Clinical Decision Support for Chronic Pain Management

Executive Summary

Prepared for

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Executive Summary

Introduction and Background

Chronic pain is common and carries a high societal and clinical burden.[9,10] Complete resolution of chronic pain symptoms is uncommon, and treating chronic pain relies on ongoing collaboration between the clinician and the patient. This shared decision-making (SDM) process can increase adoption and adherence to treatments. Maximizing treatment outcomes for chronic pain requires a multimodal, interdisciplinary approach that may include medications, procedures, and physical therapy in varying combinations for different patients.[11] Chronic pain management also requires good communication and collaboration between patients and clinicians, including SDM, which increases adoption and adherence to treatment.[12] Given this complexity, busy clinicians can benefit from clinical decision support (CDS) tools that follow the goals of the CDS Five Rights,[13] by delivering the right information to the right people in the right formats and in the right channels at the right times in the workflow. It is also important that tools are available across systems in a consistent, shareable, and interoperable manner.

A multidisciplinary team led by RTI International and including informaticians at Vanderbilt University Medical Center (VUMC) and the University of Chicago Medicine (UCM) was funded by the Agency for Healthcare Research and Quality (AHRQ) to develop publicly available, standards-based, interoperable CDS for chronic pain management and SDM in real-world settings (CDS4CPM). This includes a patient-facing CDS application called MyPAIN (My Pain Assessment and Information Needs) and a physician-facing CDS tool called PainManager. MyPAIN is a Substitutable Medical Applications, Reusable Technologies (SMART)[14] on Fast Healthcare Interoperability Resources (FHIR)[4] application that launches from an electronic health record (EHR) patient portal. MyPAIN collects patient-reported data and preferences, delivers patient-specific educational materials about chronic pain and opioids, and prepares patients for SDM with clinicians. Partnering with MyPAIN, the clinician-facing application, PainManager, is a CDS Connect application based on the AHRQ-developed pain management summary.[15,16] PainManager gives primary care clinicians and specialists a summary of patient-specific data for chronic pain and opioids, optional access to prescription drug monitoring program (PDMP) data, CDS warnings for high morphine milligram equivalent (MME) opioid doses or concurrent opioid–benzodiazepine use, information supporting SDM during primary care and specialist visits, and an ability to record the SDM results. Together, these products form a system for the delivery of patient- and clinician-facing CDS to provide end-to-end support for SDM around chronic pain management. The CDS4CPM project designed, developed, implemented, and evaluated the CDS4CPM system at UCM and VUMC.

Evaluation Methods

We evaluated development and implementation of the CDS system using four key research questions:

RQ1: What are the key issues for *developing* interoperable and publicly shareable CDS for patients and clinicians, and how did the project address those issues?

> **CONSIDERATIONS FOR IMPLEMENTERS**: Consider development of a FHIR façade to meet the requirements of the application that extend beyond the standards.

RQ2: What are the key issues for *implementing* interoperable and publicly shareable CDS for patients and clinicians, and how did the project address those issues?

> **CONSIDERATIONS FOR IMPLEMENTERS**: Work to internally identify and/or develop the technical capacity for implementing and integrating services using emerging standards like SMART and FHIR.

RQ3: What *effects (or outcomes)* does CDS have on chronic pain management in ambulatory care clinics, particularly SDM?

> **CONSIDERATIONS FOR IMPLEMENTERS**: Develop a means to leverage information from patients (patient-reported outcomes [PROs]), which can be an important driver for clinical adoption.

