INNOVATION CENTER PROGRESS REPORT

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CDSiC Innovation Center: Quarterly Report

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Prepared by:
NORC at the University of Chicago
1828 L Street NW, 9th Floor
Washington, DC 20036

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.

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PUBLIC DOMAIN NOTICE

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Introduction

NORC at the University of Chicago (NORC) is pleased to submit the thirteenth 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 projects and activities being conducted within the CDSiC Innovation Center in year four between January and March 2025.

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 PC 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 PC 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 through March 2025. Over this period, the Innovation Center has focused on continuing four projects across both Cores and finalizing project work from year three 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 developing new approaches for measuring PC CDS and building the evidence base for implementing and scaling PC CDS in real-world settings. The goals of these

projects are to conceptualize how artificial intelligence (AI) can be used in PC CDS, to develop a framework and inventory for patient engagement measurement, and to conduct real-world pilots of PC CDS technologies.

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

- Level I 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 II projects involve a medium amount of effort and one mode of research or real-world assessment.
- Level III projects are shorter-term and may be proof-of-concept ideas or pilots.

Core 1 is undertaking two Level III projects and Core 2 is undertaking two Level II projects.

Core 1: Measurement and Value of PC CDS

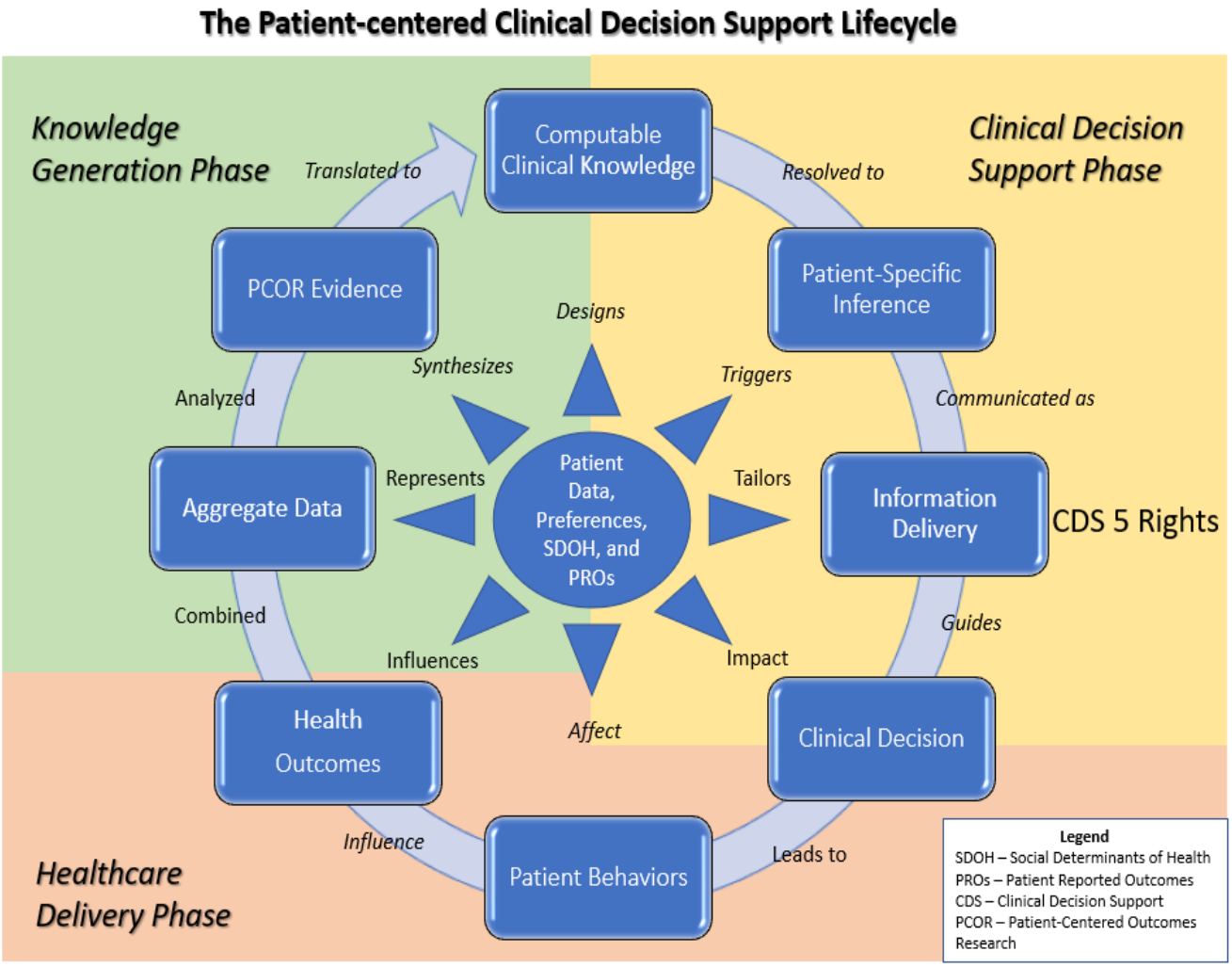
Significant gaps exist in the tools, techniques, and standards required to accurately measure and monitor the performance of PC CDS across the design, development, implementation, and use lifecycle.[1] To address these gaps, Core 1 has undertaken two projects: 1) identifying measures across the PC CDS lifecycle to measure successful patient engagement with PC CDS technologies, and 2) detailing the current landscape of use cases for AI in PC CDS to establish a foundation for future performance measurement efforts. In addition, Core 1 continued disseminating findings from the prior year's project on a measurement framework for PC CDS performance.

