

Implementation Guide

Factors to Consider in Managing Chronic Pain: A Pain Management Summary

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Introduction

The Agency for Healthcare Research and Quality (AHRQ) has elected to sponsor a project to help generate a systematic and replicable process for transforming patient-centered outcomes research (PCOR) findings into shareable and standards-based clinical decision support (CDS) artifacts. A CDS artifact is the template for defining how decision support is provided for a given clinical situation, often including triggers, logic, operations, recommendations and actions, and supporting evidence. A main outcome of this project is an online Repository for storing and accessing CDS artifacts. It is hoped that this publicly available Repository promotes the usage of CDS in everyday clinical settings, and that it serves as the linchpin for connecting high-quality CDS to the United States healthcare community.

Background

The purpose of the CDS Connect Repository is to store and provide access to CDS artifacts, including text and computable versions of the decision logic; suggested trigger events; text recommendations and suggested actions; pilot and implementation details; lessons learned during development, integration, and clinical use; and metadata, including original evidence links, decisions made in creating the artifact, sponsoring clinical organizations, and keywords. It is envisioned that the Repository will also become a home for artifact-related user feedback and experience data. The CDS Connect Repository enables users to search easily for desired artifacts, to explore their contents, and to facilitate their transfer into and use in electronic health records (EHRs), CDS services, and other technology tools. The provenance and sponsorship of any artifact is visible and searchable in the Repository.

The concept of a CDS repository was introduced in the Department of Health and Human Services (HHS)-sponsored Roadmap for National Action on Clinical Decision Support¹ (2006). Subsequent efforts, including the CDS Consortium (2008), Advancing CDS contract (2010), National Quality Forum CDS Expert Panel (2011), Health eDecisions (2012), and the National Academy of Medicine Optimizing Strategies for CDS project, among others, have advanced the concept of shared CDS. The CDS Connect project advances the goal of shareable CDS by establishing an actual public repository of CDS that can be contributed to and consumed by many stakeholders.

Additional feature development work projected for the Repository includes:

- enhancing application programming interfaces (APIs) that facilitate the upload of artifacts in varied formats
- providing several options for displaying and using repository information
- allowing users to subscribe to artifact updates
- allowing users to review and rate artifacts in the Repository and provide usage data

- providing artifact download tracking (for notification of updates, deprecated artifacts, etc.)

These features will enhance the quality, validity, and value of the Repository, and create a climate of mutual ownership of artifacts across the CDS and Electronic Healthcare Record (EHR) user community.

Audience, Purpose, and Scope of This Implementation Guide

This document is intended to provide information about the development, implementation, and routine operation of the “Factors to Consider in Managing Chronic Pain: A Pain Management Summary” (“Pain Management Summary”) artifact. The information provided by the artifact is presented to the clinician as a Pain Management Summary dashboard, implemented as a Substitutable Medical Applications, Reusable Technologies (SMART) on Fast Healthcare Interoperability Resources (FHIR) application. Additional information on the SMART on FHIR application and integration with the EHR is described in this document in the section “Integration with the EHR, as well as in the *CDS Connect Pilot Final Report*.

Various audiences may find this information helpful, including:

1. **Clinicians and Quality Leaders** at healthcare organizations and practices who wish to implement, test, and execute CDS related to this topic in their EHRs or other health information tools
2. **Patients and Family Caregivers** who are interested in the process of CDS development and implementation for shared decision making in this topic and in general
3. **CDS Developers and Informaticists** who may have suggestions, additions, or seek to add CDS artifacts on similar topics, or who want to make use of well-developed structured logic and clinical quality language (CQL) in their own work
4. **Organizations or Individuals** interested in developing their own CDS artifacts, who may find this document helpful as a resource for the process by which clinical guidelines are translated into mature CQL artifacts

Implementing and Using This Artifact

Description and Purpose of the Artifact

This artifact provides relevant information to consider when managing a patient’s pain to inform the care decision-making process. The information is presented to the clinician as a Pain Management Summary dashboard that provides a variety of key “factors” for clinicians to

consider when assessing the history of a patient’s chronic pain. The key factors include subjective and objective findings, along with recorded treatments and interventions to support shared decision making on treatment moving forward.

Summary of the Clinical Statement

Although inspired by the Centers for Disease Control and Prevention (CDC) *Guideline for Prescribing Opioids for Chronic Pain*¹, this artifact is not directly derived from any one recommendation statement. Instead, it is meant to complement several recommendation statements within the CDC guideline by providing a consolidated view of the patient’s pain experience and the management of their condition. Ultimately, the populated pain management summary is intended to promote discussion between the patient and the provider regarding the effectiveness of existing treatments, and the benefits and risks of future interventions while considering the use of non-opioid and/or non-pharmacologic treatment when possible.

For contextual awareness, examples of CDC recommendations that the summary data indirectly support include the following:

- **Recommendation #3:** Before starting, and periodically during opioid therapy, clinicians should discuss with patients known risks and realistic benefits of opioid therapy and patient and clinician responsibilities for managing therapy (recommendation category: A, evidence type: 3).
- **Recommendation #8:** Before starting, and periodically during continuation of opioid therapy, clinicians should evaluate risk factors for opioid-related harms. Clinicians should incorporate into the management plan strategies to mitigate risk, including considering offering naloxone when factors that increase risk for opioid overdose, such as history of overdose, history of substance use disorder, higher opioid dosages (greater than or equal to \geq 50 morphine milligram equivalents [MME]/day), or concurrent benzodiazepine use, are present.
- **Recommendation #10:** When prescribing opioids for chronic pain, clinicians should use urine drug testing before starting opioid therapy and consider urine drug testing at least annually to assess for prescribed medications as well as other controlled prescription drugs and illicit drugs.
- **Recommendation #11:** Clinicians should avoid prescribing opioid pain medication and benzodiazepines concurrently whenever possible.²

Primary Use Cases

In the primary use cases, the artifact is intended for use by clinicians delivering care in an outpatient setting. The clinical use cases are particularly relevant to clinicians specializing in primary care, family medicine, internal medicine, geriatrics, and/or pain management.

The artifact presents a patient-specific Pain Management Summary, supplied as a dashboard displaying clinical concepts that a clinician might consider before making a treatment decision regarding chronic pain. (Note that the specific method used to trigger the display of the Pain Management Summary is dependent on local implementation decisions. Refer to the section on “Integration With the EHR.”) Typical scenarios include:

1. When deciding whether to initiate, continue, modify, or discontinue non-opioid pharmacologic treatment for chronic pain.

Dr. Alpha is currently reviewing the record of Ms. Bravo, a scheduled patient with a history of chronic hip pain. Dr. Alpha reviews the Pain Management Summary for Ms. Bravo. He compares Ms. Bravo’s medication history, self-reported pain levels, and functional status, noting that while her condition initially improved on a low dose of a non-opioid medication, her improvement has since plateaued. Dr. Alpha decides to recommend increasing the dose of the non-opioid pain medication to attempt to achieve further improvements in functional status.

