

Clinical Decision Support Innovation Collaborative Base Period of Performance Report

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PURPOSE

The Clinical Decision Support Innovation Collaborative (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 to improve health outcomes of all patients by creating a proving ground of innovation. The CDSiC prepared a publicly available Period of Performance Report to summarize the activities, outputs, and outcomes of the CDSiC over the base period spanning October 2021 through September 2023.

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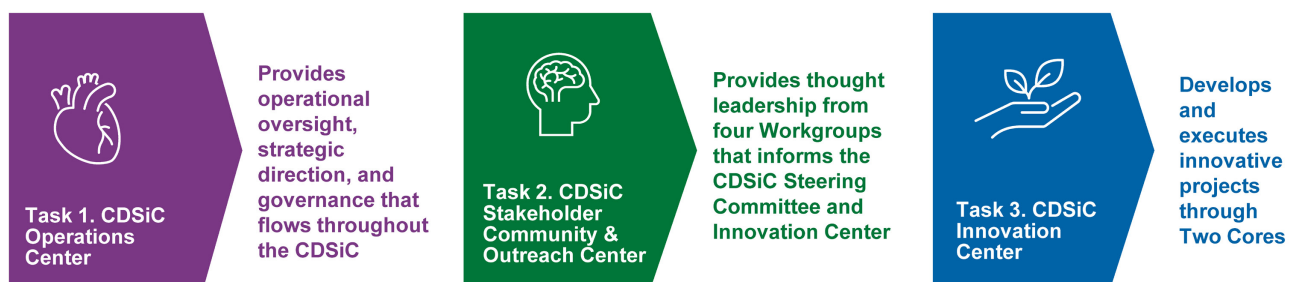
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Executive Summary

The discipline and practice of clinical decision support (CDS) have evolved significantly in recent years. However, CDS will be most impactful when it can integrate patient-centered and patient-specific information with evidence-based clinical guidance to inform healthcare decision making that aligns with patient needs and preferences. Accordingly, patient-centered CDS (PC CDS) uses findings from patient-centered outcomes research (PCOR) and/or patient-specific data (e.g., patient-generated health data, patient preference data, social determinants of health data) to deliver CDS to patients, caregivers, and/or healthcare professionals to support shared decision making.¹

In 2016, the Agency for Healthcare Research and Quality (AHRQ), through the PCOR Trust Fund, initiated a multicomponent Initiative to help advance implementation of PCOR into practice through CDS. AHRQ funded the Clinical Decision Support Innovation Collaborative (CDSiC) in 2021 to generate more evidence and resources to help translate PC CDS into practice. The CDSiC aims to better understand what makes CDS patient-centered by serving as a proving ground of innovation for PC CDS concepts and creating resources to support the development, testing, implementation, tracking, and measurement of PC CDS in the real world. The CDSiC is strategically organized into three Centers that emphasize patient-centeredness: The Operations Center, the CDSiC Stakeholder Community & Outreach Center (Stakeholder Center), and the Innovation Center. Through their coordinated activities, the Centers seek to strategically advance and innovate PC CDS in a manner that is reflective of stakeholder needs and priorities.

The CDSiC's Three Centers



In this report, we present an overview of the activities, outputs, and outcomes of the first 2 years of the CDSiC and summarize lessons learned. The intended audiences for this report are clinicians, CDS researchers, CDS content developers, electronic health record (EHR) developers, app developers, device and wearable manufacturers, health information technology (IT) standards developers, policymakers, patients/caregivers, and payers.

Methods

To track the progress and accomplishments of the CDSiC, the team used a program evaluation approach to develop a CDSiC assessment framework that characterizes:

- **Activities:** The actions carried out in the day-to-day implementation of the CDSiC, including the development of CDSiC infrastructure and development and sustainment of the CDSiC's Centers and committees.
- **Outputs:** The products of CDSiC activities, including reports, resources, and dissemination to share this work.
- **Outcomes:** Engagement of the CDS stakeholder community and reach and adoption of CDSiC outputs, as well as broader awareness of PC CDS.

The team used this framework to collect and synthesize data to summarize the CDSiC's progress to date. Data sources for the CDSiC progress assessment included website, newsletter, and social media analytics; program administrative documents and meeting attendance rosters; feedback from CDSiC Annual Meeting 2023 attendees; and qualitative feedback received from stakeholders (e.g., emails, social media posts).

Results

During the first 2 years of the CDSiC, the team developed the operational infrastructure for the CDSiC's three Centers and engaged over 100 CDS stakeholders in discussions around the current state and future promise of PC CDS. In doing so, the CDSiC convened and sustained the CDSiC's 26-member Steering Committee, four Workgroups comprising 49 stakeholders representing diverse experiences and viewpoints, and two Innovation Center Cores that pushed the current limits of PC CDS to develop new concepts and technologies. During this period, the CDSiC team also synthesized over 1,200 peer-reviewed and grey literature resources; engaged 93 experts through key informant interviews, focus groups, and technical expert panels; and developed over 30 resources for the CDS community that provide concrete recommendations and guidance for advancing the scalability, quality, and effectiveness of PC CDS. Finally, the CDSiC disseminated PC CDS resources and CDSiC outputs through various channels, including scientific journals, conference presentations, newsletters, viewpoint pieces, and the CDSiC website. The CDSiC's accomplishments from its first 2 years are summarized on the next page.

The CDSiC’s Accomplishments (October 2021-September 15, 2023)

CDSiC ACTIVITIES

The CDSiC engaged stakeholders from the patient-centered clinical decision support (PC CDS) community across its three Centers.

The CDSiC community represented a **diverse group of stakeholders**, including: Patients and Patient Representatives | Caregivers | Informaticians | Medical and Academic Institutions | Researchers | Standards Developers | Clinicians | CDS Content Developers | EHR Developers | Federal Agencies and Policymakers | Health System Representatives

26 

Steering Committee members engaged in providing strategic guidance through participation in **9** meetings.

49 

Workgroup members who provided thought leadership through **63** Workgroup meetings.

7 

Planning Committee members who provided strategic input on developing real-world implementation projects

The CDSiC team synthesized over

1,200 

peer-reviewed and grey literature resources.



The CDSiC team engaged

93 

PC CDS experts in key informant interviews, focus groups, and technical expert panels.

CDSiC OUTPUTS

The CDSiC team developed **15 products and projects** under the Stakeholder Center and Innovation Center, as well as **17 resources and 6 conference presentations** to increase awareness of PC CDS.

