INNOVATION CENTER PROGRESS REPORT
OCTOBER 2022

CDSiC Innovation Center Quarterly Report

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Rockville, MD 20857

PROJECT:
CDS Innovation Collaborative (CDSiC)
Contract No: 75Q80120D00018
Task Order No: 75Q80121F32003

TASK & DELIVERABLE:
Task 3.3

PRESENTED BY
NORC at the University of Chicago

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Introduction

NORC at the University of Chicago (NORC) is pleased to submit the third 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 all projects and activities being conducted within the CDSiC Innovation Center.

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**: This 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 status report provides updates on progress of the activities of the Innovation Center from July to September 2022[1], including conducting literature reviews and key informant interviews, developing reports, and facilitating a Planning Committee. The report also describes upcoming activities.

Innovation Center Cores

The Innovation Center Cores are tasked with developing and completing three projects in the first two years of the CDSiC that advance PC CDS research. Based on discussions with AHRQ and the Planning Committee, Innovation Center leadership identified three projects aimed at addressing gaps in measuring and monitoring PC CDS performance. The overarching goals of these projects are to develop a comprehensive performance measurement framework along with measurement and

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[1] More detailed background on the CDSiC, the Innovation Center, and Innovation Center activities from January through June 2022 can be found in the first and second quarterly reports.

monitoring 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 one Level 1 project and Core 2 is undertaking one Level 2 and one Level 3 project. The projects are being conducted concurrently and in an iterative manner, with findings from each project being incorporated as relevant into the others to enhance and refine outputs.

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.[viii] To address these gaps, Core 1 is undertaking three activities: the development of a PC CDS lifecycle diagram, a PC CDS workflow execution model, and a performance measurement framework.

PC CDS Lifecycle Diagram

To guide development of the framework, Innovation Center leadership merged and expanded upon the CDS five rights[i] and the analytic framework for action (AFA) developed by the PC CDS Learning network)[ii] to create a new, more comprehensive model (see Exhibit 1) that outlines a three-phase lifecycle of PC CDS.[2] The goal of this new, expanded model is to highlight the myriad of stages in the PC CDS lifecycle that must be adequately negotiated by all participants in the healthcare delivery system, including patients and their caregivers, to achieve the desired changes in behavior and the resulting improvements in personal health and lifestyle, societal health and happiness, and economic outcomes. During Q3, Innovation Center leadership drafted a manuscript describing the methods used to develop the model and the role of each stage and phase in the PC CDS lifecycle. The manuscript will be reviewed by AHRQ and the Planning Committee and eventually submitted to a peer-reviewed journal.

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[2] A detailed description of the model can be found in the Q1 report.