2. When deciding whether to initiate, continue, modify, or discontinue non-pharmacologic treatment for chronic pain.

Dr. Charlie is currently reviewing the record of Mr. Delta, a scheduled patient with a complaint of low back pain. Dr. Charlie reviews the Pain Management Summary for Mr. Delta. He reviews Mr. Delta’s self-reported pain levels and functional status, noting that his pain functional status has been unacceptably low, and his pain level remained elevated over the past 6 months. Dr. Charlie notes that no non-pharmacologic treatments have been ordered for Mr. Delta in the past 6 months. Dr. Charlie decides to recommend physical therapy to Mr. Delta to help improve his functional status as well as acupuncture to reduce his level of pain.

3. When deciding whether to initiate, continue, modify, or discontinue opioid pharmacologic treatment for chronic pain.

Dr. Alpha is currently reviewing the record of Ms. Echo, a scheduled patient with a history of chronic pain with opioid therapy. Dr. Alpha reviews the Pain Management Summary for Ms. Echo. He reviews Ms. Echo’s opioid risk assessments since inception of opioid therapy, noting that she was initially judged low risk for opioid abuse or diversion. Ms. Echo’s subsequent risk assessments show no elevated risk factors for opioid misuse or abuse. Dr. Alpha reviews her urine drug screening results for the past 6 months, noting no aberrant findings; however, the most recent result suggests use of the opioid Ms. Echo was prescribed at this office in addition to another opioid that she was not prescribed at this office. Dr. Alpha then decides to review the local Prescription Drug Monitoring Program (PDMP) database externally to determine whether Ms. Echo received prescriptions for this or other medications of concern from another medical professional. Dr. Alpha further discusses with Ms. Echo to assess whether her use of an

additional opioid is related to misuse, pseudo addiction, diversion, or other underlying conditions, to help him determine whether opioid therapy should be continued or tapered.

Additional Use Cases

Additional use cases make use of the decision logic or Pain Management Summary, but may require adjustments for a different workflow, type of user, or mode of operation. Additional use cases for this artifact could include:

1. Identification of care gaps:

Dr. Charlie's practice is running a quarterly quality screen to evaluate the care of patients with chronic pain. The CDS inclusion logic for this artifact is run as a report for all patients in the practice to identify all patients with known or suspected chronic pain or recent opioid medication or adjuvant analgesic recorded. The CDS logic is extended and run as a modified report to determine what care gaps exist (e.g., overdue for Urine Drug Screening, no non-pharmacologic therapies ordered). Recommendations appropriate to a given patient could display on each patient's individual To-Do list, as a message or alert to the responsible provider, or compiled into an overall report that is reviewed by the provider or other care management staff in the practice.

2. Identification of patient safety issues:

Dr. Alpha's practice is running a quarterly quality screen to identify patients with potential safety issues. The CDS inclusion logic is run as a report for all patients in the practice, to identify all patients with known or suspected chronic pain or recent opioid medication or adjuvant analgesic recorded. The CDS logic of this artifact could be extended and run as a modified report to determine what red flags (e.g., exceeds total recommended dose of opioids) exist. Recommendations appropriate to a given patient could display on each patient's individual To-Do list, as a message or alert to the responsible provider, or compiled into an overall report that is reviewed by the provider or other care management staff in the practice.

Recommendations and Suggested Actions

The populated pain management summary intervention provided by this CDS artifact can be found in detail under **“Intervention(s) and Action(s)” in the Semi-Structured Representation section of the artifact**. The structured representation of this artifact supports the following:

1. Indicate whether the patient is within the inclusion criteria (greater than [$>$] or equal to [$=$] 18 years of age AND [a condition associated with chronic pain OR one or more opioid medications order or recorded within the past 180 days OR one or more adjuvant analgesic medications ordered or recorded within the past 180 days]).

2. Display the heading “Pertinent Medical History” and populate it with the following items:
 - a. Patient’s conditions associated with chronic pain including the status, start date, stop date, and recorded date.
3. Patient’s risk factors for opioid-related harms including the name, status, start date, stop date, and recorded date. If the identified risk factor is provided through the visit information, the name of the risk factor and visit date are included.
4. Display the heading “Pain Assessments” and populate it with the following items:
 - a. Patient’s pain assessment data including the score and date of the assessment. (Note that the assessment tools expressed in this artifact are specific to the tools implemented in the pilot organization’s EHR (e.g., Wong-Baker FACES Rating Scale; Pain intensity, Enjoyment of life, General activity (PEG) Pain Scale; Keele STarT Back Screening Tool. See the Decision Log in Appendix A for additional information on this approach.)
5. Display the heading “Historical Pain-Related Treatments” and populate it with the following items:
 - a. Any treatments found in the patient’s record related to opioid or non-opioid pain medications ordered or recorded within the last 2 years, including the name, type (statement or order), start, and end dates.
 - b. Non-pharmacologic treatments ordered or referrals made for the patient within the last 2 years, including the name, type (procedure, procedure request, or referral), and date.
 - c. Stool softeners and laxatives ordered or recorded for the patient within the last 6 months, including the name, type (statement or order), start, and end dates.
6. Display the heading “Risk Considerations” and populate it with the following items:
 - a. Patient’s most recent opioid MME (if available and calculated externally to the CDS artifact).
 - b. Patient’s urine drug screening dates and results within the last year, including the name, result, interpretation (if available), and date.
 - c. Benzodiazepine medications ordered or recorded for the patient within the last 2 years, including the name, type (statement or order), start and end dates.
 - d. Naloxone medications ordered or recorded for the patient (ever)
 - e. Patient’s risk screenings that are relevant to pain management with their overall scores and dates for the past year.
7. Suggested Action: Discuss the information displayed on the Pain Management Summary with the patient, including the patient’s pain management goal and potential interventions and treatments.

8. Suggested Action: Document the patient’s pain management goal and the outcome of the shared decision-making discussion.
9. Suggested Action: Determine next follow-up appointment.

Guideline Interpretation and Clinical Decisions

It is often necessary to interpret or adjust clinical guidelines to make them suitable for computation. Although inspired by the CDC *Opioid Guideline for Prescribing Opioids for Chronic Pain*, this artifact is not directly derived from any one recommendation statement. Instead, it is meant to complement several recommendation statements within the guideline by providing a consolidated view of the patient’s pain experience and the management of their condition. Ultimately, the populated pain management summary is intended to promote discussion between the patient and the provider regarding the effectiveness of existing treatments and the benefits and risks of future interventions, while considering the use of non-opioid and/or non-pharmacologic treatment when possible.