- ▶ The four CDSiC Workgroups developed **12 unique PC CDS products**. 
- ▶ The Innovation Center developed **3 unique PC CDS implementation projects**, spanning **10 deliverables**, including **2 manuscripts** for publication in peer-reviewed journals.
- ▶ The Operations Center published **10 AHRQ CDSiC Insider Newsletters**, **3 leadership viewpoint** pieces, the **public-facing CDSiC website**, an **infographic** explaining the definition of PC CDS, and a **vignette** describing the real-world application of PC CDS.
- ▶ The CDSiC team **presented on PC CDS at AcademyHealth’s 2023 Annual Research Meeting and MedInfo 2023**.
- ▶ The CDSiC team will have **4 presentations** at the **American Medical Informatics Association (AMIA) 2023 Annual Symposium**. 

CDSiC REACH AND ENGAGEMENT

The Operations Center has publicly disseminated information about PC CDS and the CDSiC to the CDS community.

CDSiC Newsletter 

543 subscribers

CDSiC Website 

16,700+ views by **3,800** unique visitors between March 2023 and September 15, 2023

Social Media

1,500,000+ combined Twitter/X Impressions 

Lessons Learned

In establishing the CDSiC and managing the collaborative through its first 2 years, the team has consistently reflected upon its processes, achievements, and challenges. This has afforded the team frequent opportunities to identify successful strategies for advancing the field of PC CDS through the work of the CDSiC, while navigating and adapting to any difficulties that have arisen. Key takeaways are listed below.

1. To meaningfully advance the state of PC CDS through the development and dissemination of over 30 innovative resources, the CDSiC has operationalized the following lessons:
 - Ensuring coordination across the Workgroups and Innovation Center is essential so that the whole is greater than the sum of its parts. Maintaining alignment across the Workgroups and Innovation Center was essential to ensure that they worked collaboratively to inform each other's work, created outputs that built on the CDSiC's previous work, and ultimately furthered the CDSiC's goals to advance PC CDS and shared decision making.
 - The importance of strategic planning, given the size and scope of the collaborative. Strategic planning, both across and within teams and in both large and small forums, has been imperative to ensure that the CDSiC's various components work together smoothly and toward one shared vision.
 - The necessity of keeping a pulse on the PC CDS landscape. Staying informed of recent developments in the CDS landscape was critical to prevent the replication of previous work and to ensure the CDSiC built on the innovative and helpful work of other experts in the field of CDS.
 - Ensuring that we are deliberate in engaging our patient stakeholders. Meaningfully advancing the field of PC CDS requires that patients be involved in all stages of the PC CDS lifecycle. The team sought to consciously engage patients in various aspects of the CDSiC's operations (e.g., through the Steering Committee and Workgroups, and via key informant interviews, focus groups, and technical expert panels) to ensure that the CDSiC's outputs ultimately benefit patients by incorporating their needs, values, and preferences.
2. To operate a successful collaborative that had the necessary infrastructure in place to generate innovation in the field of PC CDS, the CDSiC team identified the following important lessons:
 - Maintaining stakeholder engagement and participation. The scope and geographic dispersion of the CDSiC community required the use of deliberate strategies to maintain participation in CDSiC activities and solicit feedback, both synchronously during meetings and asynchronously between meetings.
 - Maintaining competing timelines. To maintain momentum and hit target deadlines, each of the Workgroups developed and revised two or three products simultaneously. This required Workgroup support teams to create detailed internal timelines and identify how to optimally sequence different product tasks, divide tasks efficiency across team members, and employ

processes for soliciting and rapidly incorporating Workgroup member feedback into products while maintaining product scope and timeline.

- Being adaptive and flexible. The team needed to remain nimble to adapt project plans to real-world constraints, including those caused by COVID-19, as well as challenges in engaging key informants in emerging areas that have had limited work to date (e.g., visualization of patient-generated health data).

Conclusion

The CDSiC aims to advance the design, development, testing, implementation, evaluation, and measurement of PC CDS by creating publicly available resources and serving as a proving ground of innovation for PC CDS concepts. Comprised of three Centers—the Operations Center, Stakeholder Center, and Innovation Center—the CDSiC has mobilized and engaged diverse CDS stakeholders with a range of perspectives to establish a collaborative network focused on advancing the science and practice of evidence-based, shareable, interoperable, and publicly available PC CDS. Furthermore, during its first 2 years, the CDSiC developed 12 public-facing Workgroup products; 10 Innovation Center deliverables, including two manuscripts for publication in peer-reviewed journals; and 17 additional resources to raise awareness of PC CDS, disseminated through email, social media, and on the CDSiC website.

The CDSiC has created products and resources that can help to build a foundation for use of PC CDS in clinical practice. The accomplishments of the CDSiC to date have hinged on strategic planning and coordination within and across tasks, staying up to date on PC CDS developments, identifying strategies for meaningfully engaging stakeholders—including patient advocates and representatives, managing competing timelines, and by flexibly adapting to unforeseen challenges. In the future, the CDSiC will continue to engage patients, clinicians, researchers, developers, payers, and Federal agency representatives to identify additional gaps and opportunities in the PC CDS landscape, develop pragmatic resources and guidance for PC CDS, and encourage the widespread use of PC CDS tools to improve the health of all patients.

1. Introduction

The Clinical Decision Support Innovation Collaborative (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. This report presents an overview of the activities, outputs, and impact from the base period (October 2021-September 2023) of the CDSiC.

1.1 Background and Context

The discipline and practice of CDS have evolved significantly in recent years. Access to mobile technologies and broadband internet has allowed consumers to become more engaged participants in their own healthcare. Furthermore, the emergence of Fast Healthcare Interoperability Resources® (FHIR) and other CDS standards are beginning to reduce barriers to CDS deployment and integration. These standards have provided a scalable architecture for many CDS services and applications. However, to deliver on its promise of higher quality care delivery and improved health outcomes, CDS must provide patients, caregivers, and care teams with the right information, in the right formats, through the right channels, at the right times.^{2,3} CDS will be most impactful when it can integrate patient-centered and patient-specific information with evidence-based clinical guidance to inform healthcare decision making that aligns with patient needs and preferences (i.e., PC CDS).⁴ PC CDS supports individual patients or caregivers and their care teams in health-related decisions and actions using findings from patient-centered outcomes research (PCOR) and/or patient-specific information (e.g., patient-generated health data [PGHD], social determinants of health [SDOH] data, patient preference data).⁵

In 2016, the Agency for Healthcare Research and Quality (AHRQ), through the PCOR Trust Fund, introduced a multicomponent Initiative to help advance the implementation of PCOR into practice through CDS.⁶ AHRQ's initiative has included funding a learning network, funding targeted CDS research, building a platform for sharing CDS (CDS Connect),⁷ developing an application programming interface to access AHRQ evidence-based resources (CEDAR)⁸, and conducting an evaluation of the overall initiative.⁹ The knowledge gained from this initiative highlighted the need for more evidence and resources to help translate PC CDS into practice. The AHRQ-funded CDSiC builds on AHRQ's prior work to serve as a hub for stakeholder engagement to advance the field of PC CDS.¹⁰

1.2 Roadmap of Report

This report summarizes and reflects on the progress of the CDSiC during the collaborative's first 2 years. Chapter 2, *Methods*, describes the assessment framework used to develop and organize the report, as well as the report's data sources. Chapter 3, *Results*, presents the CDSiC's activities and accomplishments, organized across the CDSiC's three Centers. Chapter 4, *Discussion*, discusses the lessons learned from the first 2 years of the CDSiC, including the CDSiC's strategies for successfully engaging and collaborating with a broad group of stakeholders that contribute diverse perspectives on CDS.

