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EXPERIENCE REPORT

Learning Health Systems

Healthcare systems collaborating to implement a shared decision-making tool in the electronic health record and build evidence on its adoption and use

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Abstract

Introduction: Shared decision-making (SDM) is a method of care by which patients and clinicians work together to co-create a plan of care. Electronic health record (EHR) integration of SDM tools may increase adoption of SDM. We conducted a "lightweight" integration of a freely available electronic SDM tool, CV Prevention Choice, within the EHRs of three healthcare systems. Here, we report how the healthcare systems collaborated to achieve integration.

Methods: This work was conducted as part of a stepped wedge randomized pragmatic trial. CV Prevention Choice was developed using guidelines for HTML5-based web applications. Healthcare systems integrated the tool in their EHR using documentation the study team developed and refined with lessons learned after each system integrated the electronic SDM tool into their EHR. CV Prevention Choice integration populates the tool with individual patient data locally without sending protected health information between the EHR and the web. Data abstraction and secure transfer systems were developed to manage data collection to assess tool implementation and effectiveness outcomes.

Results: Time to integrate CV Prevention Choice in the EHR was 12.1 weeks for the first system, 10.4 weeks for the second, and 9.7 weeks for the third. One system required two 1-hour meetings with study team members and two healthcare systems required a single 1-hour meeting. Healthcare system information technology teams collaborated by sharing information and offering improvements to documentation. Challenges included tracking CV Prevention Choice use for reporting and capture of combination medications. Data abstraction required refinements to address differences in how each healthcare system captured data elements.

Conclusion: Targeted documentation on tool features and resource mapping supported collaboration of IT teams across healthcare systems, enabling them to

integrate a web-based SDM tool with little additional research team effort or oversight. Their collaboration helped overcome difficulties integrating the web application and address challenges to data harmonization for trial outcome analyses.

KEYWORDS
data harmonization, electronic health record, embedded research, implementation science, pragmatic trials, shared decision-making

1 | INTRODUCTION

Shared decision-making (SDM) is a method of care by which patients and clinicians work together in conversation to co-create a plan of care that advances the problematic situation of the patient while responding to the patient's goals and priorities.[1] Decision aids are tools that can be designed, implemented, and used during the clinical encounter to support these conversations. When pertinent, these tools not only bring forward the best available evidence about the relative benefits and harms of the relevant care options, but also offer tailored, individualized estimates of risk for each of these outcomes. This information is then presented in ways that foster patient and clinician understanding of the situation and how it can be addressed with these options.

Decision aids have been found in randomized trials to improve patient knowledge and patient participation in decision-making, and to decrease patient decisional conflict.[2] Encounter tools (i.e., decision aids designed to be used within a clinical encounter, rather than distributed directly to patients for use outside of a clinical conversation) have also been found to increase patient and clinician satisfaction with the consultation and to have no significant impact on its visit duration.[3] However, the adoption of SDM tools and their routinization in clinical practice settings have been limited, patchy, and slow.[4]

The integration of SDM tools into clinical and electronic workflows is a key strategy for increasing their adoption and use.[5,6] The latter is particularly pertinent to the use of SDM tools that draw from extant patient data in the electronic health record (EHR) to present individualized information to clinicians with minimal need for manual data entry. EHR functionality can also serve to remind clinicians of opportunities to engage in SDM.[7] Many SDM tools are created by external vendors, though, requiring healthcare systems to go through approvals and security screenings prior to implementing them. Time and technical challenges serve as barriers to EHR integration of SDM tools;[8] processes to integrate SDM tools in the EHR have been reported to take between 6 and 18 months.[9,10]

Research is needed to improve the adoption and routine use of SDM tools in diverse practice environments, using SDM tools that are widely available for future dissemination. We are conducting a pragmatic stepped wedge randomized controlled trial to understand the effectiveness of tailored implementation strategies in varied healthcare systems on increased adoption and routine use of an SDM tool, CV Prevention Choice.[11] CV Prevention Choice is a decision aid that supports conversations between patients and clinicians about individualized cardiovascular risk and preventive care options. As it is meant for use in clinical encounters, it was designed using methods of human-centered design (e.g., analysis of video-recorded clinical encounters) to increase its function and fit of within the clinician workflow.[12] Making CV Prevention Choice available in the EHR was a critical step in fostering adoption and use in the trial.

In this *Experience Report*, we describe the work we did with the three healthcare systems in the trial to implement CV Prevention Choice within their EHRs, including our process for facilitating collaboration to streamline implementation as each new healthcare system was randomized to start active implementation activities. We also report our experience developing data abstraction systems and harmonizing data across healthcare systems. While EHR integration is a critical step for increasing adoption and use of SDM, the ability to abstract data is critical for assessing adoption and use in pragmatic trials.

2 | QUESTIONS OF INTEREST

This article explores the experiences of a multisite study team integrating an encounter-based SDM tool in three EHRs and developing systems to harmonize data for evaluation of tool use in a pragmatic stepped wedge randomized trial.