Throughout the development of this artifact, numerous decisions were made regarding the structured artifact representation, as well as integration with the pilot site EHR. Decisions outlined in Appendix A explain, in detail, how source content informed development and how representations were defined during artifact creation. Some of the key interpretations and decisions include:

1. The artifact was developed to align with the CDC guideline’s intended population (i.e., the guidelines are intended for individuals 18 years of age or older with chronic pain, excluding patients in active cancer treatment, palliative care, and end-of-life care). Future implementers may choose to adjust the inclusion criteria to support a broader population of patients. For example, patients younger than 18 may be considered, or patients with any kind of pain.
2. The CDC exclusion criteria (active cancer treatment, palliative care, and end-of-life care) was not encoded in this artifact, primarily because of the lack of structured electronic data in a primary care setting to accurately determine if the patient is undergoing end-of-life or palliative care, or cancer treatment. To ensure clinicians were aware of the CDC exclusion guidelines during the pilot implementation of this artifact, a notification displays at the top of the Pain Management Summary dashboard in the SMART on FHIR application to alert them to this exclusion.
3. The Pain Management Summary CQL retrieves relevant information to consider when managing a patient’s pain. A Web-based SMART on FHIR application invokes the CQL and displays the results to the clinician as a Pain Management Summary dashboard. The SMART on FHIR application enables the provision of alerts and/or notifications reinforcing specific CDC guidelines, along with potential contraindications or patient safety warnings related to the data that is displayed.

4. The specific method used to trigger the Pain Management Summary CDS and present the SMART on FHIR application is dependent on EHR integration options and subsequent implementation decisions made at each site. For the initial pilot site, the Pain Management CDS is triggered when a clinician clicks on a “Pain Summary Information” link found within a specific patient record in the EHR. Additional information on the pilot integration of the Pain Management Summary is described in the CDS Connect *Pilot Final Report*.

Information for Clinicians When Using the CDS

This section is directed toward clinicians who use the CDS while providing patient care. The information provides context on aspects of patient-centered care and shared decision making related to pain management. Additional references and perspectives are also discussed regarding the most effective use of the Pain Management Summary to facilitate shared decision making and engage the patient via the CDS.

Pain Management

Successful treatment of chronic pain requires consideration of the patient’s previous medical care, biology and genetics, individual behavior, physical environment, and social circumstances. The scope and complexity of data needed by the care team (patient, caregivers, and clinicians) to relieve pain and improve health and wellness are staggering. Relevant data can be fragmented and difficult to find, share, and interpret. Though not all-encompassing, the Pain Management Summary CDS artifact compiles and displays available and relevant information for the care team to use when treating and managing pain. This information informs the care team while they determine the most appropriate actions and plan of care. Hence, the key to success is holistic, comprehensive, patient-centered care.

The following information provides background material on patient-centered care and shared decision making. Both concepts are crucial to effective pain management. The final sections provide information on use of the CDS to provide patient-centered care and other areas of consideration related to patient-centered chronic pain management.

Patient-Centered Care

In patient-centered care, the patient and their clinicians partner to plan and manage the patient’s treatment and care. This includes identifying expectations, setting goals to treat medical problems and reach best health, finding service providers, collaborating with others to develop a plan to meet the goals and expectations, and learning what works and doesn’t work. Planning and managing also includes tracking status and progress across time and settings, and considering the financial impact of treatment and service. Planning and managing often includes a care partner.

Patient-centered care compels the clinician and health care team to understand the patient behind the symptoms and interact in a way that affirms the patient’s vitality and attends to the stresses and life circumstances of the patient.

Patient-centered clinical decision support informs and facilitates care for *specific* patients and their caregivers/care teams. Thus, it includes knowledge (evidence-based research); data (patient-generated health data, patient-reported outcomes and preferences, and/or patient-specific social/environmental/genetic/cultural factors as they affect individual patient health); and tools for patient (and/or caregiver) involvement in informed decision making.³ It supports holistic care of the patient and the concept of “slow medicine,” one that deviates from the “fast” healthcare model of today to that of recognizing the great value of taking time to listen to patients, and working to create a structure in which this can be supported.⁴

Facilitating Shared Decision Making

Shared decision making is one component of patient-centered care. It allows an individual and their healthcare provider together to determine the most appropriate treatment or care choices.⁵ When implemented effectively, CDS can facilitate this objective.

CDS and decision aids can be used before, during, or after a clinical encounter to enable patients to become active, informed participants.⁶ Success depends on establishing a trusting relationship, so that information is shared, and patients are supported to express their preferences and views and participate in the decision-making process.

Elwyn, et al., propose a model of how to employ shared decision making. The model has three steps: 1) introducing choice; 2) describing options, often by integrating the use of patient decision support; and 3) helping patients explore preferences and make decisions. This model rests on supporting a process of deliberation and on understanding that decisions should be influenced by exploring and respecting what matters most to patients as individuals, and that this exploration in turn depends on them developing informed preferences.⁷

Use of Summaries to Facilitate Care

Treating patients with pain, especially chronic pain, is extremely complex. Treatment requires the consideration of multiple factors, such as psychiatric comorbidity (e.g., depression, suicide), a variety of pharmacological treatments for chronic pain (opioids as well as non-opioid medications), and non-pharmacological treatments proven to be effective such as yoga, acupuncture and meditation.^{8,9} The National Pain Strategy (2016) highlights the importance of improving “physician education on pain management practices and team-based care in which multiple treatment options are offered—moving away from an opioid-centric treatment paradigm.”¹⁰ The *CDC Guideline for Prescribing Opioids for Chronic Pain* clearly highlights the importance of nonpharmacologic therapy and nonopioid pharmacologic therapy for the

treatment of pain, as well as additional complex factors to consider, such as the MMEs currently prescribed for the patient and risk factors for opioid therapy.

The challenge for clinicians is to appropriately collect, distill, and interpret patient information, critical to the clinical decision-making process, from a variety of sources and formats while separating important clues from background noise.¹¹ The way the information is structured and presented to clinicians can profoundly influence their decision making. An accurate, well-designed and context-specific pain management summary can potentially save time, improve clinical accuracy, and reduce potential errors in both outpatient and inpatient care.¹² The complexities of pain management require bringing together all the items that should be addressed into one comprehensive summary format to systematically address each factor.

Studies have evaluated the effectiveness of a summary and determined these summaries are a valuable resource to clinicians. The summaries facilitate enhanced communication, have low implementation costs, and significantly improve physician performance in certain diseases, such as disease management for diabetes.¹³

This pain management summary combines key subjective and objective factors in pain management, including pertinent medical history, pain assessments, historical treatments, and risk factors and assessments to create a comprehensive view of key data for facilitated patient and clinician decision making.

Providing Patient-Centered Care Using the Pain Management Summary CDS

The Pain Management Summary CDS presents a variety of key factors for patients and clinicians to consider when assessing the history of a patient's chronic pain and determining the next step in care. Although presented to the clinician via a link in the EHR during the MITRE pilot of this work, the summary data provide valuable information to share with patients, too.

Of note, patients will likely need some orientation to the summary and why each component is relevant. Each individual patient is unique in their readiness, interest, and ability to process the information in the summary; one standard approach on how to introduce the information is not advised. Likewise, a multitude of factors impact how a clinician receives information in the pain management summary and how they engage patients with the information. Patients, caregivers, and clinicians use clinical decision support evidence and tools in context of the patient's changing life and health circumstances, clinician experience, and community standards. Consider the factors below when using this CDS summary:

1. History of injury and/or disease leading to pain (including acute, genetic, chronic conditions).
2. Determinants of health impacting the patient: personal characteristics and behavior, their physical environment, and social and economic circumstances.