Exhibit 1. The Patient-Centered Clinical Decision Support Lifecycle

The Patient-centered Clinical Decision Support Lifecycle
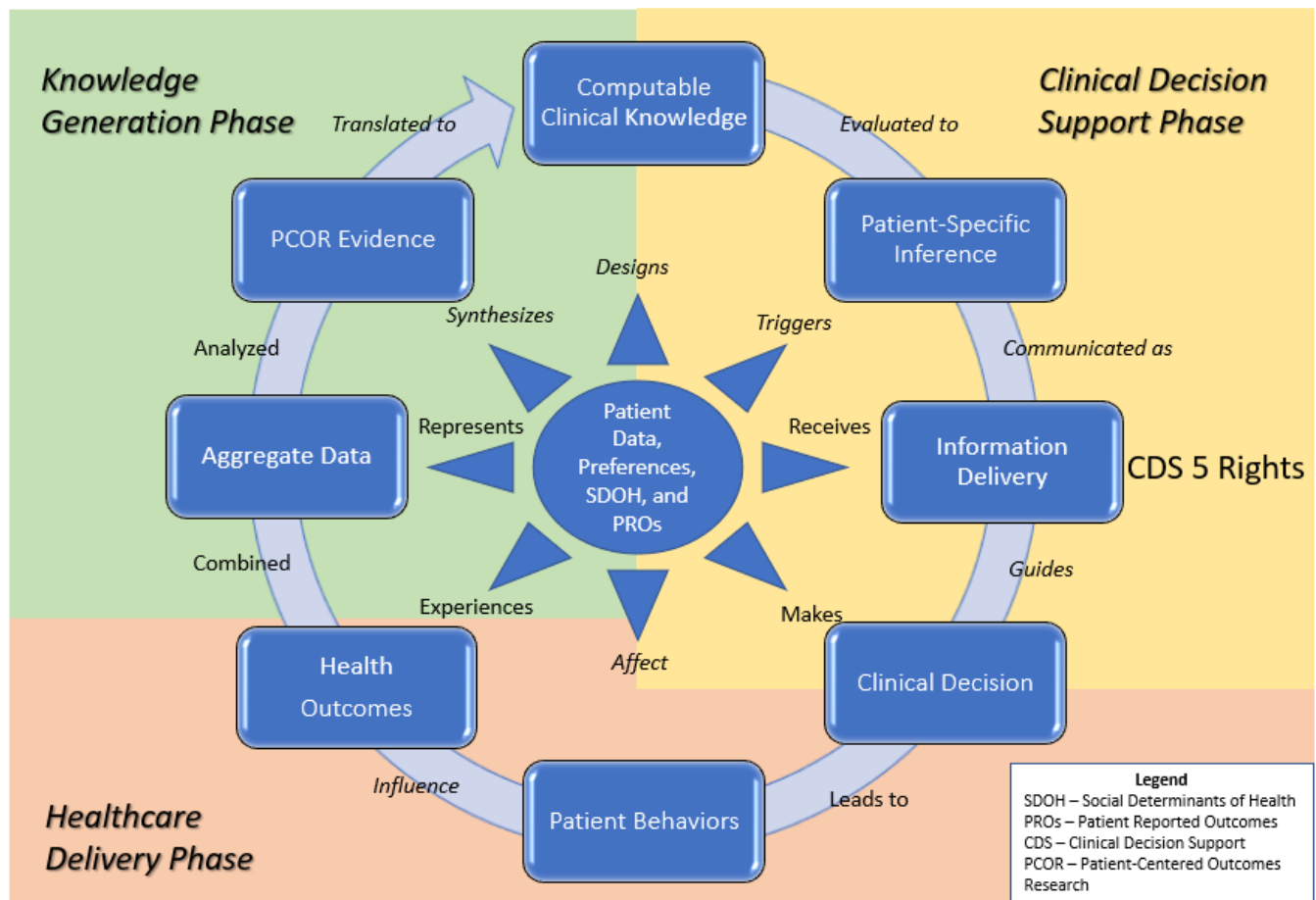
PC CDS Workflow Execution Model

PC CDS interventions are typically composed of complex, multi-step processes that are predicated on medical knowledge, clinician experience, and patient responses to questionnaires and treatments. Each of these steps can be considered an individual workflow component, i.e., an opportunity to provide patient-specific information to patients or clinicians (e.g., office or ED visit) or a computer-, device-, or human-generated message from or to a patient or clinician (e.g., PRO collected or laboratory test result available). These latter messages can include data, information, or knowledge. In Q3, Core 1 began developing a PC CDS Workflow Model that will describe the relationships among the numerous workflow components in common PC CDS scenarios (e.g., chronic condition management). The Workflow Model will ultimately be used to inform the development of the performance measurement framework.

Performance Measurement Framework

In Q3, Core 1 began mapping measure domains and subdomains to each phase of the PC CDS lifecycle based on a literature review of existing CDS and PC CDS measurement and evaluation

frameworks. Through this process, a common set of measurement domains emerged across phases, with differing subdomains based on the phase. Gaps in measurement guidance were also identified, particularly in the Knowledge Generation Phase, and supplemental literature scans will be conducted to address these areas. Based on the mapping exercise, the team began drafting the performance measurement framework.

Core 1 also held six key informant interviews with CDS artifact developers, implementers, health systems, and EHR and application developers to understand existing CDS measurement capabilities and future opportunities. In addition to semi-structured discussion, interviews involved demonstrations of developers' tools to ascertain what kind of measurement frameworks are used and how measures are implemented in the real world. Findings from the interviews will be incorporated into the framework, such as through refinement of measure domains and subdomains and addition of more specific guidance on operationalization.