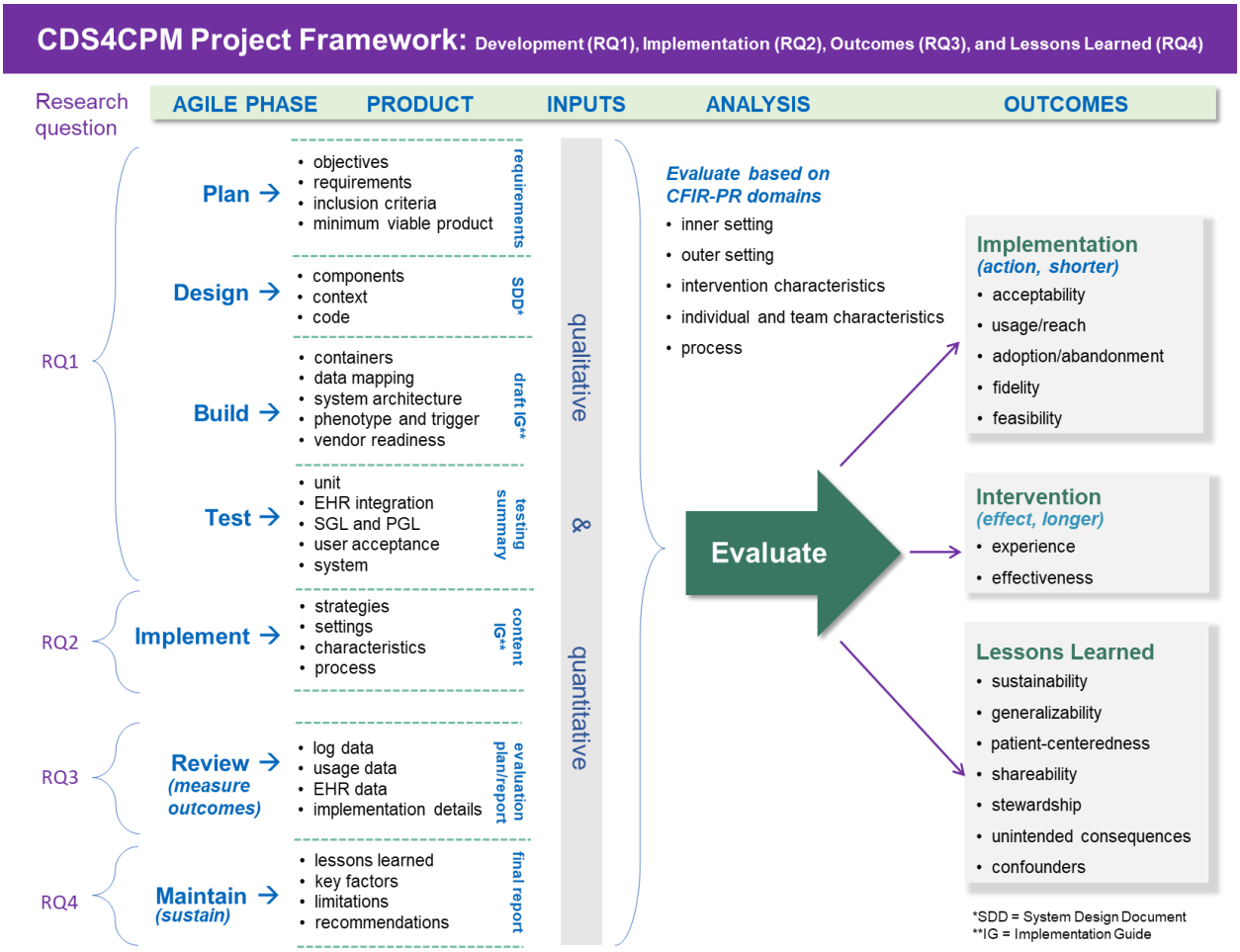
RQ4: What *lessons learned* arise from the project's experiences with developing and implementing interoperable and publicly shareable CDS for patients and clinicians?

> **CONSIDERATIONS FOR IMPLEMENTERS**: Anticipate the complexity of workflow integration for CDS and SDM and build in time for monitoring, performance optimization, and stabilization.

Because the combined elements of the CDS4CPM system were novel and complex, and implementation was occurring at two sites, we applied the Consolidated Framework for Implementation Research (CFIR) and its modified variant for Process Redesign (PR) to track the implementation process and clinical outcomes. An overarching project framework mapped the research questions, project activities, and work products to the CFIR domains and constructs (***Figure ES. 1***) and was used to guide the development of specific interview questions and the quantitative approach.