3. Resources available to the patient for assistance and support (e.g., availability of family or caregivers, the cost of care).
4. Effectiveness of previous pain treatments (medical and non-medical, medication and non-medication).
5. History of functional status changes (baseline pre-disease/injury through recent past).
6. Patient preferences and attitudes toward pain management.
7. Settings used for pain management (e.g., home, street, clinics, emergency departments (EDs), hospitals, pharmacies).
8. Degree of life disruption for clinician, patient, and caregivers caused by pain and pain management.
9. Clinician experience and training in pain management.
10. Community/agency standards for pain management.

Opportunities to address some of these dynamics include educating clinicians and patients to take a holistic approach to managing care; facilitating clinician-provider interaction outside of visits; developing more collaborative, trusting relationships; building electronic tools for tracking assessments, comments, and communication; authorizing personal information sharing across settings and time; and designing clinic workflow and reimbursement so patients and their clinicians have sufficient time together to make informed decisions.

With additional development, this CDS might further foster patient-centered care by providing access to the information via a patient portal, allowing the patient or clinician to edit entries, integrating commonly used pain and risk assessments with the tool, along with the capability to query and display information from a patient’s pain journal.

Artifact Manifest

The “Factors to Consider in Managing Chronic Pain: A Pain Management Summary” artifact is comprised of six distinct files listed in Table 1 (below).

Table 1. Artifact manifest

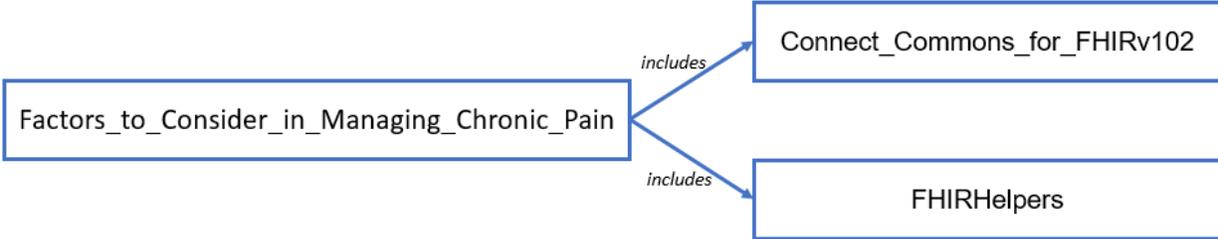
Filename	Purpose	Author(s)
Factors_to_Consider_in_Managing_Chronic_Pain.cql	CQL representation of “Factors to Consider in Managing Chronic Pain: A Pain Management Summary,” specifying the necessary logic to query and return structured summary information pertaining to the relevant factors a clinician may consider when managing a patient’s pain	Chris Moesel, David Winters, Sharon Sebastian

Filename	Purpose	Author(s)
Factors_to_Consider_in_Managing_Chronic_Pain.json	JavaScript Object Notation (JSON) representation of “Factors to Consider in Managing Chronic Pain: A Pain Management Summary,” specifying the necessary logic to query and return structured summary information pertaining to the relevant factors a clinician may consider when managing a patient’s pain	Chris Moesel, David Winters, Sharon Sebastian
CDS_Connect_Commons_for_FHIRv102.cql	Common CQL functions that may be called by CDS Connect artifacts	Julia Afeltra, Chris Moesel, David Winters
CDS_Connect_Commons_for_FHIRv102.json	JSON representation of common CQL functions that may be called by CDS Connect artifacts	Julia Afeltra, Chris Moesel, David Winters
FHIRHelpers.cql	Common CQL functions used to convert CQL data elements to FHIR and back again ¹⁴	Bryn Rhodes
FHIRHelpers.json	JSON representation of common CQL functions used to convert CQL data elements to FHIR and back again	Bryn Rhodes

Artifact Relationship Diagram

Clinical Quality Language developers are encouraged to refactor commonly used functions into their own files. The diagram in Figure 1 shows the relationships between the files included in this artifact (as described above). In this case, the `Factors_to_Consider_in_Managing_Chronic_Pain` file includes several libraries. When implementing this artifact, please ensure that all files are present and the filenames have not been modified.

Figure 1. Artifact relationship diagram



Testing

The Pain Management Summary artifact was tested using an automated testing framework written in Node.js. This framework accepted test cases specified in YAML Ain't Markup

Language (YAML) files, executed the artifact against each test case, and reported the success or failure of each test case. Test cases were developed to investigate efficacy for basic expected functionality and to test the expected inclusion criteria and summary results. The entire set of test data resides in a zip file attached to the CDS artifact in the Repository. Implementers should review their organizational priorities and develop a similar testing framework (and test cases) prior to implementation in a production system.

Implementation Checklist

Boxwala, et al.³ developed a multi-layered knowledge representation framework for structuring guideline recommendations as they are transformed into CDS artifacts. The framework defines four “layers” of representation as depicted in Figure 2 and described here:

1. **Narrative** text created by a guideline or clinical quality measure (CQM) developer (e.g., the recommendation statement described as a sentence).
2. **Semi-structured** text that describes the recommendation logic for implementation as CDS, often created by clinical subject matter experts. It serves as a common understanding of the clinical intent as the artifact is translated into a fully structured format by software engineers.
3. **Structured** code that is interpretable by a computer and includes data elements, value sets, and coded logic.
4. **Executable** code that is interpretable by a CDS system at a local level. This code will vary for each site.

This artifact is a **structured** representation of medical knowledge that contains code files that represent the source content (e.g., recommendation statement).

Figure 2. CDS artifact maturity process



Prior to incorporating this artifact in a production setting, implementers should consider the following items:

- Analyze the purpose, clinical statement, and use case sections of this document to ensure that your organization understands and agrees with the intended goals of the clinical guideline on which this artifact is based.
- Review the “Guideline Interpretation and Clinical Decisions” section of this document (including the cited “Decision Log” in Appendix A) to ensure that your organization

understands and agrees with the decisions made during the process to convert the underlying clinical guideline to a structured, computable CDS artifact.

- Technical staff should read through each of the files in the artifact manifest to understand their respective purposes and how they can be successfully incorporated into a clinical information technology (IT) system. At the time of publication, many commercial off-the-shelf (COTS) EHR systems are unable to use CQL files natively and require a separate application to convert CQL code such that it can be used in those EHR systems. Implementers should work with vendors of their respective health IT products to understand their readiness to implement CQL code and any potential adverse impacts to existing functionality. In the pilot of this artifact, the CQL execution was embedded in a SMART on FHIR application, allowing for EHR integration via the standard SMART on FHIR Application Programming Interface (API). In other pilot settings, developers have worked around existing EHR limitations by implementing a Web service wrapper around a CQL execution engine. This is a non-trivial amount of work with two primary components:
 - A CQL execution engine with a Representational State Transfer (RESTful) Web service designed to accept requests for CQL execution and to respond with the calculated results
 - Modifications to the EHR system such that it will:
 - Trigger RESTful events to call the CQL execution engine
 - Interpret the response
 - Reflect the CQL-generated recommendations and suggested actions in the EHR user interface
- After incorporation into a development environment, the artifact should be exhaustively tested against predefined test cases. Additionally, testing should be conducted to ensure that implementation of the artifact has no adverse effect on the processing efficiency of the health IT system.
- Documentation and training materials for clinical staff should be drafted and distributed. These training materials should include descriptions of modified functionality, directions for interacting with CDS rules (if different than in the current system), and contact information for assistance if functionality does not meet expectations.