3 | METHODS

This work was conducted as part of a pragmatic stepped wedge implementation-effectiveness trial. Implementation outcomes include clinician adoption (e.g., the proportion of eligible clinicians who use CV Prevention Choice); effectiveness outcomes will assess risk-concordance of preventive care plans. The trial had four phases: start-up, usual care, active implementation, and maintenance implementation.[11] The start-up period included baseline study assessments, for example, surveys to understand organizational readiness, as well as development of health system study teams and planning for integration of CV Prevention Choice in the EHR. In the usual care phase, which started in each health system when CV Prevention Choice was fully implemented in their EHR, the tool was available to clinicians, but the healthcare systems were not actively deploying other targeted implementation strategies to increase its adoption and routine use. In the active implementation phase, each site deployed implementation

strategies like clinician education, identification of clinical champions, and academic detailing to address clinician or system barriers and facilitators. The maintenance implementation phase will be used to assess sustainability of tool use after the active study period. *The timing of EHR integration was determined by each site's readiness, itself related to the speed with which each site was ready administratively to proceed, having received Institutional Review Board and clinical and information technology leadership approvals, human subjects research training of key personnel, and authenticated all necessary contracts and agreements*. As such, integration of CV Prevention Choice did not necessarily need to happen in the randomized order, but integration in three sequential rounds allowed for iteration and efficiencies.

4 | SETTING

The central research team is comprised of implementation scientists, data analysts, statisticians, and health services researchers located at Mayo Clinic (Rochester, MN). The three participating healthcare systems are part of the Mayo Clinic Care Network, a collaborative network of healthcare systems provided access to Mayo Clinic expertise.[13] Participating healthcare systems were selected for this study based on having the Epic Systems Corporation software for their EHR and agreeing to implement CV Prevention Choice in their EHR during the trial. Participating healthcare systems are geographically diverse, serve unique patient populations, and vary in their organizational context. The first healthcare system (System 1) is a rural, not-for-profit healthcare system in North Dakota. It includes 13 practices that employ 212 physicians and 120 advanced practice providers and cares for approximately 1.1 million encounters annually with 2.2% of those visits being virtual. The second healthcare system (System 2) is a non-profit, community-based healthcare organization located in rural and urban locations in Georgia. It has 110 practices employing 1500 physicians and advanced practice providers, with approximately 3 million ambulatory clinic visits, of which about 3% are virtual. The third healthcare system (System 3) is an urban, not-for-profit, healthcare system in Virginia. It has 22 practices employing 165 physicians and 82 advanced practice providers and conducts approximately 250 000 visits annually (12% virtual). Each healthcare system identified at least three primary and preventive care practices to participate in the study. Although, CV Prevention Choice was available to all users in the healthcare systems once it was integrated in their EHRs, only clinicians and patient encounters in the selected practices—where primary cardiovascular preventive conversations were likely to occur—were targeted for implementation strategies and included in data abstraction.

For this study, healthcare systems developed local implementation teams that included a site investigator and implementation facilitator to champion the project and assemble the local resources needed to implement the intervention and develop and support implementation strategies, for example, administrators, information technology (IT) personnel, and clinician leaders.

5 | INTERVENTION

CV Prevention Choice was designed for use in clinical encounters to support SDM conversations between patients and clinicians.[12] It presents individualized estimates of a patient's 10-year risk for atherosclerotic cardiovascular disease (ASCVD) and demonstrates the effect of different lifestyle (e.g., diet, exercise, and smoking cessation) and pharmacological options on reducing that risk (Figure 1).[12] CV Prevention Choice is recommended to be used with patients without a first atherothrombotic clinical event and who are between ages 40–75 (i.e., primary prevention patients). The tool was based on the widely used Statin Choice decision aid,[13] a tool that only supported decisions about using statins (and not the range of lifestyle and medications options supported by the new tool) that one of the participating sites had implemented in their EHR before this trial.[14]

6 | WEB PLATFORM

CV Prevention Choice is a web application design based on guidelines for HTML5-based web applications. The minimum browser requirements at the time of initial integration were Internet Explorer 9+ (IE9+), Safari, or Firefox. This was a legacy choice: all the SDM tools we have developed since the outset of our program in 2004 are web applications.

Data that populates the ASCVD calculator (e.g., age, blood pressure) can be manually entered into CV Prevention Choice or mapped to data within the EHR to enable auto-population. The web application is not password protected, does not store data entered into the application, and does not require protected patient health information to be entered. Instead, the web application was developed using Nodejs and Angularis, which supports direct interaction with the ASCVD risk calculator through the URL query string, that is, a link from within the EHR to call the web page carried parameter values that populated the ASCVD risk calculator without providing the web application with access to the EHR. The application was optimized for use with larger tablet and desktop computer displays, either during in-person or video visits.