The intended audiences for this document are clinicians, CDS researchers, CDS content developers, electronic health record (EHR) developers, app developers, device and wearable manufacturers, health information technology (IT) standards developers, policymakers, patients/caregivers, and payers.

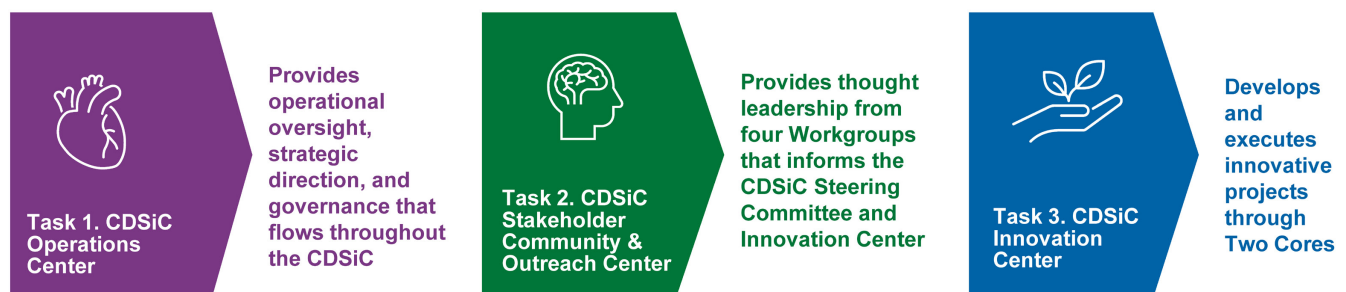
1.3 Purpose of the CDSiC

Launched in 2021, the CDSiC is a diverse community of stakeholders at the forefront of using technology to better support care teams, patients, and caregivers. The CDSiC aims to better understand what makes CDS patient-centered by serving as a proving ground of innovation for PC CDS concepts and creating resources to support the development, testing, implementation, tracking, and measurement of patient-centered CDS in the real world. The CDSiC aspires to shape the future of PC CDS by identifying gaps and opportunities to achieve a world in which patients, caregivers, and care teams receive evidence-based information to support shared decision making.

1.4 Design of the CDSiC

The CDSiC comprises four tasks: 1) governance and operations, 2) stakeholder collaboration, 3) PC CDS research initiatives, and 4) project management of the overall CDSiC. The CDSiC is strategically organized into three Centers that emphasize patient-centeredness (Exhibit 1).

Exhibit 1. The CDSiC's Three Centers



- 1) The Operations Center is the heart of the CDSiC and is instrumental in shaping the CDSiC's strategic direction, disseminating findings, and advancing the field of PC CDS. The Operations Center also houses a Steering Committee of nationally recognized multidisciplinary experts who advise and inform a vision for the CDSiC.
- 2) The Stakeholder Community and Outreach Center (Stakeholder Center) provides thought leadership for the CDSiC, drawing from the expertise of a range of stakeholders, including patients, clinicians, researchers, health IT and CDS developers, informaticians, payers, and policymakers. These stakeholders are organized in four topic-focused Workgroups: 1) CDS Outcomes and Objectives; 2) Scaling, Measurement, and Dissemination of CDS; 3) Trust and Patient-Centeredness; and 4) CDS Standards and Regulatory Frameworks. These Workgroups

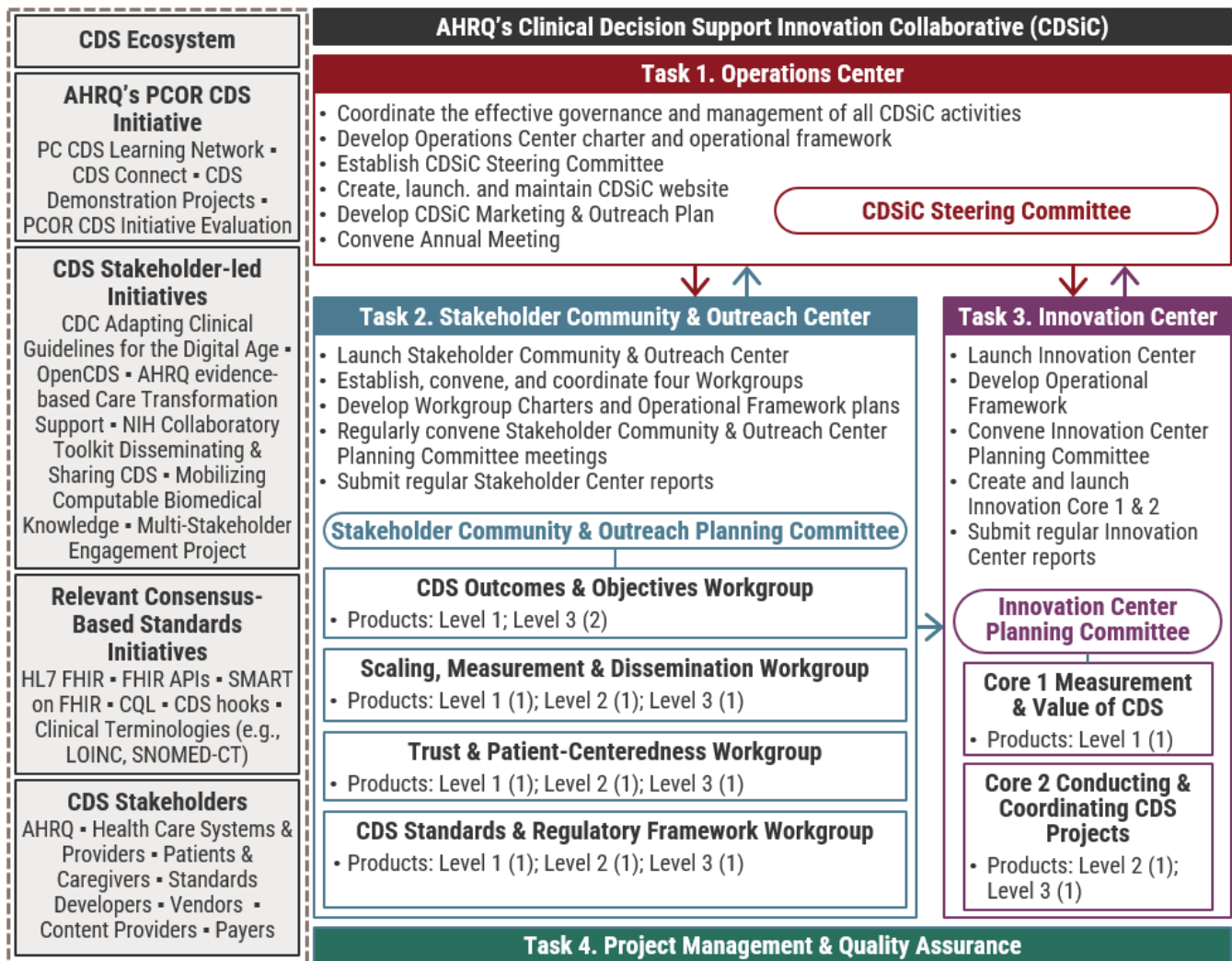
develop products such as environmental scans, research agendas, and frameworks that advance the field of PC CDS.