Potential Reuse Scenarios

CQL code within this artifact was developed to display a Pain Management Summary, but there are portions of the CQL code that are expected to be useful for other purposes.

- The `CDS_Connect_Commons_for_FHIRv102` and `FHIRHelpers` libraries included in the artifact define commonly used functions in CQL files and are not specific to the Pain

Management Summary artifact. They are expected to be used with any other CQL file that could benefit from those functions.

- Selected code blocks from `Factors_to_Consider_in_Managing_Chronic_Pain` could be copied and reused in other CQL files. For example, some might be interested in reusing the logic to query across multiple resource types to gather relevant opioid-related risk factors.

General Information About CQL

The Pain Management Summary artifact is composed of several files, but the primary focus of the artifact is the introduction of CQL files that can be used by any healthcare organization to properly identify patients who may require pain management, and to provide relevant patient-specific information that could be considered when choosing interventions to manage the patient's pain.

CQL is a data standard governed by Health Level 7[®] (HL7) that is currently a Standard for Trial Use (STU). CQL expresses logic in a human-readable document that is also structured enough for electronic processing of a query. It can be used within both the CDS and CQM domains.

The following links provide additional information on CQL:

- [CQL Release 1 STU2](#)
- [CQL on the Electronic Clinical Quality Information \(eCQI\) Resource Center](#)
- [CQL Tools on GitHub](#)
- [CQL Execution Engine \(CoffeeScript\) on GitHub *](#)
- [CQL Evaluation Engine \(Java\) on GitHub *](#)
- [CQL Online](#)
- [CQL Runner *](#)

*These websites do not support the use of Internet Explorer, and recommend using either Google Chrome, Microsoft Edge, or Firefox.

Integration With the EHR

The Pain Management Summary artifact provides relevant information to consider when managing a patient's pain. The information is presented to the clinician as a Pain Management Summary dashboard, implemented as a Web-based SMART on FHIR application. The application serves as a CQL integration engine to enable integration of the CQL logic and results with an EHR (such as Epic and Cerner) via the SMART on FHIR API. Implementers should work with their EHR vendor to determine the steps necessary to register and integrate a SMART on FHIR application within their EHR. Technical details regarding the SMART on FHIR API can be found on the [SMART Health IT](#) website.

The specific method used to invoke the Pain Management Summary CDS and present the SMART on FHIR application is dependent on implementation decisions made at each site. For the initial pilot of this artifact, the site elected to invoke the Pain Management CDS when a clinician clicks on a “Pain Summary Information” link found within a specific patient record in the EHR.

As discussed previously, the logic used to query and return data for the Pain Management Summary dashboard is expressed in the CQL. However, it is important to note that the CQL code does not enact any alerts and/or notifications to reinforce specific CDC guidelines, potential contraindications, or patient safety warnings related to the data that is displayed. Instead, rules were embedded in the SMART on FHIR application to enact notifications displayed as flags, counts, and additional information to further contextual awareness of where a CDC recommendation statement intersects with the displayed data. Future implementers may opt to include the notifications in the CQL; others may opt to expand the notifications in the app. Iterations will likely be informed by capabilities, modules, and the user interface of the EHR, among many other considerations. Figure 3 displays the first portion of a populated Pain Management Summary dashboard. The alert flags display as an exclamation point within a red circle to alert the clinician to an entry of potential concern based on the CDC guidelines. The dashboard can be navigated by scrolling or via the navigation shortcuts on the left-hand side of the page.

Figure 3. Pain Management Summary - Header and Pertinent Medical History

The screenshot shows a dashboard for a patient named Fuller Jackson, 64 YRS, MALE. At the top right, it displays '22 Total Entries' and '8 Total Flags'. The main heading is 'Factors to Consider in Managing Chronic Pain'. A prominent red alert box says 'TAKE NOTICE: This summary is not intended for patients who are undergoing end-of-life care (hospice or palliative) or active cancer treatment.' Below this, there are two sections: 'Conditions Associated with Chronic Pain' and 'Risk Factors for Opioid-related Harms'. Each section contains a table with columns for Name, Status, Start, End, and Recorded.

Name	Status	Start	End	Recorded
Fibromyalgia (disorder)	active	2012-Apr-05 (age 58)		2012-Apr-05

Name	Status	Start	End	Recorded
Agoraphobia with panic attacks (disorder)	active	2014-Sep-01 (age 60)		2015-Feb-12
Suicide attempt, initial encounter		2015-Feb-01 (age 60) - ongoing		

Figure 4 displays a list of the flags implemented in the SMART on FHIR app, along with the description of the flag logic.

Figure 4. Pain management summary flags

Pain Management Summary Flags	
Pertinent Medical History	<ul style="list-style-type: none">▪ Risk factors for Opioid-related Harms: Always flag if any are present (Depression, Anxiety, Substance Use Disorder, Suicide attempt, Sleep-disordered breathing, Renal dysfunction, Hepatic dysfunction, Pregnancy, 65 years or older).
Pain Assessments	<ul style="list-style-type: none">▪ No flags
Historical Treatments	<ul style="list-style-type: none">▪ Opioid Medications: Flag if present.▪ Non-opioid Medications: Flag if NONE.▪ Non-pharmacologic Treatments: Flag if NONE.▪ Stool Softeners and Laxatives: Flag if not present AND at least one opioid medication is present.
Risk Factors and Assessments	<ul style="list-style-type: none">▪ †Most Recent MME: Flag if MME is greater than or equal to 50.▪ Urine Drug Screens: Flag if not present AND at least one opioid medication is present.▪ Benzodiazepine Medications: Flag if present AND at least one opioid medication; Flag if present (each flag has a different message).▪ Naloxone Medications: Flag if not present AND most recent MME is 50+MME/day; Flag if present (each flag has a different message).

Additional information provided by the SMART on FHIR application user interface includes the following:

- Counts: Indicates the number of patient clinical entries, as well as flagged entries.
- Tooltips: Provide additional information about why the entry was flagged.
- Information icons: Provide information on what data was pulled to populate the summary and references.
- Uniform Resource Locators (URLs): Provide links to guidelines and additional references.

Open source code for the SMART on FHIR app is located on GitHub via the following URL: <https://github.com/AHRQ-CDS/AHRQ-CDS-PAIN-MANAGEMENT-SUMMARY>.

Appendix A: Decision Log Artifact Semi-Structured Logic

Table 2 provides the semi-structured logic statements for the inclusion and exclusion criteria, and Table 3 includes the semi-structured logic for patient-specific data that populates the pain management summary (i.e., the CDS intervention) to serve as a reference for decision log entries.