1. Identifying Patient Engagement Measures for PC CDS

In prior years of the CDSiC, several Stakeholder and Innovation Center products examined measurement of patient engagement in PC CDS, finding that it remains limited and largely focused on the process of engagement versus engagement quality or outcomes.[2,3,4,5] To address these gaps and better understand the impact of patient engagement in PC CDS, it is necessary to develop more advanced, comprehensive, and standardized measures of patient engagement.

This project aims to explore existing patient engagement measures and identify gaps and opportunities to improve measurement. The Core 1 team will map these measures to the PC CDS Lifecycle (Exhibit 1) developed in year one, to enable PC CDS developers, researchers, implementers, evaluators, and other stakeholders to assess successful patient engagement in different phases of the technology.[6] The PC CDS Lifecycle Framework defines the different phases, sequences and interactions of activities within the design, development, implementation, use, and evaluation of PC CDS. The lifecycle is separated into three separate phases: the knowledge generation phase (i.e., the development of evidence-based guidelines from patient-centered outcomes research [PCOR]), the clinical decision support phase (i.e., the transformation of evidence from research into computable logic for patients), and the healthcare delivery phase (i.e., the clinical decision-making process among patients, caregivers, and clinicians).

Exhibit 1. The Patient-centered Clinical Decision Support Lifecycle Framework



Data Collection. In Q1 2025, the Core 1 team continued abstracting and refining patient engagement measures from CDSiC products. After mapping measures to the phases of the PC CDS Lifecycle, they conducted a targeted review of peer-reviewed publications to identify additional measures within each phase. This list of measures informed the key informant interview discussion guides and information sheets tailored to each phase of the lifecycle. The Core 1 identified informants from each phase based on the peer-reviewed literature and conducted 60-minute interviews with eight informants, including researchers, measurement developers, informaticists, and patient representatives. The aims of the interviews were to 1) review and validate the patient engagement measures for PC CDS and 2) discuss potential measurement gaps, challenges, and perspectives on how to improve patient engagement measurement in PC CDS.

Synthesis and Reporting. The Core 1 team reviewed notes from the interview discussions and synthesized themes related to each engagement phase, challenges with measurement, and opportunities to improve measurement. They then drafted a report and inventory collating patient engagement measures across the PC CDS lifecycle. The goals are to describe the activities where

patients are engaged and measures of patient engagement in those activities within each phase, identify where measures are currently lacking, and describe the challenges and opportunities to advance patient engagement measurement.

Deliverables Submitted in Q1:

- Core 1 submitted the first draft of the Inventory of Patient Engagement Measures for PC CDS report that describes the background, methods, findings, and discussion of the project.