7 | LIGHTWEIGHT INTEGRATION PROCESS INTO THE ELECTRONIC HEALTH RECORD

7.1 | Initial documentation

While manual data entry is possible and makes it easy for any healthcare system to use CV Prevention Choice, integration in the EHR is critical for maximizing its fit in the clinical workflow and minimizing clinician burden. Initial documentation provided to each IT team included a technical summary of CV Prevention Choice (Data S1). This resource provided a brief overview of the study, the purpose of implementing CV Prevention Choice, details its development, an overview

of the ASCVD risk calculator, and the data requested to populate the calculator and outcome measures for the clinical trial.

The second source provided an initial set of build instructions for mapping the factors involved in completing ASCVD risk calculations (Data S2). The research team recommended each healthcare system automatically map fields in the EHR to the ASCVD risk calculator (the American Heart Association – American College of Cardiology Pooled Cohort ASCVD Calculator) fields, as shown in Table 1. Without the need for interpretation or text-string searching, these clinical factors—age, sex at birth, race, smoking status, diabetes, systolic blood pressure, HDL cholesterol, and total cholesterol—directly populated the tool. Medication listings (Data S3) were provided with the express interest of encouraging each healthcare system to map them for integration into the tool. The medication listings were reviewed by two clinicians (VMM and DM) for completeness and accuracy with a reference spreadsheet listing each class with pharmaceutical subclass names, National Drug Codes, and medication Epic code. We believed there was value in saving time for the clinician by incorporating the medications, but with the

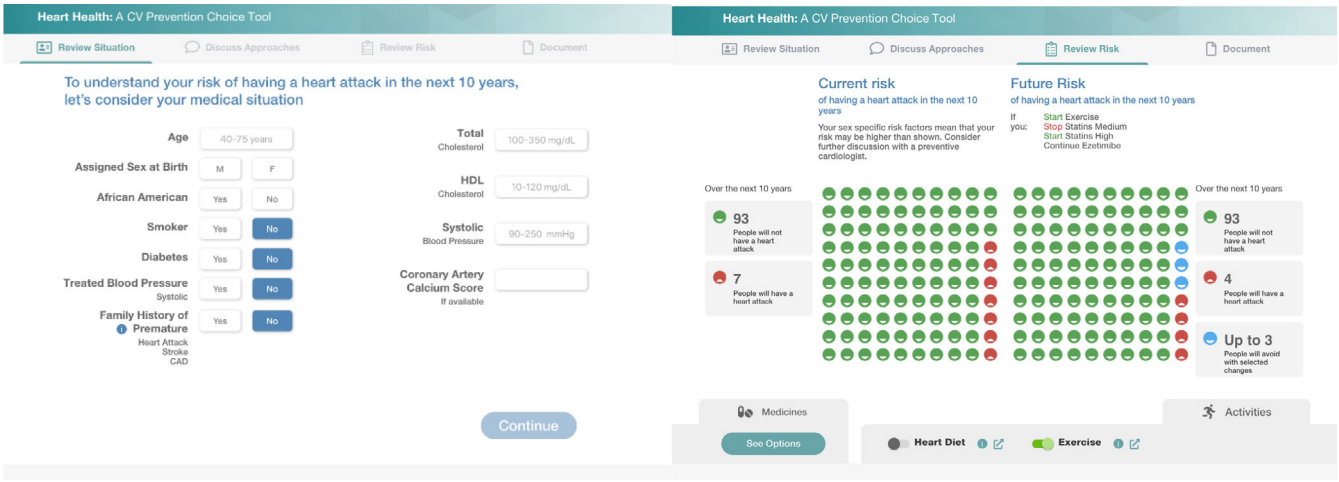

FIGURE 1 CV Prevention Choice: Patient information to calculate cardiovascular risk can be manually entered into the web-based app or autopopulated from the electronic health record (left). The infographic displays current risk, as well as future risk after options for treatment are discussed and selected (right).

TABLE 1 CV Prevention Choice fields for mapping with data from the electronic health record (Epic).

	Variables for mapping in Epic	Continuous or categorical	Documentation is available for mapping in Epic	Recommendation for mapping in Epic
ASCVD risk calculator	Age	Continuous	Yes	Yes
	Sex at birth = Male	Categorical (Y/N)	Yes	Yes
	African American	Categorical (Y/N)	Yes	Yes
	Smoker	Categorical (Y/N)	Yes	Yes
	Diabetes	Categorical (Y/N)	Yes	Yes
	Systolic blood pressure	Categorical (Y/N)	Yes	Yes
	HDL cholesterol	Continuous	Yes	Yes
	Total cholesterol	Continuous	Yes	Yes
	Treated blood pressure	Categorical (Y/N)	Yes	Yes
Family history	Family history of CVD/Heart attack/Stroke	Categorical (Y/N)	No	Consult[a]
Medications	Ezetimibe	Categorical (Y/N)	No	Consult[a]
	Statins medium dose	Categorical (Y/N)	No	Consult[a]
	Statins high dose	Categorical (Y/N)	No	Consult[a]
	Aspirin	Categorical (Y/N)	No	Consult[a]
	SGLT2 inhibitors	Categorical (Y/N)	No	Consult[a]
Activities	Heart-friendly diet	Categorical (Y/N)	No	No
	Moderate intensity exercise	Categorical (Y/N)	No	No

[a]It is recommended IT consults with their clinical champion on integration effort and priority for Healthcare System.

understanding that not all medications are up-to-date within the EHR, and recommended clinicians review the information populated to ensure it still reflected the patient's current status.