- 3) The Innovation Center is the CDSiC's research and development hub that facilitates real-world application of CDSiC tools, learnings, and insights. The Innovation Center has two Cores: 1) the Measurement and Value of CDS Core and 2) the Conducting and Coordinating CDS Projects Core.

1.5 Collaboration and Alignment Across Centers

Through their coordinated activities, the Centers seek to strategically advance and innovate PC CDS in a manner that is reflective of stakeholder needs and priorities. The products and activities of the CDSiC were designed such that the combination of different Workgroup and Core activities contribute to the larger objective of advancing PC CDS and shared decision making. In doing so, the impact of the whole (i.e., CDSiC) was envisioned to be greater than the impact of the constituent parts (i.e., each Workgroup and Core). While the day-to-day operations and governance of each Center function somewhat independently, they are ultimately linked, forming an integrated, collaborative network of tasks and deliverables. Exhibit 2 illustrates the CDSiC's technical approach to governance and synergy across all components.

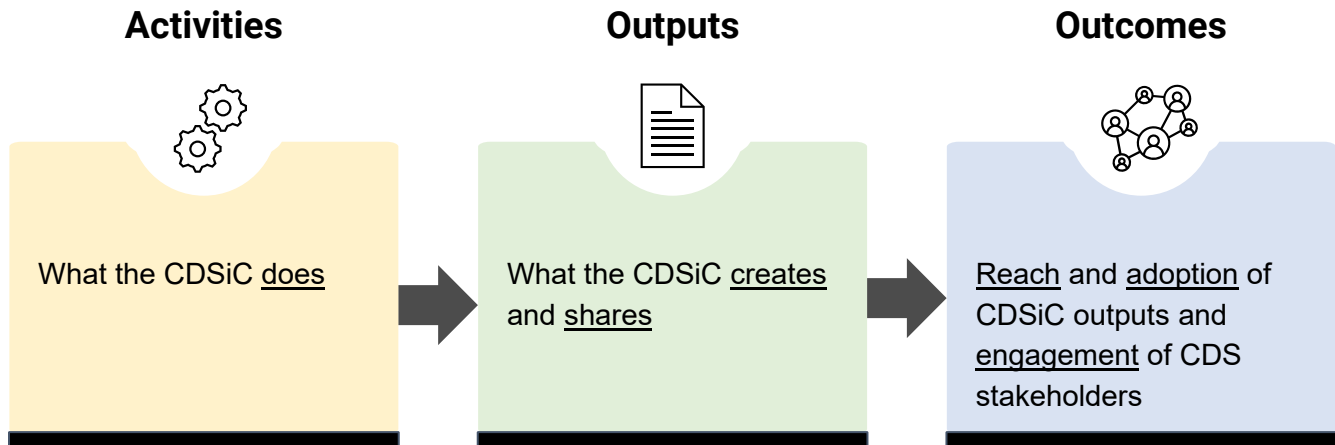
Exhibit 2. Overview of CDSiC Organizational Structure



Abbreviations: API, Application Programming Interface; CDS, Clinical Decision Support; CQL, Clinical Quality Language; FHIR, Fast Healthcare Interoperability Resources; LOINC, Logical Observation Identifiers Names and Codes; NIH, National Institutes of Health; PCOR, Patient-Centered Outcomes Research; SNOMED-CT, Systemized Nomenclature of Medicine – Clinical Terms

2. Methods

To track the progress and accomplishments of the CDSiC, NORC at the University of Chicago (NORC) developed a progress assessment framework in conjunction with AHRQ, CDSiC partners, and CDSiC Steering Committee members. The progress assessment framework was refined iteratively during project meetings and via asynchronous feedback obtained through email and on the project's Microsoft SharePoint site. The framework was developed using a program evaluation approach¹¹ and includes three sequential domains, illustrated in the logic model in Exhibit 3.

Exhibit 3. Logic Model Used to Develop the CDSiC Assessment Framework

Activities refer to the actions carried out in the day-to-day implementation of the CDSiC, including the development of CDSiC infrastructure and development and sustainment of the CDSiC's Centers and committees. Outputs refer to products of CDSiC activities, including written reports, resources, and dissemination to share this work. Outcomes refer to engagement of the CDS stakeholder community and reach and adoption of CDSiC outputs, as well as broader awareness of PC CDS. The assessment framework is provided in Appendix A.

The project team routinely collected data as a byproduct of project activities. Data sources for the CDSiC progress assessment included website, newsletter, and social media analytics; program administrative documents and meeting attendance rosters; feedback from CDSiC Annual Meeting 2023 attendees; and qualitative feedback received from stakeholders (e.g., emails, social media posts).

The CDSiC assessment framework serves as an organizing structure for this Period of Performance Report. In the sections that follow, we describe the activities of the CDSiC during its first 2 years, as well as the products of CDSiC activities (i.e., outputs), and the reach and adoption of these outputs (i.e., outcomes), based on the data available at the time of writing.

3. Results

The CDSiC's activities and accomplishments over the first 2 years are presented below. After describing the Vision and Mission statements that guide the work of the CDSiC, the activities, outputs, and outcomes are presented below by task, followed by a description of outcomes that transcend tasks and reflect the totality of the CDSiC initiative.

