how patients are advised to quit tobacco, the EHR would provide a short standardized script for the MA to follow in advising the patient to quit tobacco and requesting their permission to have the Quitline contact them.

Optimal workflow for connect

Finally, closed-loop communication between the referring provider and the Quitline would make clinicians aware of the patient's interaction with the Quitline, including contact attempts, the treatments provided, and the response to treatment. These reports should be event based so that any time and interaction between the Quitline and patient occurs or a change in the patient's status (eg starts nicotine replacement therapy or reports a change in tobacco use) a report is sent to the clinicians EHR to keep them up to date. These data would help clinicians support patients who are actively trying to quit in their cessation efforts and help clinicians to follow-up with patients who are not responding to a prescribed therapy.

IT ecosystems at CHCs

Three different EHR systems were implemented in the participating clinics. Most CHCs implemented their system, as provided by EHR companies; two CHCs had added some local configurations. Most CHCs required the help of EHR vendors to change the configuration of their system (eg decision support alerts related to assessing tobacco use) and vendors charged a fee to implement those changes. The number of IT staff working at each clinic varied, ranging from one full-time employee (FTE) in most CHCs (with a part-time person in one clinic) to three FTEs in one of the largest CHCs.

We found three main technical issues with EHR capabilities that affected the implementation of the optimal workflow for AAC ([Supplementary File S4](#)). First, skip logic for documentation templates was not available in System 2 and partially available in System 3. Second, in all three systems, the intake and e-referrals are functionally disconnected—an MA performing tobacco use assessment needs to leave the intake, open the e-referral section, and then place the referral. This process takes several mouse clicks and keystrokes, disrupting intake workflow. Third, while all three EHRs were able to submit e-referrals compliant with the DIRECT protocol and the Health Level Seven (HL7) Continuity of Care Document (CCD),³⁵ this functionality needed to be configured to connect with the Quitline provider. For the cloud-based EHR (System 2), this configuration needed to be implemented only once for all customers

nationwide. The other two EHRs needed separate configuration for every CHC.

DISCUSSION

In this multimethod study, we assessed clinical workflow related to the assessment of tobacco use and referral to the Quitline in CHCs; designed an optimal workflow for implementing AAC; and assessed the IT ecosystem of participating CHCs to identify technical barriers in implementing the optimal workflow. We found significant issues in current workflows related to tobacco assessment and cessation including inefficiency in data collection, distribution of responsibility across roles and over time, substantial variability in how patients are advised to quit, “referrals” that require the patients to call the Quitline and lack of closed-loop communication between the Quitline and referring clinics. The design of our optimal workflow seeks to address these issues. A single person (the MA) is responsible for implementing AAC during the visit intake. To maximize efficiency, the intake questionnaire is tailored to the patient’s tobacco history. To reduce variability, a standardized script is used to advise the patient to quit and there is bidirectional communication between the referring clinic and the tobacco Quitline. Despite a few important constraints, we were able to identify ways to implement AAC within the three EHR systems used at the participating CHCs.

Our findings are consistent with prior work. For example, Cantrell et al³⁶ implemented a fax referral process from clinics using paper charts to the Quitline and then examined participants’ perceptions of the process, they found that a lack of clear responsibility amongst clinical staff for each stage of the process, and the lack of communication between the clinic and the Quitline were barriers to effective implementation. More recently Karn et al³⁷ retrospectively examined the impact of an e-Tobacco protocol and then, they found the intervention was effective, but that since different clinics had different EHRs its implementation varied by the clinic and that some clinics reported disruptions to their normal workflow.

We were able to implement the AAC workflow in all three EHRs that are used at the participating CHCs. However, constraints in EHR capabilities required deviations from the optimal workflow and these deviations were different per EHR, potentially compromising user experience, as well as intervention fidelity and replicability. The upcoming trial will investigate whether these differences in implementation affect the effectiveness of AAC.³⁸

To better support the optimal AAC workflow (and other health interventions), EHR vendors should consider the following recommendations. First, EHRs should support documentation templates with skip and display logic, so that most patients only need to answer a screening question and more detailed information is collected only from appropriate patients. Second, to improve the efficiency of care, EHR vendors should enable the placement of e-referrals within, or at least within a few mouse clicks from, intake documentation templates. Third, to improve clinicians’ ability to follow-up on patients they have referred, EHR vendors should enable bidirectional communication between referring clinics and outside services. Fourth, to ease the implementation of quality improvement interventions, EHRs should enable easy configuration of intervention components. Finally, to allow for comparison of care delivery approaches, EHRs should support the implementation of different interventions by the clinic to allow comparisons in randomized designs.