For items that are captured within the EHR but not standardly captured in a binary manner, we did not advise integration, knowing that extracting this information would take additional work and its accuracy would need to be confirmed with the patient during the encounter. An example is diet and exercise: clinicians do not standardly capture this in a binary form in the EHR, instead describing the discussion about these interventions in clinical notes which would need to be reviewed for context.

7.2 | Iterative integration, intersystem collaboration, and refined documentation

While all healthcare systems had access to the initial documentation upon request, the process of integrating CV Prevention Choice into the EHR started with the first healthcare system randomized to intervention start in the stepped wedge study design. Processes and documentation were iteratively refined between steps, as shown in Figure 2. Study team support consisted of two 1-hour meetings for System 2 and one 1-hour meeting with Systems 1 and 3. All other communication was conducted via email. The designated study team member (MEB) was included in all communication. The time needed to implement the application was faster with each iteration (System 1:12.1 weeks; System 2:10.4 weeks; System 3:9.7 weeks).

7.2.1 | System 1

For the first healthcare system, an initial meeting was held between the members of the central research team and the System 1 IT team. The requirements and the initial set of instructions on mapping the recommended variables were reviewed by the following: Physician Advisory Committee approval, Family Medicine Champion, and Manager of Research Program. After their approval, the research team provided System 1 with the CV Prevention Choice URL, and the application analyst began integration within the EHR. The application analyst consulted with the study team as needed via email, but no additional meetings were required for the initial build. The lead clinician on the healthcare system local implementation team tested application use in a test environment prior to it being put into production (Table 2).

The application analyst then updated the EHR instructions to include all knowledge gained from the integration process at HS1. Specifically, additions included instructions on building the web integration record into hyperspace (Figure 3. Web Integration).

7.2.2 | System 2

The applications analyst from System 1 attended a meeting with the System 2 implementation team and presented their documentation and process for successfully integrating CV Prevention Choice into

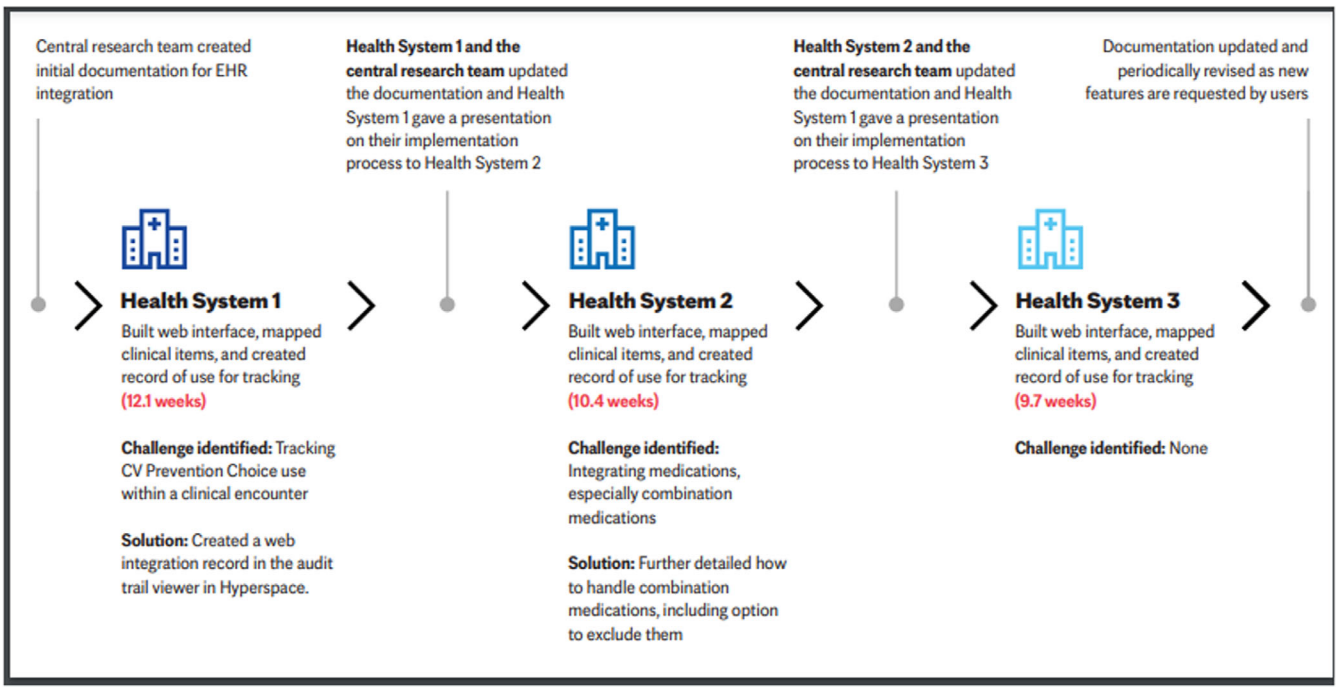

FIGURE 2 Staged integration for collaboration and learning: The central research team created initial electronic health record integration documentation and worked with each participating healthcare system sequentially. Between each healthcare system's integration, documentation was updated to reflect changes and refinement. Challenges in the first two healthcare systems were addressed and reflected in documentation edits for the next round.