3.1 Vision and Mission Statement

The collective activities of the CDSiC are guided by its Vision and Mission statements,¹² which describe what the CDSiC hopes to achieve (Vision) and what the CDSiC will do to achieve this (Mission).

Through a collaborative process, the CDSiC project team and Steering Committee developed the Vision and Mission statements as an initial activity of the project. The Vision and Mission statements were finalized and shared with the Steering Committee in February 2022.

AHRQ and the CDSiC project team called upon the expertise of the Steering Committee to ensure the Vision and Mission statements reflect the diverse perspectives and knowledge of the CDS community. We reviewed Vision and Mission statements from other collaboratives and initiatives to identify the core components the CDSiC would address as defined by the scope of the project and the intended impact. Based on this initial review, we drafted four Vision statements and three Mission statements, and collected initial feedback on these draft statements from the Steering Committee at the inaugural Steering Committee meeting in December 2021. The CDSiC project team then revised the statements based on the initial feedback and gathered asynchronous feedback from the Steering Committee via a Qualtrics feedback form. Steering Committee members ranked the four Vision statements and three Mission statements and suggested revisions to the wording of their most preferred statements. AHRQ and the CDSiC leadership team selected the most popular Vision and Mission statements and revised them according to Steering Committee feedback, their expertise, and what made sense within the scope of the project. The collective feedback of the Steering Committee is reflected in the final Vision and Mission statements below (Exhibit 4). These statements provide essential context for the results described within this section.

Exhibit 4. The CDSiC's Vision and Mission Statements**CDSiC VISION STATEMENT**

A world where patients, caregivers, and care teams have the right information at the right time to make evidence-informed decisions that improve health and well-being for all individuals.

**CDSiC MISSION STATEMENT**

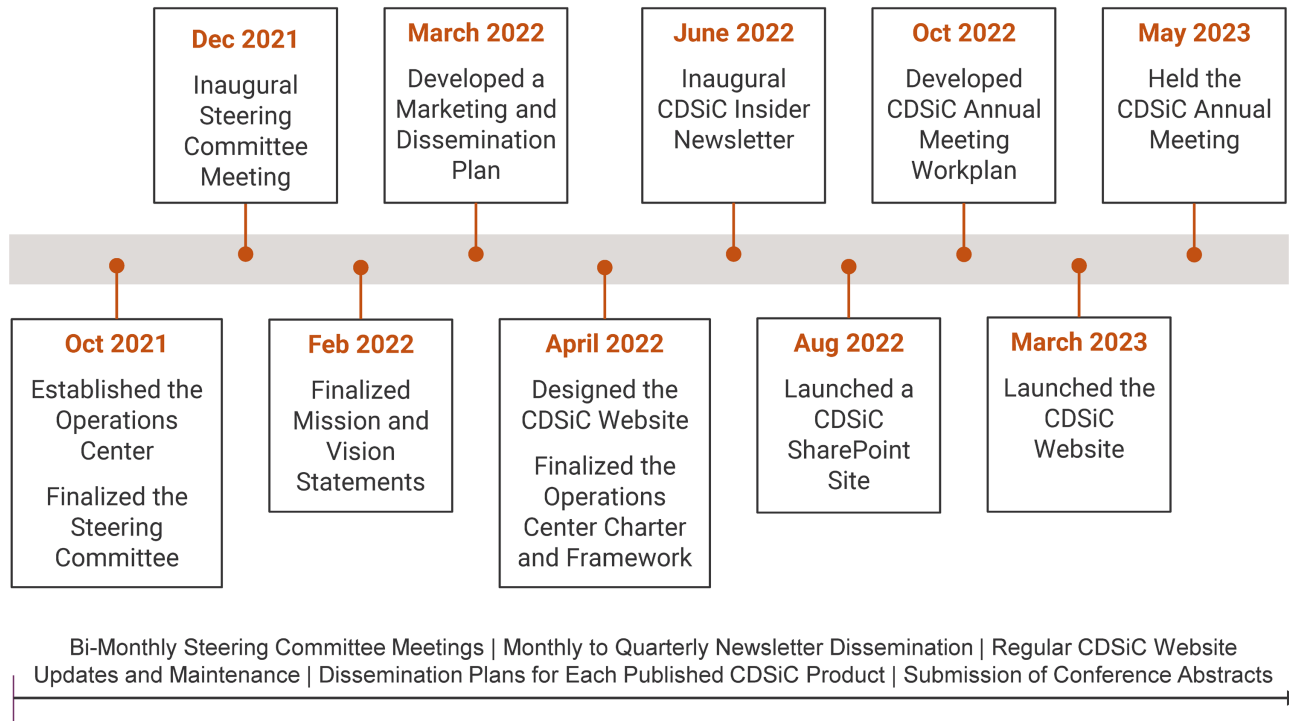
The CDSiC aims to advance the design, development, dissemination, implementation, use, measurement, and evaluation of evidence-based, shareable, interoperable, and publicly available patient-centered clinical decision support (PC CDS) to improve health outcomes of all patients by creating a proving ground of innovation. To achieve this, the CDSiC will:

- Create a learning community to share and advance the knowledge, tools, standards, frameworks, and techniques for designing, developing, implementing, using, measuring, and evaluating high-quality, PC CDS.
- Promote the practice and adoption of PC CDS that facilitates whole-person care and considers the patient, caregivers, and clinician workflows, preferences, and values around shared decision making.
- Advance standards-based PC CDS that can be shared with patients, caregivers, clinicians, healthcare organizations, and health IT developers across the U.S. and result in measurable improvements in healthcare, patient health, patient care experience, and provider experience.

3.2 Task 1: Operations Center

During the first 2 years of the CDSiC, the Operations Center laid essential groundwork for the daily activities of the CDSiC and played a crucial role in shaping the CDSiC's strategic direction, raising awareness of the CDSiC's efforts and disseminating findings, and advancing the field of PC CDS. The activities of the Operations Center are described below, followed by the outputs and outcomes stemming from these activities. Section 3.2.3 summarizes challenges experienced over the course of this work and strategies for resolution. Exhibit 5 provides key milestones and major ongoing activities of the Operations Center between October 2021 and September 2023.

Exhibit 5. Overview of Operations Center Activities and Timeline



3.2.1 Operation Centers Infrastructure and Activities

Since its launch in October 2021, the CDSiC Operations Center established infrastructure to serve as the foundation of CDSiC activities and drive the direction of the CDSiC. The Operations Center developed a Charter and Operational Framework (finalized April 2022), visual identity guidelines that were consistent and complimentary with AHRQ branding (November 2022), the CDSiC Outreach and Marketing Plan (finalized March 2022), and a CDSiC SharePoint site (finalized August 2022). The Operations Center also convened the CDSiC’s Steering Committee and held quarterly meetings. These activities are described in more detail below.

