INNOVATION CENTER PROGRESS REPORT

MARCH 2024

CDSiC Innovation Center: Quarterly Report

Agency for Healthcare Research and Quality
5600 Fishers Lane
Rockville, MD 20857
www.ahrq.gov

Contract No: 75Q80120D00018

Prepared by:
NORC at the University of Chicago
4350 East - West Highway Suite 800
Bethesda, MD 20814

PURPOSE

The CDS Innovation Collaborative (CDSiC) Innovation Center prepares a publicly available quarterly progress report to provide a summary of the status of all projects and activities being conducted within the CDSiC Innovation Center's two Cores and Planning Committee during the reporting period.

FUNDING STATEMENT

This project was funded under contract number 75Q80120D00018 from the Agency for Healthcare Research and Quality (AHRQ), U.S. Department of Health and Human Services (HHS). The opinions expressed in this document are those of the authors and do not reflect the official position of AHRQ or HHS.

PUBLIC DOMAIN NOTICE

Table of Contents

Introduction

NORC at the University of Chicago (NORC) is pleased to submit the first 2024 quarterly report to the Agency for Healthcare Research and Quality (AHRQ) on the Clinical Decision Support Innovation Collaborative (CDSiC) Innovation Center. This quarterly report provides a summary of the status of new projects and activities being conducted within the CDSiC Innovation Center in year three.

The CDSiC aims to advance the design, development, dissemination, implementation, use, measurement, and evaluation of evidence-based, shareable, interoperable, and publicly available patient-centered clinical decision support (PC CDS) to improve health outcomes of all patients by creating a proving ground of innovation. Products put forth by the CDSiC will provide innovative solutions that promote the adoption of PC CDS to facilitate whole-person, evidence-based care and improve patients' health and care experience. Ultimately, the CDSiC aims to create a world where patients, caregivers, and clinicians have the information needed to make decisions that improve health and well-being for all individuals.

The CDSiC Innovation Center is the real-world test bed of the CDSiC, leading the development and application of CDSiC tools, learnings, and insights. The Innovation Center consists of a Planning Committee and two Cores:

- **Core 1. Measurement and Value of CDS:** The purpose of this Core is to standardize the measurement of all aspects of PC CDS and demonstrate PC CDS utility through the implementation of safe and effective PC CDS.
- **Core 2. Conducting and Coordinating CDS Projects:** The purpose of this Core is to test PC CDS projects in real-world settings to ascertain best practices for implementation and monitoring to ease last mile implementation challenges.

Status Report

This quarterly report provides a summary of the status of all projects and activities being conducted within the CDSiC Innovation Center from January 2024 through March 2024. Over this period, the Innovation Center has focused on planning and developing four projects for the third year of the CDSiC.

Innovation Center Cores

The Innovation Center Cores are tasked with developing and completing four projects that advance PC CDS research. Based on discussions with AHRQ and the Planning Committee, Innovation Center leadership identified projects aimed at addressing gaps in measuring and monitoring PC CDS performance and using novel technology to facilitate PC CDS. The overarching goals of these projects are to validate a comprehensive performance measurement framework and to develop chatbot

prototypes to help patients, clinicians, and CDS developers understand real-world implementation and measurement considerations for PC CDS and any unintended consequences.

The projects vary in terms of expected length of time to complete based on scope, falling into one of three Levels.

- Level 1 projects are the largest in scope, involving significant effort and multiple modes of research or real-world assessments, with the expectation of tangible results.
- Level 2 projects involve a medium amount of effort and one mode of research or real-world assessment.
- Level 3 projects are shorter-term and may be proof-of-concept ideas or pilots.

Core 1 is undertaking two Level 2 projects and Core 2 is undertaking two Level 1 projects. One of Core 1's projects will be supporting the evaluation of both Core 2 projects.