Ultimately, the framework will provide a basis for consistent measurement and evaluation (e.g., identification of best practices; return on investment analyses; or assessment of the number of interventions needed to affect change) of PC CDS design, development, implementation, use, and evaluation. The aim is for the framework to be extensible and adaptable to different health care settings, patient populations, and CDS developers.

Core 2: Conducting and Coordinating CDS Projects

Clinical dashboards provide real-time feedback to healthcare providers and leaders, as opposed to a retrospective summary of care activities. Data visualization techniques can lead to a more effective decision-making process by reducing cognitive load and improving comprehension of patient data. However, there are several considerations that can impact their performance, such as data sources and availability, the design of visualizations, level of user experience and expertise, individual cognitive factors, or device being used (i.e., PC or mobile device).[iii]

Core 2 is developing two dashboards intended to operationalize the fundamental PC CDS measurement framework being developed by Core 1. The dashboards will seek to create easy-to-use, succinct views of the key measures developed for each of the facets of the framework.

Project 1: PRO Performance Measurement Dashboard. The first dashboard will be an interactive PC CDS performance dashboard focusing on interventions that use patient-reported outcomes (PROs). The dashboard will be modeled on an existing prototype CDS dashboard that is under development at Vanderbilt University that captures information from PRO-driven PC CDS, including depression screenings, fall risk assessments, and more. The dashboard is intended to support clinical director-level personnel and informaticians/developers. It will depict the status and effectiveness measures of PRO CDS at an institution in terms of "reach," "engagement," and "effectiveness." In Q3, Core 2 completed a literature review of existing PC CDS dashboards and measures. The search identified 22 papers. Findings from the literature review are being used to develop a design considerations document outlining the types of visualizations and capabilities the team will build into the dashboard. The intent is for the dashboard to improve quality and patient safety of the CDS interventions associated with the PROs collected.

Core 2 also participated in key informant interviews conducted by Core 1 to gain insight into the dashboards used by CDS developers.

After developing the design considerations document, the team will:

1) Refine the prototype at Vanderbilt
2) Load PC CDS and PRO data from the EHR and potentially other sources into the dashboard's database.
3) Conduct an expert-led heuristic usability evaluation of the prototype
4) Conduct a guided, think-aloud usability evaluation of the prototype with representative PC CDS stakeholders, including PC CDS developers, clinicians, patients, and their caregivers

Project 2: PGHD Prototype Tool. The second dashboard tool will be a prototype software toolkit for patient and clinician use that implements best practices for presentation and analysis of selected types of patient-generated health data (e.g., patient-collected, physiologic measurements) during clinical decision-making. It will include a patient app, a clinician app, and a software library that will allow others to adapt or create new visualizations for their needs. PC CDS clinical dashboards that integrate could support informed and shared decision-making processes. PGHD, in particular continuously measured physiologic parameters such as blood pressure or glucose, presents unique issues of integration into and presentation during clinical decision-making tasks due to limited availability and use of interoperability standards, the potential volume of data, and the variable circumstances in which the data is obtained and reported. On the other hand, the use of PGHD to inform clinical decisions can improve engagement and connectedness with patients,[iv] which can lead to better health outcomes, increase patient satisfaction, and improve self-management.[v] PGHD can provide a holistic picture for continuous care.[vi] Currently, there is a dearth of knowledge on optimal ways to integrate and visualize PGHD so that it informs care processes and integrates into provider workflows.

As a first step in developing this dashboard, the Core 2 team completed a scoping literature review of existing patient-collected, physiological measurements and visualization techniques, identifying best practices and challenges for presentation of this data. The team drafted a manuscript describing the literature review findings, which will be reviewed by AHRQ and the Planning Committee and eventually submitted to a peer-reviewed journal. The team will then develop a specifications document based on the literature review to inform the development of the toolkit. The document will describe at a high level the information, use cases, and capabilities of the toolkit. For example, the clinician app will include prepackaged visualizations for hypertension (e.g., blood pressure) and diabetes (e.g., blood glucose), timeline views and tabular metric displays, and the ability for the app user or support staff to add new visualizations through point-and-click configuration (e.g., for asthma, for sleep). The patient app will present self-reported blood pressure information visually to patients. Finally, the software will involve modules for visualization of FHIR data.