We conducted interviews with eight clinicians, eight administrators, and other project team members across the two sites. Where possible, implementation success was measured quantitatively: data on the use and stability of MyPAIN and PainManager were collected from log files, and patients were polled on the effectiveness of CDS4CPM in promoting SDM. In addition, clinicians, administrators, and other key players were interviewed to glean information on how various nonquantifiable factors (site inner and outer setting, individual and team characteristics, and others) affected successful implementation.

Figure ES.1 CDS4CPM Project Framework



Results and Lessons Learned

During the project and the pilot period, which ran from March 10, 2021, until May 30, 2021, the team implemented the CDS4CPM applications in eight clinics (five at UCM and three at VUMC). MyPAIN was launched 1,055 times and PainManager was launched 274 times. At UCM, there were 214 launches of MyPAIN by patients and 194 launches of PainManager by clinicians. At VUMC, there were 841 launches of MyPAIN by patients and 80 launches of PainManager by clinicians. Our multimethod analysis also yielded important lessons learned for each phase of the project, outlined as follows.

Development (RQ1)

Combining participant interviews and quantitative data collection yielded important results and lessons learned for the *development* of CDS (CFIR constructs in **bold**, results in *italics*, then lessons learned):

- **Shareability**: *Limited PDMP data were available in PainManager for the pilot.* However, those data are available for reconciliation in many cases, and data reconciliation in the EHR can extend integration. Clinicians indicated that integrated PDMP data would be important in assisting them with decreasing overprescribing, suggesting that reconciled PDMP data using a FHIR interface was an effective approach.
- **Fidelity**: *An MME/day calculator was successfully integrated into PainManager and used during the pilot.* This calculator supported guiding safe, appropriate decisions concerning changes to opioid medication regimens. Although there are multiple such calculators to choose from, this project demonstrated success in integrating an existing CDS Connect application based on the Centers for Disease Control and Prevention's Guideline for Prescribing Opioids for Chronic Pain[17] into PainManager as an MME/day calculator rather than using EHR-based MME calculations.
- **Feasibility**: *According to clinicians, alerts for accessing PainManager were used with varying success during the pilot based on the type of alert.* Clinician interviewees stressed the need for PainManager alerting systems to be aligned with practice workflows. As such, a deep understanding of local needs, existing data standards, the EHR environment, and overall system capabilities will reduce challenges in implementation.
- **Usage**: *Only one participant utilized the optional system tool incorporated to capture the outcome of SDM.* Documentation of SDM at each visit is crucial. We used a separate EHR system tool that allowed a clinician to generate a note regarding an SDM session at the end of a patient's visit.
- **Generalizability**: *A FHIR façade was successfully used by both sites to handle standards- and nonstandards-based services to meet the requirements for PainManager.* Incorporating a FHIR façade into the system architecture provided a bridge between FHIR and site-specific EHRs while maintaining standards-based interoperability. This was critical for integrating standards- and nonstandards-based services, both of which remain common in clinical practice.
- **Adaptability**: *According to system integrators, development of testing data to fully evaluate the CDS had significant successes.* The process of testing an implementation relies on adequate data availability, so a pre-implementation assessment of likely data availability can pave the way for success.
- **Team characteristics**: *The project team noted that finding and leveraging the right stakeholders for development, implementation, and evaluation was often challenging.* A multidisciplinary team established well before implementation should include relevant skills and may need to be supplemented with external partners.
- **Patient-centeredness**: *Existing educational resources were identified to include in MyPAIN and met with some success in use.* Tailored educational materials for patients extend the reach of the tool and are effective at increasing uptake and use.

Implementation (RQ2)

- **Implementation strategies**: *We identified 11 strategies from the CFIR-PR framework to support the implementation of the CDS4CPM system at both sites and determined that of the 11 total strategies, UCM used 7 and VUMC used 9.* Both sites conducted educational meetings, developed/distributed materials, identified and prepared champions, provided local technical assistance, and provided general

reminders to encourage clinicians to use PainManager. Implementation strategies were more likely to be used for PainManager than for MyPAIN.