Core 1: Measurement and Value of CDS

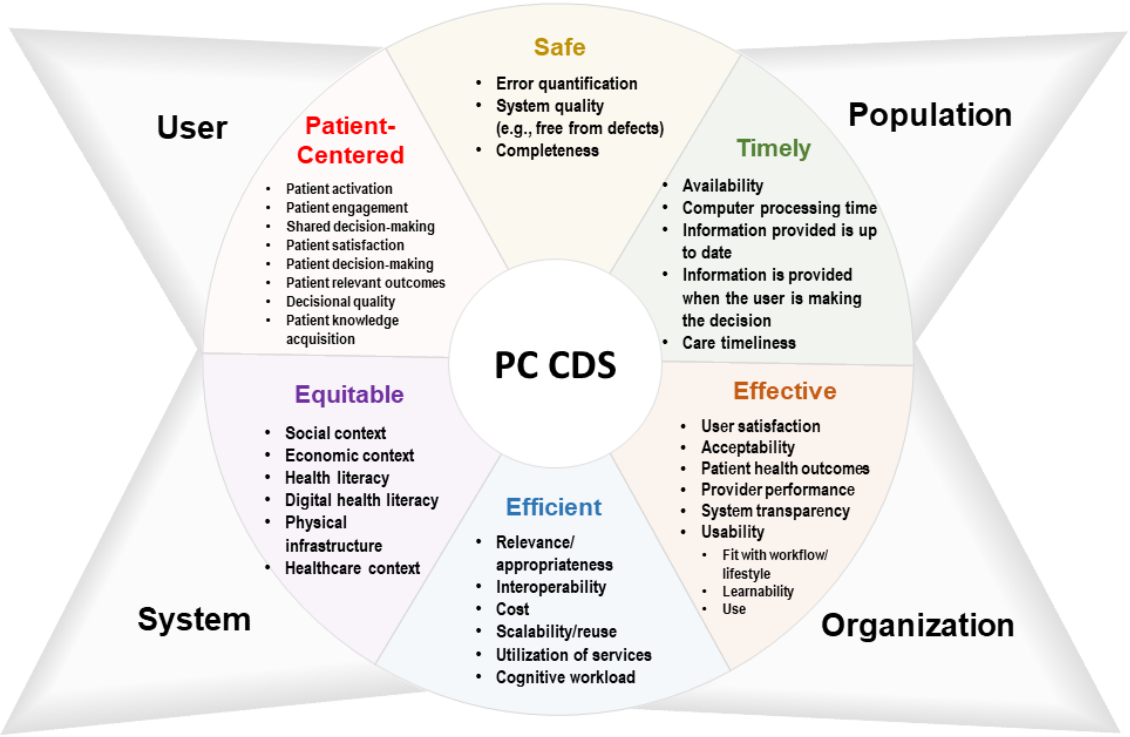
Significant gaps exist in the tools, techniques, and standards required to accurately measure and monitor the performance of various forms of PC CDS across the design, development, implementation, and use spectrum. To address these gaps, Core 1 is undertaking two projects: 1) conduct a cross-cutting assessment of PC CDS measurement in the real-world, and 2) evaluate Core 2's prototype PC CDS tools (see details in the Core 2 section below).

1. Cross-cutting Assessment of Real-World Experience in PC CDS Measurement

In years one and two of the CDSiC, the Innovation Center developed a new comprehensive PC CDS performance measurement framework that includes key domains, subdomains, and levels of measurement that CDS developers and others should consider when assessing PC CDS interventions (see Exhibit 1). The goal of this framework is to provide a basis for consistent measurement of PC CDS design, development, implementation, and use across the structure, process, and outcome spectrum.

In the third year of the CDSiC, the Core 1 team tested the framework by examining how current AHRQ-funded projects are evaluating and measuring real-world PC CDS interventions. The four aims of the cross-cutting assessment were to: 1) identify measures being used to assess PC CDS interventions; 2) gather perceptions on the measures used, limitations, and challenges; 3) understand factors that drive PC CDS technology adoption and use and how they impact measurement; and 4) develop an action plan for advancing the development and use of PC CDS performance measures.

Exhibit 1. The Patient-centered Clinical Decision Support Performance Measurement Framework



In Q1 2024, the Core 1 team conducted nine key informant interviews with principal investigators and other key project personnel that focused on the experiences and challenges with measures used in their studies, gaps in PC CDS measurement found across projects, and future opportunities for PC CDS measurement. The studies were identified during a literature review conducted in Q4 2023 that gathered information on the phase of the PC CDS (i.e., design, development, implementation, use), the types of user populations and medical condition addressed by the PC CDS, the types of technology and data leveraged by the PC CDS, and the measures used in the studies (see Q4 2023 report for more details). The team then conducted a rapid analysis of key takeaways from each interview and synthesized themes across interviews. These preliminary findings were presented to the seven-member Planning Committee to solicit feedback on relative importance. Finally, the team drafted and submitted a final report on real-world PC CDS measurement based on the cross-cutting findings from the data abstraction and key informant interviews. The findings are organized by common areas of measurement, gaps in measurement, and challenges for measurement. The discussion section describes how the findings impact the PC CDS performance measurement framework and identifies six action items for future PC CDS measurement development.