Dissemination Activities in Q1:

- Core 1 presented the project to Planning Committee members on March 7, 2025. The team provided minutes following the meeting.

2. Examining Use Cases of Generative AI in PC CDS

The use of AI in PC CDS tools has potential implications for PC CDS technology, patients/caregivers, and clinicians. In particular, generative AI (GenAI), which can create new content from textual and media input,[7] has strong capabilities to synthesize large amounts of data for PC CDS through various mediums (e.g., unstructured data in electronic health records [EHRs], clinical visit recordings, patient-generated health data [PGHD]).[8] Because of the rapid growth of GenAI and concerns with its transparency and regulatory oversight, there is need to clarify how it is being implemented in the PC CDS landscape.

The aim of this project is to create a consolidated resource that documents current use cases of GenAI-supported PC CDS and its implications and considerations for practice and research. The Core 1 team will emphasize the implications of GenAI-supported PC CDS for patients/caregivers, as the current literature focuses on implications for clinicians and healthcare leaders using traditional CDS.[9,10,11,12]

In Q1 2025, the Core 1 team drafted a perspective piece about use cases of GenAI-supported PC CDS titled, “The Use of Generative AI in Patient-Centered Clinical Decision Support: Implications for Practice and Research” for the Journal of the Medical Informatics Association (JAMIA). The manuscript focuses on the use of GenAI in PC CDS for patients/caregivers and/or clinicians. The paper details its implications for practice and research, including benefits and considerations for its use, as well as areas to advance the technology.

Deliverables Submitted in Q1:

- Core 1 submitted a first and second draft of the Perspective manuscript on GenAI-supported PC CDS. They will submit to a peer-reviewed journal after AHRQ’s approval.

Dissemination Activities in Q1:

- Core 1 presented project progress to Planning Committee members on March 7, 2025. The team provided minutes following the meeting.

- Core 1 submitted an abstract to AcademyHealth's 2025 Annual Research Meeting (ARM). The panel presentation is titled, "The Use of AI in Patient-Centered Clinical Decision Support: Implications for Practice and Research."

- Core 1 began drafting an abstract to submit to the American Medical Informatics Association (AMIA) 2025 Annual Meeting that will focus on the use cases for GenAI-supported PC CDS and implications for practice and research.

3. PC CDS Performance Measurement Framework *[Continued from the Prior Year]*

In prior years, Core 1 developed a framework for measuring PC CDS performance that CDS developers, clinician informaticians, clinical leaders, and others could use to assess PC CDS across the lifecycle. The framework is informed by traditional CDS and health information technology literature as well as key informant interviews with experts in the field of PC CDS. It includes several domains and subdomains of measurement to assess PC CDS performance that are extensible to different health care settings, patient populations, and PC CDS developers.

In Q1 2025, the Core 1 team continued revising the manuscript that describes the framework for submission to the Journal of Medical Informatics Research (JMIR). The manuscript is titled, "Realizing Patient-Centered Clinical Decision Support: A New Performance Measurement Framework." They received two rounds of JMIR reviewer feedback, responded to reviewers' comments, and resubmitted the manuscript to JMIR for review.

Dissemination Activities in Q1:

- Core 1 revised and resubmitted a manuscript for publication to JMIR. They submitted first round review feedback on March 6, 2025, and submitted second round reviewer feedback on March 21, 2025.

Core 2: Conducting and Coordinating PC CDS Projects

PC CDS tools have the potential to improve patient safety and quality of care by remotely monitoring patients' conditions and symptoms. Remote monitoring is particularly pertinent for chronic conditions such as hypertension that impact a large patient population and can contribute to more serious conditions like early onset cardiovascular disease and, if pregnant, complications during or after delivery. Mobile health technology, which utilizes smartphones, tablets, or personal computer in the management of chronic disease, has been shown to be effective for patients that must adhere to medication regimens or monitoring over extended periods of time.[13, 14] Due to the burden of hypertension and the efficacy of mobile health, Core 2 has undertaken two projects: 1) implementation and evaluation of a PC CDS prototype to support hypertension medication adherence; and 2) implementation and evaluation of a PC CDS prototype for postpartum hypertension.