- **Structural characteristics**: *Both sites were able to use MyPAIN and PainManager in the production environment to support chronic pain management but with significant PainManager performance issues.* Characteristics of the intervention site are likely to be strongly associated with success and therefore should be evaluated in advance. These include the ability of the site to adapt the system to existing and ongoing chronic pain management processes and the site's ability to implement a system with high complexity.
- **Stewardship**: *One site took the lead on developing the FHIR façade, and the other site took the lead on testing the MME/day calculator. Each site transferred that knowledge to the other.* Ease of implementation was also affected by site readiness, including technical capacity to implement a complex system, type and amount of available IT resources, and the degree to which staff training would be needed for implementation.
- **Feasibility**: *System alerts for PainManager were useful, even increased, during the pilot period, and some additional monitoring was done to evaluate the effectiveness of the alerts.* System alerts for CDS tools, if implemented appropriately, are feasible. Also, we did not find that there was "alert fatigue," which is often a concern. To mitigate potential issues, it is important to test as fully and as often as possible and to incorporate a monitoring activity to review and make adjustments.
- **Social**: *Interviewees reported that the coronavirus disease 2019 (COVID-19) pandemic was a factor in delays getting to pilot and in compressing the pilot timeline.* Between initial responses in the clinical environment to the COVID-19 burden, then technical responses to vaccination rollout, this was a complicating factor throughout the project period.
- **Policy**: *Interviewees reported that the advent of United States Core Data for Interoperability (USCDI) in the Office of the National Coordinator for Health Information Technology's Cures Act Final Rule[7] affected the ease of implementation.* Initially a motivator for participating sites, USCDI helped establish an interoperability baseline and an incentive to continue to move that line and develop local capacity for standards-based solutions.
- **Team characteristics**: *At each site, the implementation team consisted of a diverse group of site administrators, project team members, and clinicians.* Implementation was improved when these staff worked in subteams for greater efficiency and decreased strain on IT resources and when a clinic champion was available and visible.

Outcomes (RQ3)

To assess the effect of CDS on chronic pain management and SDM, we measured outcomes related to the implementation process and the intervention itself. Specifically, we assessed use and adoption of the system, and the degree to which patients and providers were better prepared for their interactions.

- **Usage**: *Clinicians had performance issues with PainManager throughout the pilot. There were about 4 times as many launches of MyPAIN (1,055) compared with launches of PainManager (274).*

- **Fidelity**: *Both sites worked with the same version of the applications, received and implemented the same releases, used the same version of the FHIR façade, and implemented similar workflows.* Given the standards-based approach used during implementation, there was a high degree of fidelity between the systems implemented at each site.
- **Adoption**: *Launches indicate reasonably good adoption of the system.* Adoption of the system was driven in part by the promise of patient-reported information and was most successful if the system was perceived to add value to or build on existing efforts.
- **Utilization and experience**: *Interview participants agreed that adoption and use of MyPAIN were successful, and users found the experience to be positive.* In contrast, adoption of PainManager by clinicians was generally poor due to missing data and long load times.
- **Performance**: *There were limited data on execution time and only anecdotal information about total execution time of the system, but interviews and other reports indicated performance issues with PainManager.* Without a stabilization period and the flexibility to modify the applications, optimization and tuning were attempted in the FHIR façade. These marginally improved performance for PainManager but not enough to be noticeable to clinical users.
- **Effectiveness (in promoting SDM)**: *A majority of patients at specialty and primary care clinics reported feeling prepared for SDM at future visits (83% and 67%, respectively)*. This supported the notion that the CDS4CPM system facilitates the five steps of AHRQ's SHARE Approach for SDM.

Maintenance (RQ4)

- **Utilization and experience**: *Based on their experiences with MyPAIN and PainManager, both sites indicated that they would like to find a way to continue to use MyPAIN and would not continue using PainManager (due primarily to performance issues).* There were no clear plans to support either application beyond the pilot period. Working with MyPAIN and PainManager as production-ready tools will require support for their ongoing development. Scoping maintenance for the system is somewhat dependent on adoption (to what extent are users accessing the tools) and use (to what extent does use require support or expansion) and is associated with issues of stewardship and sustainability.
- **Effectiveness (in promoting SDM)**: *Clinicians were motivated and spent time trying to access patient data submitted via MyPAIN, but that alone does not constitute an SDM session.* Perceived value is still a key component of sustainability, and the value of the patient-reported outcomes delivered via MyPAIN appeared to be strong based on this work, but the performance issues with PainManager will make ongoing stewardship and sustainability more challenging until these issues are addressed.