This study has multiple strengths. We used a multimethods approach to describe current clinical workflows. We are unaware of prior studies that have evaluated workflows for tobacco cessation. This is the first study that has sought to implement AAC in clinics with low IT resources and more constrained EHRs; clinics that have previously implemented AAC were a part of a large network that used a single, highly customizable EHR, with strong local IT support.³⁹ This is an important effort since it is well documented that low-resource settings have lower adoption of certain EHR capabilities.²⁰ The workflow analysis and the collection of input from front-line clinicians and staff on the optimal AAC workflow produced several refinements to the workflow that may further improve clinician satisfaction and efficiency. We used a nonambiguous notation to represent the optimal workflow, thus allowing for the reproducibility of this work. Finally, we assessed the IT ecosystems in CHCs; rural and urban community health clinics and their IT ecosystems are understudied.

This study has limitations. First, not all patients whose visit was observed were tobacco users, so direct observation of tobacco cessation workflow was mixed with self-report of common practices and variations. In addition, since participants were aware of the purpose of the project, there is a high likelihood of social desirability bias in some responses (eg overreporting of tobacco use assessment). However, since tobacco use assessment was already high in the clinics we observed,⁴⁰ and this was a qualitative study to describe the workflow and its variants we do not believe that this significantly impacted our results. Finally, EHR constraints imposed deviations from the optimal workflow for AAC implementation.

Future work should also seek to evaluate the implementation of AAC on the efficiency of care such as patients’ total time in the clinic, and MA and provider time with the patient, which prior work suggests may substantially affect the real-world implementation of preventive health programs.⁴¹ Finally, unintended consequences associated with changes to workflow should be evaluated.⁴²

CONCLUSIONS

We describe the current tobacco cessation workflow and optimal workflow for “Ask-Advise-Connect” in Community Health Centers (CHC). We found existing workflow around tobacco assessment and referral contained numerous points of a potential breakdown. We also found that IT infrastructure varied between CHC systems. Researchers and practitioners intending to implement EHR-based implementation strategies may benefit from using clinical workflow analysis to develop and adapt the EHR, particularly in low-resource health systems.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Journal of the American Medical Informatics Association* online.

CONTRIBUTORSHIP STATEMENT

B.G., H.K., C.W., G.D.F., D.B., C.L., C.R.S., I.N.S., and M.E.F. were involved in design of the work, data collection, data analysis and interpretation, drafting the article, and revision of the article. M.N., C.B., S.S., and A.P., were involved in drafting the article, and revision of the article and final approval of the version to be published. T.S. was involved in data collection, drafting the article, and

revision of the article. D.W.W. was involved in conception of the work, data analysis and interpretation, drafting the article, revision of the article and final approval of the version to be published.

ACKNOWLEDGMENTS

We would like to thank the leadership of AUCH, and the participating CHCs, and most particularly, the participants in this study, without whom this project would not have been possible.

FUNDING

This work was supported by Patient Centered Outcomes Research Institute (PCORI) Project Program Award grant number PCS-2017C2-7613 Additional support was provided by the National Center for Advancing Translational Sciences of the National Institutes of Health (UL1TR002538), by the National Cancer Institute of the National Institutes of Health (P30CA042014), and by the Huntsman Cancer Foundation. Disclaimer: All statements in this report, including its findings and conclusions, are solely those of the authors and do not necessarily represent the views of the Patient-Centered Outcomes Research Institute (PCORI), its Board of Governors or Methodology Committee.

Conflict of interest statement. None declared.

DATA AVAILABILITY STATEMENT

The data underlying this article will be shared on reasonable request to the corresponding author.