It is important for implementers and clinicians to understand that this CDS presents a summary of several pertinent clinical and psycho-social factors to consider when managing pain and considering opioids. Data populated in the summary may reveal contraindications to opioid therapy. At present, the CQL does not provide alerts and/or notifications to reinforce the contraindications. Instead, the notifications (via flags generated by coded rules) are embedded in the SMART on FHIR app used to integrate the CQL with the pilot site EHR. Future implementers of this artifact may choose to include alerts reinforcing specific CDC guidelines directly in to the CQL code based on available templates and modules in the EHR. Clinician training is imperative, so that they have the knowledge and resources to interpret and act upon the summary data (e.g., modify benzodiazepine medications and/or opioid medications so they are not administered simultaneously).

Table 2. Semi-structured inclusion and *exclusion* logic

Inclusions	Exclusions
<p>Age >=18 years AND</p> <ul style="list-style-type: none"> ▪ OR Conditions associated with chronic pain (<i>confirmed, active or recurring status, onset date, asserted date, abatement date</i>) ▪ OR Opioid pain medication <ul style="list-style-type: none"> ○ <i>Orders (date, active, completed, or stopped within past 180 days) Statements (date, active, or completed within past 180 days)</i> ▪ OR Adjuvant analgesic medication <ul style="list-style-type: none"> ○ <i>Orders (date, active, completed, or stopped within past 180 days)</i> ○ <i>Statements (date, active, or completed within past 180 days)</i> 	<p>None</p>

Table 3. Semi-structured CDS intervention logic

CDS Intervention
POPULATE Pain Management Summary
<p><u>Pertinent Medical History</u> (unrestricted lookback):</p> <ul style="list-style-type: none"> ▪ Conditions associated with chronic pain (<i>confirmed, active or recurring status, onset date, asserted date, abatement date</i>) ▪ Risk factors for opioid-related harm <ul style="list-style-type: none"> ○ <i>Risk Conditions (represented by a union of value sets) - (confirmed, active or recurring status, onset date, asserted date, abatement date)</i> ○ <i>Encounter Risk Diagnosis (represented by a union of value sets) - (name, visit date, onset date, abatement date, and recorded date)</i> ○ <i>Pregnancy Observation in the past 42 weeks</i> • Age \geq65 years
<p><u>Pain Assessments</u> (lookback of 2 years):</p> <ul style="list-style-type: none"> • Wong-Baker FACES Assessment (<i>score, interpretation, date</i>) • PEG Assessment (<i>question response and total score, interpretation, date</i>) • STarT Back Screening Tool (<i>total score, interpretation, date</i>)

CDS Intervention

Historical Treatments (lookback of 2 years for all except stool softeners, which is 6 months):

- Opioid pain medication
 - *Orders (date, active, completed, or stopped)*
 - *Statements (date, active, or completed)*
- Non-opioid pain medication
 - *Orders (date, active, completed, or stopped)*
 - *Statements (date, active, or completed)*
- Non-pharmacologic treatment
 - *Orders (date, accepted, in progress, or completed)*
 - *Referrals (date)*
- Stool softener and laxative
 - *Orders (date, active, completed, or stopped)*
 - *Statements (date, active or completed)*

Risk Considerations:

- MME calculation (*most recent, verified, value [as quantity], date in past 6 months*)
- Urine drug screen (*verified, result, interpretation, date in past 1 year*)
- Benzodiazepines medication
 - *Orders (date, active, completed, or stopped in the past 2 years)*
 - *Statements (date, active, or completed in the past 2 years)*
- Naloxone medication
 - *Orders (date, active, completed, or stopped)*
 - *Statements (date, active, or completed)*
- Risk assessments relevant to pain management (*represented by a value set*) - (*total score, range, interpretation, date in past year*)
 - *Verified “single question r/t alcohol use” Observation*
 - *Verified “single question r/t drug use” Observation*

CDS Intervention

DISPLAY link to the *CDC Guideline for Opioid Prescribing for Chronic Pain* (i.e., <https://www.cdc.gov/mmwr/volumes/65/rr/rr6501e1.htm>)

DISPLAY Notice header: “TAKE NOTICE: This summary is not intended for patients who are undergoing **end-of-life care** (hospice or palliative) or **active cancer treatment**.”

Concept Definitions from the Semi-Structured Logic

Table 4 provides definitions of many of the terms used in the semi-structured representation of the CDS logic to ensure clarity and provide awareness of how and why each data element was defined as they are.

Table 4. Semi-structured logic concept definitions

Location in CDS Logic	Concept	Definition and/or Rationale
Inclusion, Intervention	“conditions”	Diagnoses
Inclusion, Intervention	“Conditions associated with chronic pain”	List of diagnoses that often cause or imply chronic pain. The list was informed by peer-reviewed research (i.e., “Using Electronic Health Records to identify patients with chronic pain in a primary care setting” by Tian, T. Y., Zlateva, I & Anderson, D. R. in 2013. Accessible at https://www.ncbi.nlm.nih.gov/pubmed/23904323). The value set can be accessed at: https://vsac.nlm.nih.gov/valueset/2.16.840.1.113762.1.4.1032.37/expansion .
Inclusion, Intervention	“medication”	A drug or other substance used to treat disease or injury; a medicine
Inclusion, Intervention	“orders”	A prescription by a physician, dentist, nurse practitioner, or other designated health professional for a medication, treatment, procedure, etc.
Inclusion, Intervention	“statement”	Verbal acknowledgement by the patient. A statement could be related to a treatment, whether it was ordered by a different provider or initiated by the patient independently (e.g., “I take ibuprofen 600 mg every 6 hours as needed for pain.”)
Inclusion	“past 180 days”	Occurring within 180 calendar days of the CDS trigger (e.g., clicking on the link to the pain management summary CDS). Note: This concept is expressed as a parameter in the CQL code so future implementers can adjust the time, if preferred.

Location in CDS Logic	Concept	Definition and/or Rationale
Inclusion, Intervention	“Opioid pain medication”	<p>Opiate and opioid medication classes derived from descendants of the following terms “opioids,” “opioid analgesics,” “opioid agonist,” “narcotics,” and “analgesics, opioids.”</p> <p>For additional details, please see: https://vsac.nlm.nih.gov/valueset/2.16.840.1.113762.1.4.1032.34/expansion.</p>
Inclusion	“Adjuvant analgesic medication”	<p>Non-opioid medications that have a <i>primary</i> indication for chronic pain. Medications that have a primary indication for a “non-pain” condition, but are occasionally used to treat pain, are not included (e.g., serotonin-norepinephrine reuptake inhibitors for depression). This constrained definition of a non-opioid pain medication is intended to populate the summary for the most appropriate group of individuals.</p> <p>For additional information, please see: https://vsac.nlm.nih.gov/valueset/2.16.840.1.113762.1.4.1032.54/expansion.</p>
Intervention	“Pertinent Medical History”	<p>Category heading in the summary that provides context to the listed conditions (whether that be conditions associated with pain and conditions that may complicate or impact pain treatment)</p>
Intervention	“risk factors”	<p>A medication, calculation, assessment result, lab result, etc., that elevates the degree of danger or harm to an individual</p>
Intervention	“Risk factors for opioid-related harms”	<p>Health conditions (along with age >65) that may elevate the level of risk for harm to a patient if an opioid is prescribed. The conditions include depression, anxiety, substance use disorder (SUD), suicide attempt, sleep-disordered breathing, renal dysfunction, hepatic dysfunction, and pregnancy. This list is outlined in the CDC guidelines as an outcome of evidence-based research. Each condition is represented by a distinct value set. The object identifier (OID) for each value set is included in the CQL code.</p>