Discussion

Table ES-1 synthesizes results and maps them to their CFIR constructs, relevant informatics themes, and implications beyond the project.

Table ES.1 Results Mapped to Implications

CFIR Construct	RQ	Result	Informatics Theme	Implication
Adaptability	1	Only parts of the system were fully tested prior to reaching pilot.	*Testing, training, and support*	Complex CDS interventions rely on adequate data availability. A pre-implementation assessment of likely data availability can pave the way for success.
Adoption	3	Pain clinicians involved in the project provided important insights into and examples of the most essential information to support SDM for chronic pain management.	*User-centered design*	Focusing on a single key driver of adoption, in this case, collecting patient-reported data, and working with clinicians and patients to develop a design around that driver can optimize adoption.
Effectiveness (in Promoting SDM)	3	Patients indicated satisfaction with using MyPAIN to prepare for their SDM encounter. However, this measure is just an early process measure of SDM.	*Data capture, quality, and integration*	Provide adequate time and resources (including subject matter expert input and patient engagement) to determine how to leverage prior work to maximize outcome measures.
Effectiveness (in Promoting SDM)	4	Several investigators mentioned that the project was very ambitious and that the proposed intervention brought too many novel tools and approaches together to be able to be successful and sustainable after just one pilot project.	*Sustainability*	It is critical that, from the proposal stage to the end of the project, the project team maintains focus on the key goal(s) of the intervention. Remember that starting simple and expanding from there is often directly tied to better sustainability.
Feasibility	1	Alignment with practice workflow increased acceptance and positive evaluation.	*Workflow and readiness to implement*	Prior to any CDS implementation, an assessment should be done to include local needs, proprietary solutions in place, available data standards, EHR environment, and system capability.

CFIR Construct	RQ	Result	Informatics Theme	Implication
Feasibility	2	Clinicians reported that alerts to access PainManager and MyPAIN data were helpful and could be made more effective.	*CDS Five Rights*	Planning for monitoring tools (reports on use, performance data, etc.) to help guide adjustments during a stabilization period can be crucial to finding the right balance to foster adoption.
Fidelity	1	Pain specialists and general practice clinicians alike valued robust, accurate MME/day data.	*Data capture, quality, and integration*	A calculated value for total MME/day can be effectively incorporated using FHIR.
Fidelity	3	Both sites reported that being in a similar place with their EHR system rollout and their overall technical infrastructure made it possible to independently develop components of the system, then share those with each other.	*Technical capacity and environment*	From the data element crosswalk to the EHR system release package, determining where overlaps exist (or do not) can provide for a more efficient implementation.
Generalizability	1	The CDS4CPM system included a FHIR façade to leverage standards-based and nonstandards-based services.	*Data capture, quality, and integration*	Incorporating a FHIR façade into the system architecture provides a bridge between FHIR and site-specific EHRs while maintaining standards-based interoperability.
Implementation Strategies	2	Each site reported leveraging implementation strategies suited to their individual environments.	*Testing, training, and support*	Leveraging implementation strategies can help prepare sites for rollout in the early stages of development. Tracking these strategies can also provide key insights for the evaluation.
Patient-centeredness	1	Based on patient downloads and use of MyPAIN, the app seemed favorable, but without the ability to directly contact patients about their experience with the use of this tool, this finding remains an assumption.	*User-centered design*	Tailored patient educational materials are effective at driving use. Clinicians are inclined to use the system if MyPAIN data is present and patients are inclined to use the system if their clinician recommends it.