For dissemination, the Core 1 team submitted a poster abstract to the Mobilizing Computable Biomedical Knowledge (MCBK) North American Chapter Meeting, which was accepted and presented on February 28th. The poster focused on the common areas of measurement used by real-world PC CDS projects and their relevance for advancing computable patient-centered care. They also submitted a poster abstract to the American Medical Informatics Association (AMIA) 2024 Annual Symposium that focuses on the

validation of the PC CDS performance measurement framework and the Action Plan for PC CDS performance measurement.

Deliverables Submitted in Q1:

- Core 1 submitted the first draft report of the Cross-Cutting Assessment of PC CDS Measurement in Real-World Projects that describes the aims, methods, findings, implications for the PC CDS performance measurement framework, and Action Plan for PC CDS performance measurement.

Dissemination Activities

- Core 1 presented preliminary findings of the cross-cutting assessment to the Innovation Center Planning Committee in February.
- Core 1 presented a poster about the common measurement areas from the cross-cutting assessment at the MCBK North America Chapter Meeting in February.
- Core 1 submitted a poster abstract about the PC CDS performance measurement framework validation and related Action Plan items to the AMIA 2024 Annual Symposium in March.

2. Evaluation of Core 2's Prototypes

To build understanding of PC CDS performance measurement, Core 1 will conduct two evaluations of Core 2's prototype tools. The team will leverage the PC CDS performance measurement framework and findings from the cross-cutting assessment to determine measurement domains and subdomains for each project evaluation. Further details about each project's evaluations can be found in the next section.

Core 2: Conducting and Coordinating CDS Projects

Artificial intelligence (AI) can facilitate the collection and use of patient information for PC CDS to provide summative, distilled information to clinicians, leaders, and patients making health care decisions. In recent years, large language models (LLMs) like OpenAI's ChatGPT[1] have been increasingly utilized in health care applications, namely in the areas of education, triage, and contextual question-answering.[2, 3] The evidence reported has been mostly positive in terms of effectiveness and user satisfaction, with evaluators indicating some responses from chatbots to be more empathetic and higher quality compared to those from physicians.[4] However, there are several considerations for the use of AI in decision support tools, and more studies are needed exploring patient and clinician perspectives on the subject. To address these gaps, Core 2 is undertaking two projects: 1) design, develop, and implement a chatbot prototype to support medication adherence; and 2) design and develop a chatbot prototype to support patient-clinician communication.

1. Design, Development, and Implementation of a Chatbot Prototype to Support Medication Adherence

In this project, Core 2 is co-designing, developing, and implementing a pilot study of a text-messaging application (app) to help patients improve adherence to medication for hypertension. Working with a health system partner, the app will leverage an AI-based tool to text patients who have recently started a hypertension medication treatment or whose medications were modified to ensure that a) patients begin and continue taking their medications as prescribed, and b) the medications have the desired effect. The app will ask questions in English or Spanish and will use natural language processing (NLP) to understand patient responses, but it will not provide medical advice. The app will be integrated with the electronic health record (EHR) using Substitutable Medical Applications and Reusable Technologies (SMART) on Fast Healthcare Interoperability Resources (FHIR®)[5] to allow clinicians to monitor the patient's medication use between visits and intervene if necessary.

In Q1 2024, the Core 2 team finalized the Specifications & Requirements document for the app. The report describes the technical approach and provides model conversations for various scenarios. They began setting up systems for the pilot, such as designing the solution architecture using existing cloud-based technologies (e.g., Twilio[6] for text messaging, Amazon Web Services[7] for chatbot services and hosting the app). The Core 2 team also held discussions with three different health systems to assess their interest and readiness to serve as a pilot site.

For dissemination, the Core 2 team presented demonstrations of the early prototype to three different stakeholder groups: AHRQ project officers, the CDSiC Steering Committee, and the Innovation Center Planning Committee. The presentations provided an overview of the technical solution architecture and a video demonstration of various conversation scenarios supported by the app in both Spanish and English. Furthermore, the team submitted a panel abstract to the AMIA 2024 Annual Symposium exploring the use of AI in PC CDS. In this panel, the Core 2 team will provide an overview of the app prototype, the decision to use a chatbot versus LLM for this use case, and the lessons learned by the end of the pilot.