Charter and Operational Framework

CDSiC leadership developed the Operations Center Charter to formally initiate the work of the Operations Center.¹³ This Charter outlines the Operations Center’s purpose and objectives, as well as outputs and projected outcomes of Center activities, potential challenges, relevant stakeholders involved in Center work, and decision-making frameworks. CDSiC leadership also produced an Operations Center Operational Framework to establish the Center’s structure, functions, goals, and processes related to the Center’s

Charter and Operational Framework Produced

- Operations Center Charter
- Operations Center Operational Framework

core activities, including dissemination, stakeholder coordination, and strategic planning.¹⁴ Core elements of these documents were shared with key CDSiC stakeholders during the first CDSiC Steering Committee meeting in December 2021. The Operations Center Charter and Operational Framework are both available for reference on the CDSiC's SharePoint and public CDSiC website.

Steering Committee

The CDSiC is guided by a 26-member Steering Committee that serves to advise, support, and guide the project's activities and strategic vision. Within 3 weeks of contract award, CDSiC leadership reached out to all proposed Steering Committee members, confirmed their participation, and established agreements for their participation. The Steering Committee was formed by November 2021. The Steering Committee comprises experts representing a range of disciplines and stakeholder groups, including patient advocates, EHR developers, health system leaders, researchers, and Federal representatives (Exhibit 6).

Exhibit 6. Composition of the CDSiC Steering Committee



Since October 2021, CDSiC leadership has organized nine Steering Committee meetings, with the first Steering Committee meeting held in December 2021. Each 2-hour, virtual Steering Committee meeting serves as an opportunity to share critical project updates, receive feedback on CDSiC activities, and feature presentations relevant to the CDS community. The meetings are well-attended, with an average of 19 Steering Committee members attending each meeting. Exhibit 7 provides a description of Steering Committee meeting topics and attendance.

Exhibit 7. Steering Committee Meetings, Topics, and Attendance

Meeting Date	Meeting Topics	Steering Committee Member Attendance
December 16, 2021	<ul style="list-style-type: none"> • Introduction to the CDSiC • Input on CDSiC mission and vision statements • Discussion of roles and expectations of the Steering Committee as outlined in the Operations Center Charter 	20
February 24, 2022	<ul style="list-style-type: none"> • Review of final CDSiC Mission and Vision statements • Discussion on CDSiC website content 	22
April 28, 2022	<ul style="list-style-type: none"> • Preview of CDSiC dissemination plan • Steering Committee member presentations on EHR developer-led PC CDS efforts 	21
June 23, 2022	<ul style="list-style-type: none"> • Presentation and discussion of proposed Workgroup products 	16
September 6, 2022	<ul style="list-style-type: none"> • Steering Committee member presentation on PC CDS trends in the field • External stakeholder presentation led by Story Health • Presentation and discussion of Innovation Center projects 	19
November 10, 2022	<ul style="list-style-type: none"> • Steering Committee member presentation on FDA CDS Software Final Guidance • CDSiC 2023 Annual Meeting update and discussion • Preview of CDSiC measurement efforts 	17
January 11, 2023	<ul style="list-style-type: none"> • Steering Committee member presentation on the Centers for Disease Control and Prevention's (CDC's) Adapting Clinical Guidelines for the Digital Age Initiative • Review and discussion of CDSiC 2023 Annual Meeting agenda • Summary of the CDSiC's accomplishments • Discussion of the CDSiC's Progress Assessment Framework 	20
March 7, 2023	<ul style="list-style-type: none"> • External stakeholder presentation led by PatientLink Enterprises on a CDS tool developed with CDC • Review of updated CDSiC 2023 Annual Meeting agenda and proposed breakout session exercise • Update on the Stakeholder Center Workgroup products • Review of CDSiC dissemination activities and dissemination prioritization activities 	22
<i>Note: A Steering Committee meeting was not held in May 2023 due to the CDSiC 2023 Annual Meeting.</i>		
July 13, 2023	<ul style="list-style-type: none"> • CDSiC 2023 Annual Meeting recap and discussion of the meeting's key takeaways • Update on Stakeholder Center Workgroup products • Update on Innovation Center products • Preview of upcoming meetings and project next steps 	15

CDSiC Outreach and Marketing Plan

The CDSiC’s marketing and outreach activities are guided by a multifaceted, comprehensive, and strategic Outreach and Marketing Plan that was approved by AHRQ’s Office of Communications (OC) in April 2022. Activities described in the plan support AHRQ’s broader dissemination work, and the team coordinates closely with OC on each individual product dissemination campaign. The key objectives of the plan are to 1) increase the visibility of the CDSiC, 2) position the effort as a trusted source of information that increases uptake of CDSiC products and findings, and 3) enable bidirectional engagement of diverse stakeholders. The plan identifies and describes key target audiences, including clinicians and healthcare system stakeholders, researchers, CDS and health IT developers, patients, families and advocates, payers, and policymakers. The plan also includes details about the processes and mechanisms that guide outreach and marketing efforts, as well as a description of the channels and formats to leverage (Exhibit 8).

Exhibit 8. Summary of Identified Channels and Formats for CDSiC Outreach and Marketing

Channels How Content Arrives to the Audience	Formats What Form the Content Takes
<ul style="list-style-type: none"> • AHRQ CDSiC website • CDSiC SharePoint • Newsletters <ul style="list-style-type: none"> – AHRQ News Now electronic newsletter with 130,000 subscribers – AHRQ CDSiC Insider Newsletter distributed bimonthly to a list of key stakeholders (over 540 subscribers) • Social media including @AHRQNews and other stakeholder accounts on LinkedIn, Facebook, and YouTube • Amplifier networks <ul style="list-style-type: none"> – Steering Committee – Workgroup leadership and members – AcademyHealth – NORC team • Events and conferences <ul style="list-style-type: none"> – CDSiC Annual Meeting – CDSiC webinars – External conferences • External outlets <ul style="list-style-type: none"> – Healthcare Innovation Blog – Health IT Buzz blog • Journals (examples) <ul style="list-style-type: none"> – Journal of American Medical Informatics Association – Journal of Biomedical Informatics – Applied Clinical Informatics – BMJ Health & Care Informatics – Journal of the American Medicine Association – EHRIntelligence 	<ul style="list-style-type: none"> • Published report or white paper • Webinar or presentation • Discussion panel • Innovation snapshot • Viewpoint post • Peer-reviewed manuscript • Commentary or editorial • Video • Infographic • Image

Visual Identity Guidelines

To help increase visibility of the CDSiC—one of the key objectives of the Outreach and Marketing—the team recognized the importance of consistently capturing the ethos of the CDSiC visually. The team developed the Visual Identity Guidelines in accordance with the AHRQ Publishing and Communications Guidelines. Approved by AHRQ in November 2022, the guidelines ensure that the CDSiC’s visual identity is communicated correctly internally and presented consistently to external audiences. The guidelines support a uniquely recognizable visual identity to stand out from other efforts and remain memorable in the minds of stakeholders. They were instrumental in guiding the design of the CDSiC’s website, as well as other communications products such as slide decks, report covers, poster templates, and other publicly available documents. Specifically, the guidelines describe the CDSiC design elements, color palette, typographic fonts, and photography style. As an AHRQ initiative, all public-facing CDSiC documents and products also include the required AHRQ branding and contract information in accordance with AHRQ Publishing and Communications Guidelines. Additionally, design elements associated with the CDSiC use the Digital Healthcare Research branded color palette.