Location in CDS Logic	Concept	Definition and/or Rationale
Intervention	“date of onset”	Date of diagnosis. Of note, this is a challenging data concept to accurately evaluate due to the way it is captured in EHRs (i.e., the date displayed in a patient record is often the date that is it entered in the EHR). Most clinicians are aware of this limitation, but it should be reinforced during pilot training.
Intervention	“Pain Assessment”	<p>Category heading in the summary that groups together pain intensity and multi-dimensional assessment scores. A lookback of 2 years enables the provider to determine trends over time and the effectiveness of previous treatments.</p> <p>Note: Each of the three pain assessments below were expressed individually in the CQL code (as opposed to being expressed using a value set) because the PEG and STarT Back tools are not yet represented by a Logical Observation Identifiers Names and Codes (LOINC) code.</p> <p>A much larger number of evidence-based pain assessments could have been included in this section, had they been represented by LOINC codes. The assessments below were selected because they are available in the pilot site’s EHR and clinicians at the pilot location utilize the three assessments.</p>
Intervention	“Wong-Baker FACES Assessment”	A pain intensity rating tool that enables patients to quantify the intensity of their pain. The score is usually reported on a scale of 0–10.
Intervention	“Pain Enjoyment General Activity (PEG) Assessment”	A multi-dimensional tool that enables patients to quantify their average pain intensity (P), and the degree to which pain interferes with enjoyment of life (E) and general activity (G). Since ratings for each of these components is informative to managing pain, the CQL queries for the response to each question, along with the total score.
Intervention	“STarT Back Screening Tool”	A multi-dimensional tool that assesses and screens primary care patients with low back pain using nine questions. Since displaying the response to all nine questions would have taken up too much space in the summary presentation, only the final score is included in the CQL query.

Location in CDS Logic	Concept	Definition and/or Rationale
Intervention	“Historical treatments”	<p>Category heading in the summary that lists pharmacologic and non-pharmacologic pain treatments, along with stool softeners and laxatives (which are often required to manage constipation if a patient is on long-term opioid therapy). A lookback of 2 years for pain treatments provides reference information that can be evaluated against pain ratings to determine the effectiveness of treatment. A lookback of 6 months for the stool softeners and laxatives was considered adequate to provide information on the patient’s recent constipation treatments.</p>
Intervention	“Non-opioid medications”	<p>Medications with analgesic effects which may provide therapeutic benefit in treating chronic pain (including aspirin, acetaminophen, nonsteroidal anti-inflammatory drugs, anticonvulsants, antidepressants, muscle relaxants, and topical analgesics).</p> <p>The value set can be accessed at: https://vsac.nlm.nih.gov/valueset/2.16.840.1.113762.1.4.1032.26/expansion.</p>
Intervention	“Non-pharmacologic treatments”	<p>Non-medication procedures and therapies employed to treat pain (e.g., physical therapy, massage, yoga). Treatments included in this value set were compiled from pain management systematic reviews.</p> <p>Note: It is often challenging to query for these types of treatments in a patient record, since they are usually captured as unstructured “free text.” Additionally, patients may seek self-treatment, which may not be entered in to the patient’s record. Despite these limitations, this is an important concept (e.g., it should often be the first line of treatment); therefore, all <i>available</i> non-pharmacologic treatments should be displayed.</p> <p>This value set can be accessed at: https://vsac.nlm.nih.gov/valueset/2.16.840.1.113762.1.4.1032.36/expansion.</p>
Intervention	“referrals”	<p>A way to direct a patient to specialized care (e.g., a pain management specialist or counseling). This was added to the logic as an additional way to identify treatments not captured as an order.</p>

Location in CDS Logic	Concept	Definition and/or Rationale
Intervention	“Stool softeners and laxatives”	<p>Although the CDC guidelines do not offer guidance on managing constipation (a common side effect of opioid therapy), these medications were included in the summary because they are relevant to managing pain and treatment selection. The value set can be accessed at: https://vsac.nlm.nih.gov/valueset/2.16.840.1.113762.1.4.1032.44/expansion.</p>
Intervention	“Risk Considerations”	<p>A contextual category that lists additional risks not expressed in the “Risk factors for opioid-related harm” value set. Concepts in this category include: MME amount, urine drug screen results, evidence of benzodiazepine or naloxone medications and risk assessment results. These items were informed by the CDC guideline and should be considered by the clinician prior to making a pain management decision (e.g., the patient is already receiving 50 MMEs/day; the patient has a positive urine screen for an opioid that was not ordered by the clinical practice that they are being seen at).</p>
Intervention	“MME”	<p>The total amount of MMEs (in mg) that the patient is receiving in 1 day. This is calculated by determining the total daily amount of each opioid the patient takes, converting each medication to MMEs and adding the amounts together. Ideally this would include medications prescribed outside of the primary care setting where the patient is being seen. It is important for clinicians to know whether the calculated amount is based upon prescriptions from their practice only, or includes opioids prescribed from other providers. The CQL queries for the ‘most recent’ calculate amount.</p> <p>Note: The CQL does not include a coded algorithm to calculate MMEs. Instead, it queries the patient record for the calculated amount (i.e., the EHR must have a calculator embedded in their system that stores the amount in a discrete field). In addition, there is not a LOINC code to express MME, therefore a local code (unique to the EHR in which it was implemented) must be used.</p> <p>For CDS that calculates MME, see https://cbs.ahrq.gov/cdsconnect/artifact/cdc-opioid-prescribing-guideline-recommendation-5, available on the CDS Connect Repository.</p>