1. Implementation and Evaluation of a PC CDS Prototype to Support Hypertension Medication Adherence

In this project, the Core 2 team will expand on the prior year's project to implement and evaluate a text-messaging application (app) to help patients monitor and improve adherence to hypertension medications. The app leverages an AI-based tool to text patients who have uncontrolled blood pressure to ensure that a) patients continue taking their medications as prescribed, and b) the medications have the desired effect. In the prior year, the Core 2 team integrated the app with an EHR system at a pilot site using Substitutable Medical Applications and Reusable Technologies (SMART) on Fast Healthcare Interoperability Resources (FHIR®)[15] to allow clinicians to monitor patients' medication use between visits and intervene if necessary. They then assessed the integration process to understand the feasibility and usability of the app in a lab simulation environment. This year, the Core 2 team will enhance the app to collect blood pressure data from patients and will implement the app with patients in a primary care setting.

App Development and Deployment. In Q1 2025, the Core 2 team continued meeting weekly with the technical team to discuss improvements to the app design and deployment to the production environment. They completed programming of text messages collecting patients' blood pressure readings, which are based on adaptive frequency relative to the patient's hypertension severity. They successfully deployed the app in the pilot site's production environment, including a patient roster view that lists all patients enrolled in the pilot and their most recent blood pressure reading and medication responses.

Pilot Implementation. In Q1 2025, the Core 2 team worked closely with the pilot site to officially launch the pilot, which will run through June 2025. The clinical lead began enrolling patients into the program to receive text messages, and patients have responded to messages that the app integrates into the EHR dashboard and roster view. Discussions during this period centered around resolving technical issues in the app and increasing patient enrollment in the first month of the pilot. This included training other primary care providers, clinical pharmacists, and residents to enroll their patients and conducting phone outreach to eligible patients.

Assessment. The Core 1 and Core 2 teams began the pilot assessment on the app's technical feasibility, performance, and usability in a real-world setting. After receiving approval on the Assessment Plan, the team conducted key informant interviews with three members of the technical team to discuss the feasibility of enhancing and deploying the app in the EHR, as well as early app performance in the production setting. The team began preparing for interviews with patients at the midpoint of the pilot to assess interim usability and acceptability, including drafting discussion guides, information sheets, and outreach emails. They also began discussing app usage metrics with the app development team, which they will program to collect on a weekly basis.

Deliverables Submitted in Q1:

- Core 2 finalized the Assessment Plan that describes the goals, research questions, methods, and data analysis for the Medication Adherence PC CDS pilot.

Dissemination Activities in Q1:

- Core 2 presented updates on the project to Planning Committee members on March 7, 2025. The team provided minutes following the meeting.

2. Implementation and Evaluation of a PC CDS Prototype to Support Postpartum Hypertension

In this project, the Core 2 team will build on an earlier prototype to monitor blood pressure for patients with postpartum hypertension. The app sends SMS text messages to patients with a web-based questionnaire that allows them to report their daily blood pressure readings and hypertensive symptom data post-delivery. It also leverages SMART on FHIR standards to safely store data and includes an EHR-integrated dashboard for clinicians to monitor their patients' symptoms. Clinicians can view flags in the dashboard next to any abnormal readings, allowing for prompt intervention for patients. In 2023, the app was pilot tested at Yale New Haven Health System and demonstrated preliminary effectiveness in promoting patient self-management of postpartum hypertension.[16] This year, the Core 2 team will conduct another pilot at a different site and enroll a larger sample of patients.

App Development. In Q1 2025, the Core 2 team finalized the Specifications and Requirements document that details the design, features, and technical and operational requirements of the app. The document provides an overview of the technical approach for key components: 1) the platforms and devices supported by the app; 2) the system architecture; 3) the data captured by the app and the decision support it provides to support patient monitoring; and 4) data storage and management.

Pilot Implementation. In Q1 2025, the Core 2 team established biweekly meetings with the pilot health system site to plan for app rollout. These included discussions regarding criteria for enrolling patients, developing a decision tree to program app logic based on patients' responses, and developing a clinical workflow. Additionally, the team discussed requirements for the technical development and integration of the app into the pilot's EHR, including app enhancements.