REFERENCES

- National Center for Chronic Disease Prevention, Health Promotion Office on Smoking. Reports of the Surgeon General. The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General. Atlanta (GA): Centers for Disease Control and Prevention (US); 2014.
- Drope J, Liber AC, Cahn Z, *et al.* Who's still smoking? Disparities in adult cigarette smoking prevalence in the United States. *CA Cancer J Clin* 2018; 68 (2): 106–15.
- Roddy E, Antoniak M, Britton J, Molyneux A, Lewis S. Barriers and motivators to gaining access to smoking cessation services amongst deprived smokers—a qualitative study. *BMC Health Serv Res* 2006; 6 (1): 147.
- (HRSA) HRSA. 2018. Health Center Program Awardee Data. <https://bphc.hrsa.gov/uds/datacenter.aspx?q=d&year=2018&state=UT#glist>.
- Pauly N, Talbert J, Parsley S, Gray B, Hahn EJ. Kentucky's Smoking Cessation Quitline: Annual Estimated Return on Investment to Employers. *Am J Health Promot.* 2019;33(2):285–288.
- Tomson T, Helgason AR, Gilljam H. Quitline in smoking cessation: a cost-effectiveness analysis. *Int J Technol Assess Health Care.* 2004;20(4):469–74.
- McAlister AL, Rabius V, Geiger A, Glynn TJ, Huang P, Todd R. Telephone assistance for smoking cessation: one year cost effectiveness estimations. *Tobacco Control.* 2004;13(1):85.
- Matkin W, Ordebeez?Mena JM, Hartmann-Boyce J. Telephone counseling for smoking cessation. *Cochrane Database Syst Rev* 2019, Issue 5. Art. No.: CD002850.
- Cummins SE, Bailey L, Campbell S, Koon-Kirby C, Zhu S-H. Tobacco cessation quitlines in North America: a descriptive study. *Tobacco Control* 2007; 16 (Supplement 1): i9–i15.
- Abrams DB, Graham AL, Levy DT, Mabry PL, Orleans CT. Boosting population quits through evidence-based cessation treatment and policy. *Am J Prev Med* 2010; 38 (3): S351–S63.
- Centers for Disease Control and Prevention. Best Practices for Comprehensive Tobacco Control Programs—2014. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2014.
- Orleans CT. Increasing the demand for and use of effective smoking-cessation treatments—reaping the full health benefits of tobacco-control science and policy gains—In our lifetime. *Am J Prev Med* 2007; 33 (6): S340–S8.
- Vidrine JI, Shete S, Cao Y, *et al.* Ask-Advise-Connect: a new approach to smoking treatment delivery in health care settings. *JAMA Intern Med* 2013; 173 (6): 458–64.
- Vidrine JI, Shete S, Li Y, *et al.* The ask–advise–connect approach for smokers in a safety net healthcare system: a group-randomized trial. *Am J Prev Med* 2013; 45 (6): 737–41.
- Pipeiro B, Vidrine DJ, Wetter DW, Hoover DS, Frank-Pearce SG, Nguyen N, Zbikowski SM, Vidrine JI. Implementation of Ask-Advise-Connect in a safety net healthcare system: quitline treatment engagement and smoking cessation outcomes. *Transl Behav Med.* 2020;10(1):163-167.
- Electronic Quitline referral. North American Quitline Consortium. <https://www.naquitline.org/page/EQR> Accessed July 15, 2020.
- North American Quitline Consortium (2017). Barriers and Challenges of Scaling-up eReferral. (Moses Tasha, Editor). Phoenix, AZ.
- Heisey-Grove DM. Variation In Rural Health Information Technology Adoption And Use. *Health Affairs.* 2016;35(2):365–70.
- Sandefer RH, Marc DT, Kleeberg P. Meaningful use attestations among US hospitals: the growing rural-urban divide. (1559-4122 (Electronic)).
- Adler-Milstein J, Holmgren AJ, Kralovec P, Worzala C, Searcy T, Patel V. Electronic health record adoption in US hospitals: the emergence of a digital “advanced use” divide. *J Am Med Informatics Assoc* 2017; 24 (6): 1142–8.
- Kawamoto K, Kukhareva P, Shakib JH, Kramer H, Rodriguez S, Warner PB, Shields D, Weir C, Del Fiol G, Taft T, Stipelman CH. Association of an Electronic Health Record Add-on App for Neonatal Bilirubin Management With Physician Efficiency and Care Quality. *JAMA Netw Open.* 2019; 2(11):e1915343.
- Kawamoto K, Flynn MC, Kukhareva P, *et al.* A pragmatic guide to establishing clinical decision support governance and addressing decision support fatigue: a case study. (1942-597X (Electronic)).
- Sieja A, Markley K, Pell J, *et al.* Optimization sprints: improving clinician satisfaction and teamwork by rapidly reducing electronic health record burden. *Mayo Clinic Proc* 2019; 94 (5): 793–802.
- Mack D, Zhang S, Douglas M, Sow C, Strothers H, Rust G. Disparities in primary care EHR adoption rates. *J Health Care Poor Underserved* 2016; 27 (1): 327–38.
- Fernandez, M.E., Schlechter, C.R., Del Fiol, G. *et al.* QuitSMART Utah: an implementation study protocol for a cluster-randomized, multi-level Sequential Multiple Assignment Randomized Trial to increase Reach and Impact of tobacco cessation treatment in Community Health Centers. *Implementation Sci* 15, 9 (2020).
- Adsit RT, Fox BM, Tsiolis T, *et al.* Using the electronic health record to connect primary care patients to evidence-based telephonic tobacco quitline services: a closed-loop demonstration project. *Behav Med Pract Policy Res* 2014; 4 (3): 324–32.
- Ratwani R, Fairbanks T, Savage E, *et al.* Mind the gap. A systematic review to identify usability and safety challenges and practices during electronic health record implementation. *Appl Clin Inform* 2016; 07 (04): 1069–87.
- Pelayo S, Anceaux F, Rogalski J, Elkin P, Beuscart-Zephir M-C. A comparison of the impact of CPOE implementation and organizational determinants on doctor–nurse communications and cooperation. *International Journal of Medical Informatics.* 2013;82(12):e321–e30.
- (HRSA) HRSA. Health Center Program Awardee Data. 2018. <https://bphc.hrsa.gov/uds/datacenter.aspx?q=d&year=2018&state=UT#glist> Accessed August 1, 2020.