CFIR Construct	RQ	Result	Informatics Theme	Implication
Performance	3	Configuration settings for MME/day conversion factors, batch processing of FHIR data, and tuning of FHIR requests and responses were site-specific solutions that were implemented along the development path.	*Data capture, quality, and integration*	Site-specific configuration, optimization, and tuning may be needed in a variety of places within the system. Detail these possible pain points as soon as possible and investigate options for addressing them.
Policy	2	Many project team members reflected that executing on this work even just a year prior would have been more difficult without changes brought about by existing standards and to some degree the advent of the Cures Act Final Rule and USCDI.	*Technical capacity and environment*	Policy drivers can have a real impact on change, although this must be complemented with the bandwidth (e.g., talent, time, funding) to lead that change. Champions who can secure and protect these resources are crucial.
Shareability	1	Clinicians reported that integrated PDMP data were critical to assisting them with decreasing overprescribing.	*Data capture, quality, and integration*	Making reconciled PDMP data interoperable using a FHIR interface is feasible and effective.
Social	2	All project team members reported issues due to the COVID-19 pandemic.	*Technical capacity and environment*	Although it may not be possible to plan for something like a global pandemic, consider the everyday stressors on the implementation environment and plan to provide some redundancy/backup for key actors in the system. Even planning for time off can help.
Stewardship	2	Project staff recognized differences in IT capacity at the two sites and worked to distribute leadership across the team.	*Technical capacity and environment*	Consider existing IT capacity and strategically balance between optimizing and developing that capacity. Although it may always seem ideal to develop capacity across project team members, it rarely is feasible given time and funding constraints.

CFIR Construct	RQ	Result	Informatics Theme	Implication
Structural Characteristics	2	Site administrators indicated that building technical capacity was a key motivating factor in site adoption; however, this must be balanced with clinical motivation for adoption.	*Technical capacity and environment*	Determine how to best balance technical and clinical readiness to support workflow changes. Timing is often key (e.g., talk about evaluation plans early, yet work on data collection testing as soon as test data is available).
Team Characteristics	1	One site was more experienced with containerized solutions, FHIR development, and the co-design process.	*Technical capacity and environment*	Multiple complementary skill sets are necessary for development of CDS. Working with an experienced CQL developer can be critical to successful CDS integration.
Team Characteristics	1	The project team noted that at the outset, it was often difficult to find the right technical or clinical liaison to help with design considerations.	*Technical capacity and environment*	The entire technical team should be established well in advance of the development process and may include clinician champions as well as varied IT staff, such as implementors and integrators.
Team Characteristics	2	Several team members mentioned team dynamics being a pivotal factor and highlighted how smaller subgroups focused on specific issues could feed into the larger team conversations more effectively.	*Testing, training, and support*	Maybe even more crucial with distributed teams working exclusively remotely (per the COVID-19 shelter period), proactively managing team, subteam, and collaboration environment dynamics can influence project success.
Usage	1	Clinicians indicate that SDM is valued, but little support exists to help document the results of SDM for a visit.	*Workflow and readiness to implement*	Our system provided an EHR-based option for a clinician to generate a specific note regarding an SDM session at the end of a patient's visit. However, this is not required. Moving forward, a service such as CDS Hooks may provide a robust way to capture the results of SDM.

CFIR Construct	RQ	Result	Informatics Theme	Implication
Usage	3	Early reports during pilot of issues with PainManager performance led to a preliminary evaluation of performance times and highlighted the need to incorporate more robust operational performance data.	*Testing, training, and support*	Consider utilization of simple, robust analytics packages (e.g., Google Analytics) to provide insights into performance issues throughout the testing process.
Utilization and Experience	3	One unanticipated technical challenge that affected adoption was the overall performance of PainManager in the EHR browser, which necessitated a rebuild of the core application and exacerbated issues with performance.	*User-centered design*	Consider within-system dependencies and limitations when designing what is effectively an embedded solution. Determine early what the challenges might be and how to overcome them.
Utilization and Experience	4	The team discussed issues of sustainability and stewardship throughout the project, and some of the decisions made along the way were impacted by and would impact sustainability.	*Sustainability*	Consider the end state for the intervention at the outset, what should happen with the intervention beyond the pilot period, and how will that be supported. Note that this really goes beyond just issues of funding.