To develop the dashboard, the team will begin by creating pilot versions of PGHD presentation and analysis tools to refine ideas, understand the limitations of existing data and analysis methods, and gather feedback on presentation methods. If possible, the team will use PGHD collected from patients in existing projects and when not possible will use sample data collected in previous trials or synthetic data designed to mimic real-world data. The team will conduct an expert-led heuristic usability

evaluation of the prototype, in which mockups will be iteratively created and feedback obtained from visualization experts.

Planning Committee

The Innovation Center Planning Committee comprises seven thought leaders in the field of CDS. The Planning Committee meets every three months and provides strategic input for all Innovation Center Core activities. The Planning Committee met once during this quarterly reporting period.

The second Planning Committee meeting occurred on July 28, 2022. During the meeting, members were asked for input on the three projects being conducted by the two Cores (detailed further below). Members discussed gaps, challenges, and opportunities for measurement and visualization of PC CDS effectiveness and trends in the PC CDS market that can inform measurement and visualization. For example, the group discussed how aspects of encouraging use and measuring the effect of PC CDS overlap or can take insights from marketing, such as companies ensuring their information comes up in Google searches, tracking patient behavior online, or using Customer Relationship Management (CRM) systems. Members also discussed including metrics in PC CDS dashboards that are indicative of impact on patients or involve patient preferences, as well as visualization strategies for dashboards, advocating for simplicity and creating longitudinal views.

The third and fourth meetings are scheduled for October 18, 2022, and January 9, 2023. The Committee will also review materials related to Core projects and help to raise awareness of Core activities within the broader CDS community, such as by sharing the CDSiC newsletter and final deliverables such as manuscripts and reports with members of their networks.

Next steps

The Innovation Center will conduct the third meeting for the Planning Committee on October 18, 2023. Over the next 3 months, Core 1 will develop and refine the PC CDS workflow execution model and the performance measurement framework, and Core 2 will begin developing the PRO PC CDS dashboard and PGHD software toolkit.

Endnotes

[i] Agency for Healthcare Research and Quality. Section 2: Overview of CDS Five Rights. Digital Healthcare Research. https://digital.ahrq.gov/ahrq-funded-projects/current-health-it-priorities/clinical-decision-support-cds/chapter-1-approaching-clinical-decision/section-2-overview-cds-five-rights

[ii] Patient-Centered Clinical Decision Support Learning Network. Analytic Framework for Action. PCCDS-LN. Date unknown. https://pccds-ln.org/analytic-framework

[iii] Dowding D, Merrill JA, Onorato N, Barrón Y, Rosati RJ, Russell D. The impact of home care nurses' numeracy and graph literacy on comprehension of visual display information: implications for dashboard design. *J Am Med Inform Assoc*. 2018;25(2):175-182. doi:10.1093/jamia/ocx042

[iv] Office of the National Coordinator for Health Information Technology. Conceptualizing a Data Infrastructure for the Capture, Use, and Sharing of Patient-Generated Health Data in Care Delivery and Research Through 2024. Health IT. January 2018. https://www.healthit.gov/sites/default/files/onc_pghd_final_white_paper.pdf

[v] Lavallee DC, Lee JR, Austin E, et al. mHealth and patient generated health data: stakeholder perspectives on opportunities and barriers for transforming healthcare. *Mhealth*. 2020;6:8. Published 2020 Jan 5. doi:10.21037/mhealth.2019.09.17

[vi] Boston D, Cohen D, Stone J, Edwards E, Brown A, Snow M, Michaels L, Gonzalez L. Integrating Patient-Generated Health Data into Electronic Health Records in Ambulatory Care Settings: A Practical Guide. AHRQ. December 2021. https://digital.ahrq.gov/sites/default/files/docs/citation/pghd-practical-guide.pdf