Assessment. The Core 1 and Core 2 teams will conduct an assessment of the app's technical feasibility, usability, and acceptability in a new pilot site. In Q1 2025, the team drafted the Assessment Plan that provides background on the app, an overview of the pilot, and an overview of the assessment, including the research goals, research questions, proposed assessment measures and collection methods, and data analysis methods. The team plans to collect qualitative data from the technical team on their experience updating and deploying the app, the care team on the app's usability and acceptability within their workflows, and patients on the app's usability and acceptability. The CDSiC team will also collect quantitative data on app usage, blood pressure readings, and symptoms. The team will develop a final report that summarizes key findings by the end of year four.

Deliverables Submitted in Q1:

- A second draft of the Specifications and Requirements document that details the technical infrastructure needed for the Postpartum Hypertension app.

- A first draft of the Assessment Plan that details the research goals and questions, an overview of the pilot, and data collection and analysis methods for the Postpartum Hypertension assessment.

Dissemination Activities in Q1:

- Core 2 presented project progress to Planning Committee members on March 7, 2025. The team provided minutes following the meeting.

Innovation Center Deliverables

In Exhibit 2, we outline each Core's completed deliverables to date.

Exhibit 2. Summary Table of Deliverables

Project	Status
Innovation Center	
Project Outline and Timeline	Complete
Revised Charter	Complete
Revised Operational Framework	Complete
Core 1	
AI-Based PC CDS Manuscript	Under AHRQ Review
Patient Engagement Measurement Framework Report and Inventory	Under AHRQ Review
Core 2	
Medication Adherence Prototype	
Medication Adherence Pilot Assessment Plan	Complete
Medication Adherence Pilot Assessment Report	Not Started
Postpartum Hypertension Prototype	
Postpartum HTN Specifications and Requirements Documentation	Complete
Postpartum HTN Assessment Plan	Under AHRQ Review
Postpartum HTN Assessment Report	Not Started

Planning Committee

The Planning Committee met once towards the end of the Q1 reporting period on March 7, 2025. The meeting focused on presenting findings and preliminary results for each of the current projects. Core 1 presented findings related to the GenAI-Supported PC CDS project and the Patient Engagement Measures for PC CDS project. Core 2 presented findings for the Medication Adherence App Pilot at

Baystate Health and the Postpartum Hypertension Monitoring App Pilot at Emory University. The team also presented proposed meeting themes and objectives for the CDSiC 3rd Annual Meeting, scheduled for May 6, 2025.

- For the GenAI-Supported PC CDS project, members shared ideas for changes to the visual of patient/caregiver and clinician use cases, such as moving certain domains under different audiences and adding more use case examples. Members also discussed ethical concerns related to the use of GenAI, and considered how the challenges could be navigated (e.g., the creation of transparent policies, the co-development and co-deployment of PC CDS tools).
- For the Patient Engagement Measurement project, members discussed the need for formal groups of patient representatives that researchers can consult with when designing PC CDS interventions to improve the availability of meaningful patient engagement measures.
- For the Medication Adherence Pilot, members suggested enhancing the app by asking patients about their comorbidities as that may be a salient factor in their medication adherence.

The next Planning Committee meeting is scheduled for June 9, 2025. The Committee will learn about the final findings of the fourth year Innovation Center projects and discuss which findings are the most salient to benefitting the broader field of PC CDS.

Next Steps

This quarterly report provides updates on the Innovation Center's project activities between January and March 2025. Over the next three months, Core 1 will submit the Perspective manuscript on GenAI-supported PC CDS to JAMIA. Core 1 will also refine the Patient Engagement Measures report and inventory based on AHRQ's feedback. Core 2 will continue implementing the two PC CDS pilots. For the Medication Adherence pilot, they will continue patient recruitment and monitoring, as well as collect qualitative data on the app's usability and acceptability. For the Postpartum Hypertension pilot, they will continue developing and testing the app in the health system environment, finalize the Assessment Plan, and launch the pilot to begin enrolling and monitoring postpartum patients.

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