TABLE 2 Healthcare systems electronic health record and analyst support.

	Healthcare system 1 (HS1)	Healthcare system 2 (HS2)	Healthcare system 3 (HS3)
Region	Rural, Midwest	Urban, South	Urban, East
Epic Version	May 2020	November 2019	November 2021
Total Epic team	60	65	60
Epic team on project	• Director of clinical applications • Application Analyst IV	• Epic project manager • Epic ambulatory analyst • Manager IT clinical applications	• Epic ambulatory analyst • Ambulatory applications manager
Meetings with Mayo Study team	2 1-hour meetings	2 1-hour meetings	1 1-hour meeting
Committee or stakeholder approval	• Physician advisory committee approval • Family medicine champion • Manager of research program	• Cardiovascular medicine service line • Epic project management team • WARP	• Chief medical informatics officer • Interim senior vice president of physician services
Hours of work by analyst	~40	~40	~9
Weeks from kick-off to activated in EHR[a]	12.1 weeks	10.4 weeks	9.7 weeks
Interacted with Epic support TS	None	Assistance with medication rule build	Assistance with FDI configuration, mapping to website, medication, and browser pop-up

[a]This does not include the time needed after putting the SDM tool into production required when updates were made to the encounter tool.

their Epic workflow. The presentation first focused on CV Prevention Choice, the purpose behind its use in the EHR, and how it could benefit the clinical encounter, this was presented by a member of the study team. The analyst from System 1 then presented an overview of the integration into the EHR and addressed questions from the System 2 IT team. Similar to the completion of integration in System 1, after integration in System 2, this team also updated the documentation. Specifically, additions included clarifications on medication integration.

7.2.3 | System 3

Upon completion of integration in System 2, the System 2 analyst updated the instructions for integration and presented to the local IT team in System 3, including a slide presentation that visually portrayed steps of interest for the System 3 audience (e.g., Epic Ambulatory Analyst, Ambulatory Applications manager). During the presentation the System 2 analyst highlighted the need to coordinate approvals with committees in the planning stage. Novel to the System 3 approach was planned mapping of both the ASCVD risk score fields and the medications. After beginning the integration process, the analyst consulted with Epic on FDI configuration (i.e., records that let Epic integrate with third-party application software), mapping to the CV Prevention Choice website, medication details, and questions related to browser popup. A member of HS3 clinical team tested the integration prior to the SDM tool being put into production. After completion, the Epic ambulatory analyst updated the documentation on integration providing clarification and verifying information is accurate.

7.3 | Integration in the clinical workflow

Each healthcare system chose how clinicians accessed CV Prevention Choice in the encounter context. All three healthcare systems chose to insert a link to the tool under a "More Activities" dropdown menu. This meant that clinicians needed to learn where to find the link to the tool or how to search for it, and then to "star" it so that it would become a favorite tab shown by default in subsequent encounters.

8 | DATA ABSTRACTION AND HARMONIZATION FOR EVALUATION

As part of the research study, it was necessary for the healthcare systems to abstract and transmit data to the central research team from the EHR. Furthermore, these data needed to be harmonized across health systems for evaluation of implementation and effectiveness outcomes in the parent implementation trial. This involved three key steps. First, evaluation of trial outcomes necessitated identification of clinical encounters where an eligible patient could have been engaged in conversation about primary cardiovascular prevention using CV Prevention Choice (i.e., a patient meeting eligibility criterion and being seen in a study setting). Eligibility for encounters to be transferred included patients between the ages 40–75, without a first atherothrombotic clinical event (Data S1) from sites identified by the healthcare system as participating in the clinical trial.

Second, the healthcare systems needed to identify when CV Prevention Choice had been used in the encounter. A minimally disruptive solution was needed that would leave a digital crumb within