The Core 1 team began planning the evaluation of the app health system intervention. The team will collect qualitative input from: 1) the technical team on the integration of the app with the EHR; 2) the clinical lead on the utility of the information and its integration into the clinical workflow; and 3) patients' feedback on the app and its utility. Overall, the evaluation will assess the patient-centeredness and usability of the app as well as the technical feasibility of integrating the app into the health system.

Deliverables Submitted in Q1:

- Core 2 submitted the final Specification & Requirements document that describes the background, technical approach, and model conversations for the app.

Dissemination Activities:

- Core 2 presented a demonstration of the early prototype to AHRQ project officers in January.

- Core 2 presented a demonstration of the early prototype to the CDSiC Steering Committee in February.
- Core 2 presented a demonstration of the early prototype to the Innovation Center Planning Committee in February.
- Core 2 submitted an abstract for a panel exploring the use of AI in PC CDS to the AMIA 2024 Annual Symposium in March.

2. Design and Development of a Chatbot Prototype to Support Patient-Clinician Communication

In this project, Core 2 is co-designing and developing an interactive LLM-powered prototype called the Patient Artificial Intelligence Guided E-messages (PAIGE) that will serve as an intermediary between patients and clinicians via the patient portal. The aim is to improve accuracy and efficiency in patient-clinician communication by using a chatbot to field and summarize information from patients about their symptoms for clinicians to make care decisions. They will partner with Vanderbilt University Medical Center® (VUMC®) to extract a sample of patient portal message and clinician responses as well as traditional triage handbooks to train different models (e.g., a local fine-tuned LLM,[8] GPT-4[9]) to ask clarifying questions on the clinicians' behalf. They will also integrate medical information from the EHR (e.g., current medication lists, recent laboratory test results) to conditionally tailor the questions and responses to each patient. They will conduct laboratory testing with clinicians to assess the quality and completeness of the LLM-generated summaries.

In Q1, the Core 2 team finalized the Specifications & Requirements document that describes the design and development of the prototype. The team continued to hold discussions with clinicians and researchers at VUMC® to gather their perspectives on using the prototype for various common scenarios (e.g., urinary tract infection, abdomen pain, refill request, COVID-19, sleeping issue, sinus infection, back pain).

The team also began engaging patients in the co-design process to ensure the tool is designed and developed with patient needs in mind. They conducted two interviews with CDSiC patient representatives to understand past experiences with patient portals or messaging clinicians virtually and to gather initial impressions on the prototype's interface design. The team will incorporate patient feedback into the iterative design process.

For dissemination, the Core 2 team presented demonstrations of the early prototype to both the CDSiC Steering Committee and the Innovation Center Planning Committee. The presentations provided an overview of the front- and back-end solution of the prototype and a video demonstration of a hypothetical conversation using the use case of a urinary tract infection. In addition, the team submitted a poster abstract to the AMIA 2024 Annual Symposium describing the design and development of PAIGE. The poster will show the prototype interface and describe findings from the initial discussions with seven clinicians on the utility of the prototype.

The Core 1 team began planning the evaluation of PAIGE to assess the performance of the system to generate relevant clarifying questions to patients. The evaluation will focus on patient perspectives on

the usability of the system (i.e., their ability to comprehend and respond to PAIGE questions). The team will collect real-world clinical questions from 5-7 patients and input the questions into PAIGE to generate clarifying questions and a "summary" of the patient's initial question and their responses. The team will ask each patient to rate the clarity of the questions, their ease of comprehension, the perceived relevance of each question, and whether the summary accurately reflects their questions. The team will also collect the time required for PAIGE to generate the list of clarifying questions and the summary.

Deliverables Submitted in Q1:

- Core 2 submitted the final Specification & Requirements document that describes the background, design specifications, technical approach, and patient co-design and testing process of the PAIGE prototype.

Dissemination Activities:

- Core 2 presented a demonstration of the early prototype to the CDSiC Steering Committee in February.
- Core 2 presented a demonstration of the early prototype to the Innovation Center Planning Committee in February.
- Core 2 submitted a poster abstract describing the design and development of the PAIGE prototype to the AMIA 2024 Annual Symposium in March.

Innovation Center Deliverables

In Exhibit 2, we outline each Core's project deliverables to date, as well as the future deliverables in progress.