SharePoint Development

The CDSiC SharePoint site, launched in August 2022, serves as a platform for collaborative document editing for the Workgroups, Steering Committee, and Innovation Center. All Workgroup, Steering Committee, and Innovation Center members and leads (76 individuals), along with NORC and AcademyHealth project staff, have access to the SharePoint and permission to edit relevant documents posted there.

The SharePoint is organized into three distinct spaces focused on the work of the Steering Committee, Stakeholder Center, and Innovation Center. This system allows CDSiC members to quickly and easily find the content most relevant to their efforts, including meeting materials, reports, and products.

CDSiC members actively use the SharePoint to review and refine project materials. Documents added to the SharePoint for collaboration include meeting materials for all three Centers, presentation slides for each of the CDSiC 2023 Annual Meeting’s 14 sessions, draft iterations of all Innovation Center projects and Workgroup products, and drafts of each CDSiC Center’s charter.

3.2.2 Operations Center Outputs and Outcomes

This section provides an overview of Operations Center outputs, such as the 2023 Annual Meeting, AHRQ CDSiC Insider Newsletter, supporting materials, social media posts, viewpoint posts, and the [CDSiC public website](#), as well as the reach of these outputs and associated engagement of the CDS community.

CDSiC Annual Meeting

The first CDSiC Annual Meeting took place May 16 and 17, 2023, at AHRQ Headquarters in Rockville, Maryland. The meeting served as an opportunity for stakeholders to engage with and learn from other members of the CDSiC and PC CDS communities, share feedback on the next phase of the CDSiC, and participate in discussions on critical PC CDS topics. The meeting was organized around the theme of, “Meeting the Moment: How can we make CDS work for today’s patients, in today’s healthcare ecosystem?” It featured a total of 14 sessions on a range of relevant topics, including trust in PC CDS, measuring PC CDS, and the PC CDS standards and regulatory landscape.

A total of 73 attendees joined the Annual Meeting, most in person and some virtually. In addition to plenary sessions, attendees also participated in an interactive breakout session in which they shared input on the solutions or resources needed to advance the field of PC CDS, and provided suggestions for actions the CDSiC can pursue in the future to move the field forward. Exhibit 9 below describes each Annual Meeting session.

Exhibit 9. Annual Meeting Sessions

Session Type	Session Topic
Day 1	
Opening Plenary	Grounding presentation that welcomed meeting participants and provided an overview of the CDSiC.
Plenary Session	Moderated roundtable featuring patient advocates that focused on the promise of PC CDS for patients.
Plenary Session	Moderated panel presentation that highlighted efforts to advance measurement for PC CDS.
Keynote Presentation	Keynote presentation by Dr. Rebekah Angove of the Patient Advocate Foundation.
Remarks from Dr. Robert Valdez	Brief remarks from AHRQ Director Dr. Robert Valdez centered on AHRQ’s patient focus.
Plenary Session	Moderated panel presentation on patient preferences for PC CDS.
Plenary Session	Demonstration of two Innovation Center dashboards, one focused on PGHD, the other on visualizing PC CDS performance metrics and patient-reported outcomes (PROs).
Closing Remarks	Brief remarks closing Day 1 of the Annual Meeting.
Day 2	
Plenary Session	Moderated panel presentation on the current PC CDS regulatory landscape and implications for PC CDS researchers and developers.
Interactive Breakout Session Orientation	Introduction to the “Advancing PC CDS” breakout session exercise.

Session Type	Session Topic
Interactive Breakout Session	Moderated breakout group discussions focused on opportunities for advancing the field of PC CDS.
Plenary Session	Debrief and full-group discussion of ideas that emerged from the small-group breakout sessions.
Plenary Session	Moderated panel presentation highlighting CDSiC work focused on increasing trust in PC CDS from design to implementation.
Closing Remarks	Reflections on the Annual Meeting's key themes and opportunities for future work.

All Annual Meeting attendees received a brief, nine-question meeting evaluation survey. The survey received 22 responses for a response rate of 29%. Feedback was largely positive, with all (100%) respondents indicating that they were “very satisfied” with the meeting’s speakers and the vast majority (95%) indicating they were “very satisfied” with the meeting’s session topics. Respondents shared that the most impactful session was the moderated patient roundtable, and qualitative feedback also noted that the presence of patients and patient advocates strengthened the meeting.

Following the Annual Meeting, the CDSiC leadership team reviewed meeting notes and identified key themes and related opportunities for advancing PC CDS. These opportunities are being summarized in a commentary that the CDSiC plans to submit to a peer-reviewed journal for publication consideration.

The AHRQ CDSiC Insider Newsletter

The CDSiC newsletter, titled the AHRQ CDSiC Insider, serves as a mechanism for the CDSiC team to share project updates, as well as news relevant to the broader CDS community, including recent publications, upcoming conferences, and webinar opportunities. Since launching in June 2022, a total of 13 newsletters have been disseminated on a near-monthly basis. Popular content (content with higher click rates) often includes CDSiC-focused materials, such as infographics and product announcements. As of September 2023, the newsletter had 543 subscribers. Subscribers largely comprise individuals who signed up initially using AHRQ’s Conference Management Application (CMA) webform, as well as individuals who joined the distribution list via the CDSiC website’s “[Get Involved](#)” form. Exhibit 10 lists each newsletter, its featured topics, and open rate (the percentage of successfully delivered newsletters that were opened by recipients).