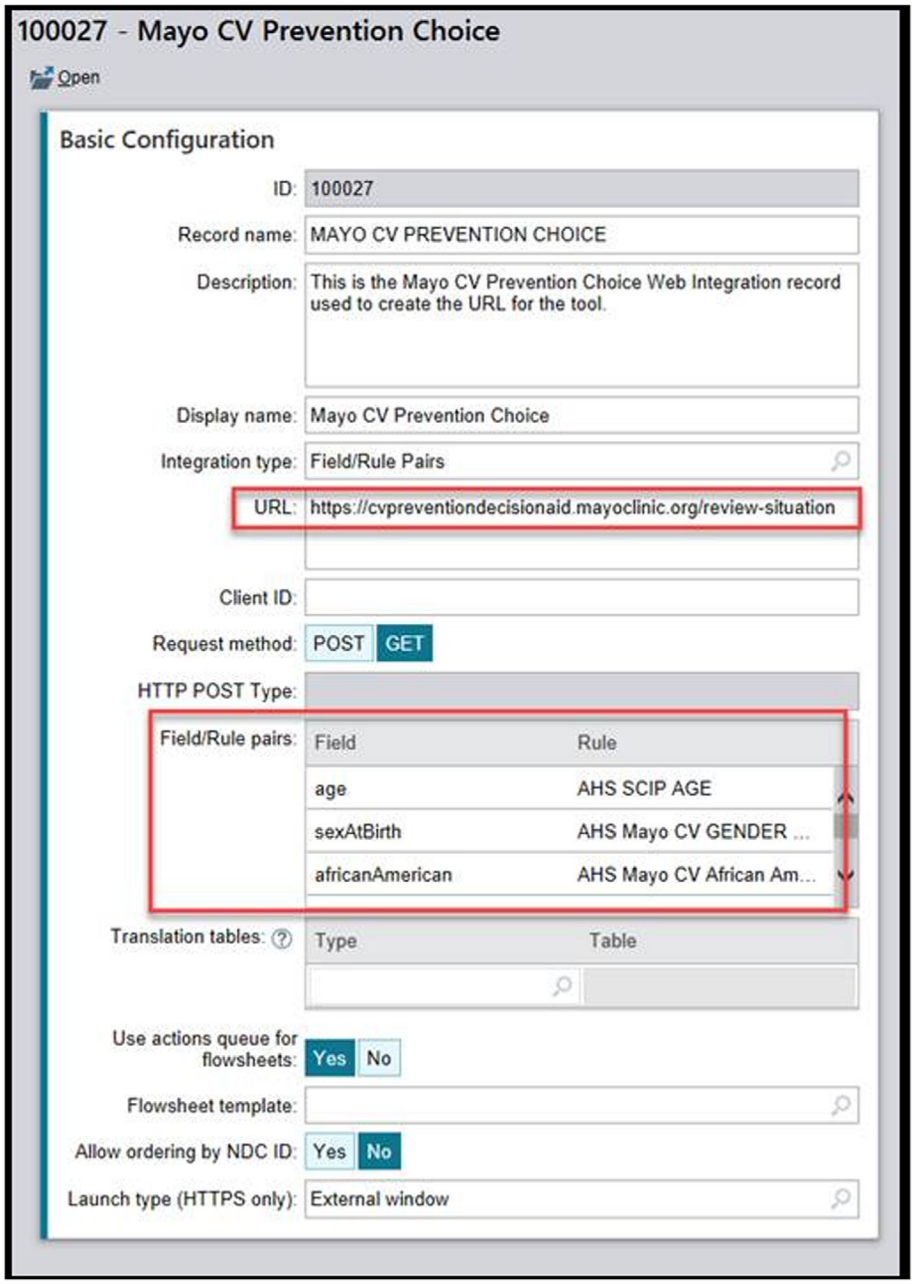

FIGURE 3 Building a web integration record: A snapshot of the view of CV Prevention Choice integration in the electronic health record.

the EHR. A Web Integration record needs to be built within Epic's Hyperspace that recorded use of the URL that triggers the web app (and transmits the data necessary to estimate the patient's ASCVD risk). This record could then be pulled by the research analysts to track and report CV Prevention Choice use within eligible encounters.

Third, the healthcare systems also needed procedures for abstracting data to evaluate effectiveness trial outcomes. The study team created a data dictionary for each healthcare system, providing details identifying each variable and how to structure and name them within the file transfer. An example of this is for smoking status, where the data dictionary defined this as: Most recent smoking status captured in the EHR. Reported as a text string along with the date the data was recorded. Only smoking status, vaping, and e-cigarettes are not included in this definition. The variable name is to be Smoking with an additional variable of dt_smoking. Each healthcare system created a random ID for the patient and the clinician, of which the healthcare system kept the crosswalk to, so clinicians and patients with multiple encounters can be identified by the central research team without the need for PHI being transferred. A secure file transfer process (sFTP) was enabled for each healthcare system with the instructions to transfer the encounters monthly. These steps created a smooth process for data transfer from each healthcare system to the central research team.

9 | CHALLENGES AND SOLUTIONS

The original configuration of the CV Prevention Choice met each healthcare systems requirements for integration. Within each

healthcare system, all necessary committees, including those focused on cybersecurity, approved the implementation after the first review. The composition of the implementation team at each site, including the IT contact person, stayed consistent throughout the integration, which ensured adequate, timely, and effective communication and documentation at every stage of the implementation.

The initial identification of CV Prevention Choice use within the EHR was thought to be only feasible through a Best Practice Advisory (BPA). BPAs are Epic decision support tools placed within workflows to warn or remind clinicians. As discussed previously, the use of BPA was not recommended for CV Prevention Choice. HS1 communicated this barrier to integration with the study team member (MEB) who then collaborated with members of the Mayo Epic IT team for insights into alternative solutions. The solution required the analyst to build a web integration record in Hyperspace. This then created a record in the Audit Trail Viewer, which is for tracking access to patient records within the EHR. This information is then able to be pulled from Epic's Clarity through the Event Logging (E1M) tables for reporting.