Location in CDS Logic	Concept	Definition and/or Rationale
Intervention	“Urine drug screens”	<p>Per the CDC guidelines, a urine drug screen should be conducted before initiating opioid therapy and at least once/year when prescribing long-term opioid therapy to evaluate for the risk of misuse or opioid-related harms. Standardized codes in this value set evaluate for adherence to prescribed therapy, diversion of prescribed medications, and misuse of illicit or prescribed medications in the context of chronic pain management. The lookback period is expressed as one year to align with the recommendation.</p> <p>The value set can be accessed at: https://vsac.nlm.nih.gov/valueset/2.16.840.1.113762.1.4.1032.28/expansion.</p>
Intervention	“Benzodiazepine medications”	<p>Per CDC guideline information and U.S. Food and Drug Administration guidance, opioids should not be prescribed if a patient is on a benzodiazepine medication since it may further depress the central nervous system, potentially leading to life threatening symptoms. The CQL looks back 2 years for evidence of a benzodiazepine to provide historical perspective.</p> <p>This value set can be accessed at: https://vsac.nlm.nih.gov/valueset/2.16.840.1.113762.1.4.1032.43/expansion.</p>
Intervention	Naloxone medications”	<p>Medications used to reverse the toxic effects of opioid overdose. Evidence of a naloxone medication in the past indicates potential misuse of an opioid or a history of receiving a high MME dosage. Awareness of the presence or absence (in some cases) of these meds is important when considering opioid therapy; therefore, the lookback period is unrestricted. This value set can be accessed at: https://vsac.nlm.nih.gov/valueset/2.16.840.1.113762.1.4.1032.42/expansion.</p>
Intervention	“Risk assessments relevant to pain management”	<p>A variety of risk assessment tools that evaluate for factors that may convey opioid-related harms (e.g., depression and anxiety screening, the risk of opioid misuse). The CQL queries for the result of all assessments completed in the past year.</p> <p>The value set can be accessed at: https://vsac.nlm.nih.gov/valueset/2.16.840.1.113762.1.4.1032.55/expansion.</p>

Artifact Development Decision Log

Numerous decisions were made by the Artifact Development Team while translating the CDC clinical practice guideline and developing the structured representation of this artifact. Table 5 provides insight on those decisions, along with where the coded representation might be expanded in the future.

Table 5. Artifact development decision log

Decision Category	Concept	Rationale
Inclusion logic/ Disambiguate	Acute versus chronic pain	Although the clinical data and notifications displayed in the summary may be informative for a broader a set of patients than expressed in the inclusion logic (e.g., individuals with acute pain), the “Conditions associated with chronic pain” value set was included in the logic to align more closely to the CDC opioid prescribing guidelines and populate the summary for the most relevant group of patients. Future implementers may choose to remove this criterion or expand the inclusion logic.
Inclusion logic/ Verify completeness	Age >=18 years old	The CDC guidelines apply to individuals over the age of 18 years old, based on researched evidence. Although earlier versions of the logic did not exclude younger patients, the age requirement was added after CDC guideline stewards counseled for exact alignment on this concept. Future implementers should be aware that expanding the age may not align with the evidence base for any contextual notifications that are enabled in the user interface of this summary.

Decision Category	Concept	Rationale
Inclusion logic/ Verify completeness	Active cancer treatment, palliative care, end-of-life care	<p>The CDC guidelines do not apply to individuals undergoing active cancer treatment or receiving palliative care/end-of-life care/hospice care since these individuals may appropriately require high dose opioid therapy to manage pain. Please note that these concepts are not expressed in the CQL because the availability of this data in a structured format in a primary care setting EHR is very low, thus impacting the ability to accurately reason over the concepts and present information that a provider can rely upon as correct.</p> <p>After consultation with CDC guideline stewards, MITRE decided to display a notification at the top of the summary display in the SMART on FHIR app that serves as the CQL engine which reads: "TAKE NOTICE: This summary is not intended for patients receiving end-of-life care or cancer treatment." In addition, this approach was discussed with pilot site clinicians during training, so they clearly understood the context of the notice and the CDC guideline.</p>
Standards limitation/Map terminology	Use of local codes for clinical concepts	<p>MITRE identified a gap in the availability of LOINC codes to represent frequently used evidence-based pain and risk assessment questions, tools, and scores. As a result, local codes were used for many of these concepts. As LOINC codes become available, future implementers may want to consider developing a value set to express these concepts.</p> <p>The list of concepts represented by local codes in the CQL includes: PEG assessment (along with each individual question), STarT Back Screening Tool, Opioid Risk Tool, and MME.</p> <p>Note: MITRE submitted applications to have all aspects of the PEG and STarT Back tools represented by LOINC codes. The LOINC codes are expected to be released in December 2018.</p>

Decision Category	Concept	Rationale
Data limitations	Encounters	Some risk factors for opioid-related harms may exist only as encounter diagnoses (as opposed to entries on a problem list). For this reason, the CQL logic queries encounters for the presence of these diagnoses. Some EHRs do not yet support retrieval of Encounters via the FHIR API, and as a result, these encounter diagnoses will be missed. In the pilot of this artifact, the piloting organization worked around this issue by implementing custom code to extend their EHR's FHIR API to support encounters.
Data limitations	Assessments and Screenings	Much of the data in the Pain Management Summary is comprised of assessments and screenings (e.g., Wong-Baker FACES, PEG, PHQ-9). Many EHRs, however, do not yet support returning assessments and screenings via the FHIR API. As a result, these critical data may be missing from the Pain Management Summary when using only “out-of-the-box” FHIR functionality in EHRs. In the pilot of this artifact, the piloting organization worked around this issue by implementing custom code to extend their EHR's FHIR API to support returning assessments and screenings as FHIR Observations.
Data limitations	Goals	<p>Patient goals related to their pain should inform every decision while managing pain. Ideally, patient goals would have been expressed in the CQL and prominently displayed in the user interface of the summary; however, patient goals are rarely captured in a structured format, and often goals are not “tied” to a specific Condition in the patient record (potentially causing query results to be outside the context required).</p> <p>This concept was not expressed in the CQL since this information was not available in a discrete field of the pilot site's EHR, and a LOINC code to represent a pain goal has not yet been created. Inclusion of patient-reported goals would be a valuable enhancement to this artifact in the future for sites that record goal-related responses in a structured format.</p>

Decision Category	Concept	Rationale
Technical limitations	Prescription Drug Monitoring Database (PDMP)	Integration of PDMP data would be valuable and ideal to include in this summary; however, this would have required a significant amount of coding that was unique to the EHR and the pilot site's implementation, involved legal and security approvals, and needed a significant amount of time to develop. Therefore, this was deemed outside the scope of this artifact. As cross-state PDMP data expand and EHRs provide integrated access to PDMP databases, inclusion of these data should strongly be considered for future iterations of this artifact.
Verify completeness	Value set creation	<p>Thirteen new value sets were created during the development of this artifact. Many are very robust and may ultimately need revision (e.g., the urine drug screen value set includes over 1,200 LOINC codes). Future implementers may want to compare how the required data are captured in their EHR to the codes in each value set and either edit the value set or just use a subset of the codes.</p> <p>In addition, please be aware that the medication value sets were developed to query for <i>all</i> medications in the desired class, as opposed to only those that are legal to prescribe in the U.S. They may need to be adjusted to support other use cases (e.g., integration with Computerized Prescription Order Entry systems in the U.S. to generate an order set).</p>
Adapt CDS to a local EHR	Wong-Baker FACES Assessment	The pilot organization's EHR accepted a numeric pain intensity response of 0-5, as opposed to 0-10 (the published range); therefore, a unique branch of the CQL was created for the pilot only.

Appendix C: References

- ¹ Centers for Disease Control and Prevention. (2016). *CDC Guideline for Prescribing Opioids for Chronic Pain – United States, 2016*.
<https://www.cdc.gov/mmwr/volumes/65/rr/rr6501e1.htm>.
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