Conclusions

This project demonstrated the feasibility and challenges of developing and implementing a complex shareable CDS program for pain management. Working together, the project team was able to successfully design, develop, implement, and evaluate the CDS4CPM system. Clinicians in the pilot valued the availability of patient-reported information so much that it was a key driver of adoption.

Ongoing support for SDM can be more effectively leveraged by engaging with patient populations in the design phases. Similar to other studies on CDS implementation, long-term sustainability of CDS programs is contingent on smooth integration into existing clinical workflows. Consequently, developing seamless data integration between CDS tools and the variety of existing EHR environments will be critical to sustainable use.

A longer-term goal for CDS, especially standards-based CDS, is to be essentially "plug and play," but this goal is rarely feasible, and some codevelopment by onsite teams is essential. To the degree that the existing standards themselves are not optimal for CDS implementation, implementers need to learn and share information about what is and is not working so that the standards can be furthered or adapted.

The generalizability of these findings is partially dependent on the implementation context as outlined in the Limitations section.

Limitations

Although this project was designed to explore the possibility of implementing at more than one site and was largely successful in doing so, both sites were well-resourced academic medical centers with prior experience with research or quality improvement projects and novel technologies. Both sites had ready access to many clinics, specialty and general practices, and patients with significant exposure to the patient portal. While generalizing to similar environments would likely be successful, working in other patient care contexts may be associated with other challenges.

This work focused on implementing in a single EHR developer system, yet the U.S. healthcare environment has dozens of EHR systems in use regularly. Although the experiences outlined here probably give a good indication of what will be encountered when implementing in any EHR, each new EHR developer environment will have its own challenges and surprises.

Future Research

Based on lessons learned from this project, several precursors to and avenues for additional research were identified:

- **Expansion of USCDI**: Assess the degree to which USCDI has facilitated access to the necessary FHIR resources of interest. If USCDI did not facilitate access, consider whether expanding USCDI support for those FHIR resources is appropriate. Or, if the standard does not adequately provide the critical information needed for implementation, address those gaps with the relevant standards community.
- **Measuring patient engagement**: Engage patients to build trust between patients and clinicians and foster use of the CDS4CPM system. Building and maintaining trust between patients and clinicians should be a priority in all stages. This can be done by measuring and communicating the impact of the CDS4CPM system on perceived value for clinicians and care quality for patients over time.
- **Implementation and evaluation expansion**: Additional research on implementation of CDS4CPM in the following areas would help to advance the shareability and re-use of CDS:
  - **Scaling the system**: Scale this work beyond the two sites to a statewide system and/or to a Federal healthcare delivery system. Expanding into other types of clinical environments such as federally qualified health centers and into other EHR system environments would also be important.
  - **Expanding the system**: Expand the delivery of the CDS intervention by optimizing performance (e.g., launching in a modern external browser), supporting non-English speakers, and improving the integration into workflow.
  - **Evaluating with a randomized controlled trial (RCT)**: Investigate the effectiveness of this shareable CDS intervention through an RCT study design, which would improve the generalizability of the findings and represent a more robust assessment of impact.
  - **Integrating with other solutions**: Explore the impact with patients and providers on SDM by combining this chronic pain intervention with one that focuses on multiple chronic conditions.
  - **Tracking long-term measures or outcomes**: Explore outcomes and impacts of CDS that may not be apparent within the time period of the implementation and/or investigate the impacts of different implementation strategies. Issues of adoption and use are short-term measures that are relatively easy to capture for CDS interventions, but measures that may take months or years to collect, such as patient outcomes, tend to be more difficult to track and measure.
  - **Investigating sustainability**: Further investigate issues of maintenance, stewardship, and sustainability to help establish a clearer trajectory for the support and use of these tools.

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Glossary

Following is a list of key terms and their definitions applicable to this report. Some terms include references to online resources with more information; links to these online resources can be found in the References section.