There were several challenges related to system approvals, though. In HS2, the IT team and clinical champions had to initiate approval processes within three separate committees (Cardiovascular Medicine Service Line, Epic Project Management Team, and WARP—an IT committee that reviews changes to software within the organization and prioritizes them to work teams). These approvals created logistical issues as the committees did not meet regularly. HS2 had first planned on mapping the items needed for the ASCVD risk score only, but, after initial testing, the clinical champion requested that the medications be mapped as well. At the time of this decision, an additional meeting with the study team was scheduled with all members who took part in the first meeting plus the clinician champion for HS2. During this meeting the status of the integration was reviewed and discussion for expanding the integration was conducted. A ticket was submitted, and the Epic Ambulatory Analyst began work on mapping the medications, in consultation with Applications Analyst at HS1. To complete the mapping of the medications, the analyst contacted Epic to assist with challenging situations, including the mapping of medications that combine different drug classes into one pill. The clinician champion for HS2 tested the integration prior to having the SDM tool moved into production.

Other challenges were related to data to populate the tool. Drawing data about medications into CV Prevention Choice required additional work, communication, and decision-making among team members. For example, prescribed statin doses needed to be classified as high- or moderate-intensity dosing when the statin was prescribed alone or in a combination tablet. Rules were established to facilitate this, for example, atorvastatin 10 or 20 mg was considered moderate-intensity dosing. The medication dose for mono-component tablets was stored as a numeric value and the rule applied using Boolean operators. For combination tablets, however, the dosing was stored as a text field. To create a rule for these, all possible dosing combinations would have to be individually listed in the rule and monitored for the emergence and subsequent ongoing inclusion of new possible medication combinations and dosing values. This was deemed unsustainable, and the systems chose to not map the combination medications, defaulting their doses to the moderate- or high-intensity category.

Finally, there were challenges with our lightweight implementation related to displaying the web tool inline within Epic. During the implementation, the default Epic browser was an early version of Internet Explorer, not fully compatible with CV Prevention Choice. The tool, therefore, had to launch on a new browser window in the healthcare system's web browser of choice (e.g., Microsoft Edge, Google Chrome, Apple Safari) outside of the Epic environment. This was later resolved when the Epic versions at the participating sites offered updated browsers.

Post-integration, a wiki was maintained to collect issues that emerged as clinicians began to use the tool in routine practice. This wiki noted the changes requested and how they were managed (i.e., to table the request, to schedule the change for the next version release, to decline the request) and was available to investigators and site study teams. The addition of new risk considerations (e.g., women-specific risk factors, high levels of both HDL and LDL cholesterol), medication options (e.g., bempedoic acid), enhancements to the legibility of printed reports, and a reduction in the number of clicks necessary to navigate the tool were important updates made after integration. Using the same channels of communication, these updates were rolled out in the same order as the original implementation (HS1 followed by HS2 and HS3) and using the same approach to sharing information across sites.

For the abstraction of the data for reporting to the central research team, each healthcare system identified a member of their reporting team to create the pull. The data crossed several data tables within the EHR's data tables. One challenge for HS3, was the mechanism in which the medications are updated within the EHR, in that the pharmacy data is not reconciled regularly, the healthcare system will provide two dates for each medication. The first date corresponds to the date the prescription was ordered, and the second date corresponds to the most recent reconciliation conducted, whether that was through the pharmacy update or by the clinician within the encounter with the patient.

Data collection is ongoing but being regularly assessed by the study statistician. It was noted that the lab data (i.e., cholesterol levels) had a high rate of missing data (~50%). Original documentation constrained the labs being sent to only those within the most recent 12 months. The documentation was updated to collect all recent labs without a time frame restriction. Each healthcare system had to resend all previous encounters to address this issue. The percentage of missing data decreased to 32%.

No differences have been noted or challenges with data structures across the healthcare systems.

10 | DISCUSSION

The 2019 American College of Cardiology/American Heart Association (ACC/AHA) guidelines strongly (Class I) recommended SDM for primary cardiovascular prevention without offering a path toward implementation in routine care.[14] Integration of SDM tools in electronic workflows is one way to encourage adoption and use. In the

parent trial, we made willingness to implement an SDM tool in the EHR a requirement for health system participation, and we are testing other tailored implementation strategies on adoption and use, leveraging data from these systems in evaluation.

Using a lightweight process, we successfully integrated a third-party web application into three diverse healthcare systems, and it has been put into production and actively used by clinicians in practice, validating successful integration. We have also put data abstraction system in place that will allow evaluation of trial outcomes that rely on documentation of CV Prevention Choice adoption and use for analyses.