Exhibit 2. Summary Table of Deliverables

Project	Status
Innovation Center	
Project Outline and Timeline	Complete
Revised Charter	Complete
Revised Operational Framework	Complete
Core 1	
Cross-cutting Assessment Report	Under AHRQ Review
Patient-Clinician Prototype Evaluation Report	In Progress
Medication Adherence Prototype Evaluation Report	In Progress

Project	Status
Core 2	
Medication Adherence Prototype	
Specification & Requirements Document	Complete
Medication Adherence Prototype Demonstration	In Progress
Patient-Clinician Communication Prototype	
Specification & Requirements Document	Complete
Patient-Clinician Prototype Demonstration	In Progress

Planning Committee

The Planning Committee met once during this quarterly reporting period on February 7, 2024. During the meeting, members were asked for input on the three active projects outlined above (excluding the Core 2 prototype evaluations). First, each Co-Lead presented the project updates and any preliminary findings. After each project presentation, Co-Leads provided at least 10 minutes of Question & Answer for the Planning Committee members to provide feedback.

- For the cross-cutting assessment, members discussed that gaps in measurement may be due to projects focusing on early-stage PC CDS technologies rather than more advanced technologies. They also suggested developing more standard measures to assess the process of engaging with PC CDS and more ways to understand the replicability of PC CDS.
- For the Medication Adherence Prototype, members asked clarifying questions about the solutions architecture and suggested limiting the pilot to just one specific hypertension medication.
- For the Patient-Clinician Prototype, members felt that this was an appropriate way to explore the use of LLM in health care settings but suggested warning patients about needing to wait 48 hours for the clinician's response. They discussed the need to eventually field test the prototype to identify real-world issues.

Due to the CDSiC Annual Meeting occurring in May, the next Planning Committee meeting is scheduled for June 26, 2024. The Committee will review materials related to Core projects and help raise awareness of Core activities within the broader CDS community.

Next Steps

This quarterly report provided updates on the Innovation Center's project activities in the third year of the CDSiC. Over the next three months, Core 1 will begin the evaluation of the two Core 2 PC CDS prototypes and submit a first draft report on the PAIGE prototype evaluation to AHRQ. Core 2 will finalize the development of both the medication adherence app and PAIGE prototypes and present final demonstrations to AHRQ.

References

[1] OpenAI. “OpenAI: ChatGPT.” OpenAI. Accessed December 1, 2023. https://openai.com/chatgpt/

[2] Milnes-Ives M, de Cock C, Lim E, et al. The effectiveness of artificial intelligence conversational agents in health care: systematic review. *J Med Internet Res*. 2020;22(10):e20346. doi:10.2196/20346

[3] Tudor Car L, Dhinagaran DA, Kyaw BM, et al. Conversational agents in health care: scoping review and conceptual analysis. *J Med Internet Res.* 2020;22(8):e17158. doi:10.2196/17158

[4] Ayers JW, Poliak A, Dredze M, et al. Comparing physician and artificial intelligence chatbot responses to patient questions posted to a public social media forum. *JAMA Intern Med.* 2023;183(6):589-596. doi:10.1001/jamainternmed.2023.1838

[5] SMART on FHIR. 2020. Computational health Informatics program. Boston’s Children’s Hospital. Boston, MA. Accessed October 19, 2023. https://docs.smarthealthit.org/

[6] Twilio. Home. Accessed March 19, 2024. https://www.twilio.com/en-us/messaging?utm_source=google&utm_medium=cpc&utm_term=sms%20gateway%20twilio&utm_campaign=G_S_NAMER_Brand_Twilio_Tier2&cq_plac=&cq_net=g&cq_pos=&cq_med=&cq_plt=gp&gad_source=1&gclid=CjwKCAjwkuqvBhAQEiwA65XxQAeHlUiVYG6mA7XUQr1ncWiXTmjFZb1J6fpC9xf4v5pI7r5pU0tDyBoCXtcQAvD_BwE

[7] Amazon Web Services. Home. Accessed March 19, 2024. https://aws.amazon.com/

[8] Liu S, McCoy AB, Wright AP, et al. Leveraging large language models for generating responses to patient messages. Preprint. *medRxiv*. 2023;2023.07.14.23292669. Published 2023 Jul 16. doi:10.1101/2023.07.14.23292669

[9] OpenAI. “OpenAI: GPT-4.” OpenAI. Accessed March 6, 2024. https://openai.com/research/gpt-4