Application (app): a program or group of programs designed for end users, typically software that a user downloads, installs, and manages

CDS Connect: a freely available web-based platform sponsored by AHRQ that enables the clinical decision support (CDS) community to identify evidence-based care, translate and codify information into an interoperable health IT standard, and leverage tooling to promote a collaborative model of CDS development

CDS4CPM: the acronym used to describe the solution that combines a patient-facing application (MyPAIN) with a clinician-facing application (PainManager) to utilize CDS to encourage and support shared decision making around chronic pain management

Clinical decision support (CDS): provides clinicians, staff, patients, and other individuals with knowledge and person-specific information, intelligently filtered or presented at appropriate times, to enhance health and healthcare[1]

Clinical quality language (CQL): a high-level, domain-specific language focused on clinical quality and targeted at measure and decision support artifact authors[2]

Code: as part of the C4 model[3] for visualizing software architecture, items that comprise a component

Component: as part of the C4 model[3] for visualizing software architecture, elements of an individual container in the given project scope

Container: as part of the C4 model[3] for visualizing software architecture, high-level building blocks of the software system in the given project scope

Epic™: an electronic health record developer and system

Fast Healthcare Interoperability Resources (FHIR): a standard for exchanging healthcare information electronically[4]

Fast Healthcare Interoperability Resources (FHIR) façade: an architectural pattern for implementing FHIR capabilities in a standards-compliant way, in the absence of that support from existing or installed EHR systems; can also be described as a switchboard, wrapper, or similar, intended to supply the necessary FHIR responses to support a FHIR application; works with site-specific adapters to achieve this support

Glossary (continued)

Feature: a set of related requirements that allow the user to satisfy a business objective or need

Function: specification of behavior between outputs and inputs

Health Level Seven International (HL7): a nonprofit, ANSI-accredited standards-developing organization founded in 1987, dedicated to providing a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery, and evaluation of health services[5]

MyPAIN: a patient-facing shareable interoperable CDS Substitutable Medical Applications, Reusable Technologies (SMART) on FHIR application to support shared decision making around chronic pain management

PainManager: a clinician-facing shareable interoperable CDS SMART on FHIR application to support shared decision making around chronic pain management

Pilot period: the time during which the applications are available within live clinic workflows and data are collected to track applications' use

Requirement: a condition or capability needed by a user to solve a problem or achieve an objective

Service: centrally managed software that provides some logic or functionality to end users, which a user accesses (via application programming interface, website, etc.)

Shareability: the extent to which anything might be made ready for sharing; for this document, application artifacts and supporting materials such as implementation guides and lessons learned are made available to other organizations interested in implementing the application in different settings; this can be accomplished by posting to a repository that explicitly allows and/or supports sharing

[Software] system: a series of components working together to deliver services

Shared decision making (SDM): a model of patient-centered care that enables and encourages people to play a role in the medical decisions that affect their health

Stewardship: the job of supervising or taking care of something, such as an organization or property

Glossary (continued)

Substitutable Medical Applications, Reusable Technologies (SMART): an open, standards-based[6] technology platform that enables innovators to create apps that seamlessly and securely run across the healthcare system; originally developed in 2010 and now an HL7 standard

United States Core Data for Interoperability (USCDI): a standardized set of health data classes and constituent data elements for nationwide, interoperable health information exchange[7]

Version: a unique state of computer software

Acronyms and Abbreviations

AHRQ: Agency for Healthcare Research and Quality

CDS: clinical decision support

CDS4CPM: Clinical Decision Support for Chronic Pain Management

CFIR-PR: Consolidated Framework for Implementation Research—Process Redesign

COVID-19: coronavirus disease 2019

CQL: Clinical Quality Language

EHR: electronic health record

FHIR: Fast Healthcare Interoperability Resources

HL7: Health Level Seven

MME/day: morphine milligram equivalent per day[8] (sometimes referred to as morphine equivalent daily dose [MEDD])

MyPAIN: My Pain Assessment and Information Needs

PDMP: prescription drug monitoring program

PRO: patient-reported outcome

PROMIS: Patient-Reported Outcomes Measurement Information System

RQ: research question

SDM: shared decision making

SMART: Substitutable Medical Applications, Reusable Technologies

UCM: University of Chicago Medicine

USCDI: United States Core Data for Interoperability

VUMC: Vanderbilt University Medical Centr