Integration of the CV Prevention Choice SDM tool required documentation, build resources, and a dedicated member of the study for timely support of implementation into the EHR. Open communication and identification of key contacts within each healthcare system who were engaged and provided timely responses fostered an environment of collaboration. Key characteristics of this experience that were also previously found to be necessary for successful integration included having a clinical site champion at each healthcare system and having standardized processes that avoid the use of patient protected health information.[6] The integration of CV Prevention Choice in this study was accomplished in less time than in prior research studies,[9,10] and our experience was that the time to integrate CV Prevention Choice reduced as new healthcare systems sequentially began integration, demonstrating the potential of leveraging shared learning in a stepped wedge pragmatic trial of EHR-integrated SDM tools.

10.1 | Strengths and limitations

Our lightweight integration of the CV Prevention Choice tool had the advantage of knowledge gained from prior integration of the Statin Choice decision aid—the predecessor to CV Prevention Choice that focused on statin use conversations.[13] The lessons learned from the integration of the Statin Choice into Epic provided a starting place for this project's ASCVD calculation in particular.

As the integration of CV Prevention Choice was part of a federally funded clinical trial, the study was budgeted to support the healthcare systems analyst time.[14] Having external funding sources to pay for the work may help prioritize the project among leadership. The information on the time and effort for the integration was collected retrospectively, including review of emails and meeting calendars to collect details on the process.

11 | CONCLUSION

Sharing documentation and resources with the IT teams and engaging in a collaborative environment set the stage for information sharing and cross-system learning. Collaboration among healthcare systems and their IT teams importantly reduced the time and effort needed to complete a lightweight implementation of a web application within the electronic workflow, rendering this aspect of conducting an implementation-effectiveness trial of an SDM tool feasible.

With the SDM tool integrated into the EHR of each healthcare system, the implementation-effectiveness trial was able to proceed per protocol, collecting information about tool adoption and use while estimating the efficacy of different implementation strategies to promote SDM in the care of at-risk patients.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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REFERENCES

1. Kunneman M, Montori VM, Castaneda-Guarderas A, Hess EP. What is shared decision making? (and what it is not). *Acad Emerg Med*. 2016;23(12):1320-1324.
2. Stacey D, Légaré F, Lewis K, et al. Decision aids for people facing health treatment or screening decisions. *Cochrane Database Syst Rev*. 2017;4(4):CD001431.
3. Dobler CC, Sanchez M, Gionfriddo MR, et al. Impact of decision aids used during clinical encounters on clinician outcomes and consultation length: a systematic review. *BMJ Qual Saf*. 2019;28(6):499.
4. Erika L, Zahirah M, Kasey B, Emily C, Elizabeth B, Leslie C. Changing hospital organisational culture for improved patient outcomes: developing and implementing the leadership saves lives intervention. *BMJ Qual Saf*. 2021;30(6):475.
5. Scholl I, LaRussa A, Hahlweg P, Kobrin S, Elwyn G. Organizational- and system-level characteristics that influence implementation of shared decision-making and strategies to address them - a scoping review. *Implement Sci*. 2018;13(1):40.
6. Peters LJ, Torres-Castano A, van Etten-Jamaludin FS, Perestelo Perez L, Ubbink DT. What helps the successful implementation of digital decision aids supporting shared decision-making in cardiovascular diseases? A systematic review. *Eur Heart J Digit Health*. 2023;4(1):53-62.
7. Lenert L, Dunlea R, Del Fiol G, Hall LK. A model to support shared decision making in electronic health records systems. *Med Decis Making*. 2014;34(8):987-995.
8. Day FC, Pourhomayoun M, Keeves D, et al. Feasibility study of an EHR-integrated mobile shared decision making application. *Int J Med Inform*. 2019;124:24-30.
9. Scalia P, Ahmad F, Schubbe D, et al. Integrating option grid patient decision aids in the epic electronic health record: case study at 5 healthcare systems. *J Med Internet Res*. 2021;23(5):e22766.
10. Lee CN, Sullivan J, Foraker R, et al. Integrating a patient decision aid into the electronic health record: a case report on the implementation of BREASTChoice at 2 sites. *MDM Policy Pract*. 2022;7(2):23814683221131317.
11. Ridgeway JL, Branda ME, Gravholt D, et al. Increasing risk-concordant cardiovascular care in diverse healthcare systems: a mixed methods

pragmatic stepped wedge cluster randomized implementation trial of shared decision making (SDM4IP). *Implement Sci Commun*. 2021; 2(1):43.
12. Hartasanchez SA, Hargraves IG, Clark JE, et al. The design and development of an encounter tool to support shared decision making about preventing cardiovascular events. *Prev Med Rep*. 2022;30: 101994.
13. Leppin A, Boehmer KR, Branda ME, et al. Developing a toolkit to implement the statin choice conversation aid at scale: application of a work reduction model. *BMC Health Serv Res*. 2019;19(1):249.
14. Arnett DK, Blumenthal RS, Albert MA, et al. 2019 ACC/AHA guideline on the primary prevention of cardiovascular disease. *J Am Coll Cardiol*. 2019;74:1376-1414.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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