30. Prgomet M, Georgiou A, Callen J, Westbrook J. Fit between individuals, tasks, technology, and environment (FITTE) framework: a proposed extension of FITT to evaluate and optimise health information technology use. *Stud Health Technol Inform* 2019; 264: 744–8.
31. Ammenwerth E, Iller C, Mahler C. IT-adoption and the interaction of task, technology and individuals: a fit framework and a case study. *BMC Med Inform Decis Mak* 2006; 6 (1): 3.
32. Object Management Group Business Process Model and Notation. Object Management group. <https://www.bpmn.org> Accessed June 30, 2020.
33. Vidrine JI, Shete S, Cao Y, Greisinger A, Harmonson P, Sharp B, Miles L, Zbikowski SM, Wetter DW. Ask-Advise-Connect: a new approach to smoking treatment delivery in health care settings. *JAMA Intern Med*. 2013;173(6):458–64.
34. Holtrop JS, Malouin R, Weismantel D, Wadland WC. Clinician perceptions of factors influencing referrals to a smoking cessation program. *BMC Fam Pract*. 2008;9:18.
35. HL7. C-CDA (HL7 CDA[®] R2 Implementation Guide: Consolidated CDA Templates for Clinical Notes - US Realm). http://www.hl7.org/implementation/standards/product_brief.cfm?product_id=492 Accessed August 1, 2020.
36. Cantrell J, Shelley D. Implementing a fax referral program for quitline smoking cessation services in urban health centers: a qualitative study. *BMC Fam Pract*. 2009;10:81.
37. Karn S, Fernandez A, Grossberg LA, *et al*. Systematically improving tobacco cessation patient services through electronic medical record integration. *Health Prom Pract* 2016; 17 (4): 482–9.
38. Fernandez ME, Schlechter CR, Del Fiol G, *et al*. QuitSMART Utah: an implementation study protocol for a cluster-randomized, multi-level Sequential Multiple Assignment Randomized Trial to increase Reach and Impact of tobacco cessation treatment in Community Health Centers. *Implement Sci* 2020; 15 (1): 9.
39. Flocke SA, Seeholzer E, Lewis SA, Gill IJ, Ordillas E, Rose JC, Albert E, Love TE, Kaelber DC. Designing for Sustainability: An Approach to Integrating Staff Role Changes and Electronic Health Record Functionality Within Safety-Net Clinics to Address Provision of Tobacco Cessation Care. *Jt Comm J Qual Patient Saf*. 2019; 45(12):798–807.
40. HRSA. Uniform Data Systems Resources. <https://bphc.hrsa.gov/data-reporting/reporting/index.html> Accessed August 1, 2020.
41. Fontanesi J, Shefer AM, Fishbein DB, Bennett NM, De Guire M, Kopald D, *et al*. Operational conditions affecting the vaccination of older adults. *American Journal of Preventive Medicine*. 2004; 26(4):265–70.
42. Hung DY, Harrison MI, Truong Q, Du X. Experiences of primary care physicians and staff following lean workflow redesign. *BMC Health Serv Res*. 2018;18(1):274.