Exhibit 10. CDSiC Newsletter Topics and Open Rates

Month	Topics	Open Rate
June 2022	Introduction to the CDSiC and PC CDS; PC CDS publications from CDSiC leadership; webinar and conference announcements	53%
July 2022	Project overview announcement; CDSiC leadership spotlight; CDSiC product descriptions; new CDS-relevant publications	41%

Month	Topics	Open Rate
August 2022	Update on Innovation Center activities; CDS's relevance to patients/patient advocates, clinicians, researchers, and developers; new CDS-relevant publications	38%
September 2022	Featured real-world PC CDS example; CDSiC Workgroup leads; conference announcements; new CDS-relevant publications	38%
October 2022	CDSiC Project Map; CDSiC Workgroup leads; conference announcements; new CDS-relevant publications	34%
November 2022	CDSiC's first-year accomplishments; Stakeholder Center updates; announcement of published CDSiC viewpoint pieces; conference and webinar news	44%
January 2023	Update on Stakeholder Center and Innovation Center products; announcement of new CDSiC leadership publication in <i>Applied Clinical Informatics</i> ; webinar and job opening news; new CDS-relevant publications	51%
March 2023	CDSiC website launch announcement featuring links to key website content	43%
May 2023	Stakeholder Center and Innovation Center updates; AHRQ PCOR CDS Initiative evaluation findings; webinar and conference news; new CDS-relevant publications	44%
June 2023	Announcement of Standards and Regulatory Frameworks Workgroup's Environmental Scan product; CDSiC 2023 Annual Meeting update; webinar and virtual workshop news; news on CDSiC poster featured at AcademyHealth conference; Innovation Center update	39%
August 2023	Announcement of the Outcomes and Objectives Workgroup's Taxonomy of Patient Preferences product	41%
August 2023	Announcement of the Trust and Patient-Centeredness Workgroup's Improving the Source Credibility of Patient-Centered Clinical Decision Support Tools product; recent articles by CDSiC leadership and members; virtual workshop news and conference news; Innovation Center and Stakeholder Center updates; new CDS-relevant publications	37%
September 2023	Announcement of the Scaling, Measurement, and Dissemination Workgroup's Approaches to Measuring Patient-Centered CDS Workflow and Lifeflow Impact product	37%

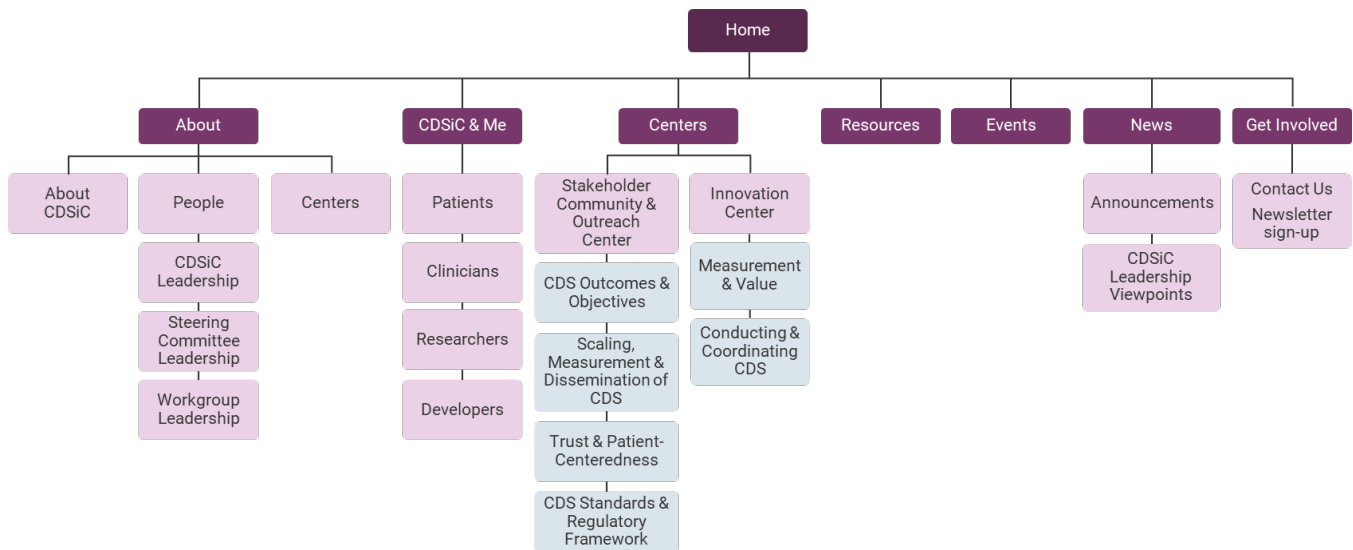
Supporting Materials

The project team has developed public-facing materials to increase awareness of the CDSiC and the broader field of PC CDS. These materials include the [PC CDS Explained infographic](#), which provides a definition of PC CDS.¹⁵ The CDSiC team also produced a [project summary](#) describing the CDSiC's goals, structure, and intended outcomes,¹⁶ which was distributed at the 2022 American Medical Informatics Association (AMIA) Symposium AHRQ booth to raise awareness of the project. Finally, the CDSiC created a [vignette](#) featuring a real-world example of a PC CDS initiative on postpartum hypertension monitoring,¹⁷ demonstrating one of many ways PC CDS can support patient-centered care.

Website Development

The [CDSiC project website](#), officially launched in March 2023, features information on the project’s aims, leadership, and structure; pages describing the CDSiC’s relevance to patients, clinicians, developers, and researchers; descriptions of the purpose and activities of each of the project’s Centers; Leadership Viewpoint pieces and project resources; announcements of upcoming events and other news; and a “Get Involved” page that allows individuals to sign up for the AHRQ CDSiC Insider newsletter or reach out to the project team.¹⁸ Exhibit 11 depicts the current site map for the CDSiC website.

Exhibit 11. Site Map of CDSiC Website



Planning for the CDSiC website began in October 2021. During the February 2022 Steering Committee meeting, the CDSiC team gathered initial feedback on how the website could be used as a dissemination tool for CDSiC products. In May 2022, during the website content development and design phase, the CDSiC project team conducted message testing with Steering Committee members representing each key stakeholder group of the CDSiC (i.e., researchers, patients, clinicians, and developers). The message testing involved collecting reactions to drafted website content to understand how it resonated with stakeholders. After message testing, the CDSiC project team finalized content for the main website landing pages.

As of September 18, 2023, the website’s resource library contains 40 resources and three Leadership Viewpoint pieces. Users can search the resource library through a keyword search feature, which allows users to conduct searches by resource publication date and title. Resources include finalized CDSiC products, reports, peer-reviewed manuscripts produced by CDSiC leadership, Center Charters and Operational Frameworks, infographics, and vignettes. Exhibit 12 provides the full list of resources available on the CDSiC website as of September 18, 2023. Resources will continue to be added to the website as they are finalized.

Exhibit 12. CDSiC Website Resources

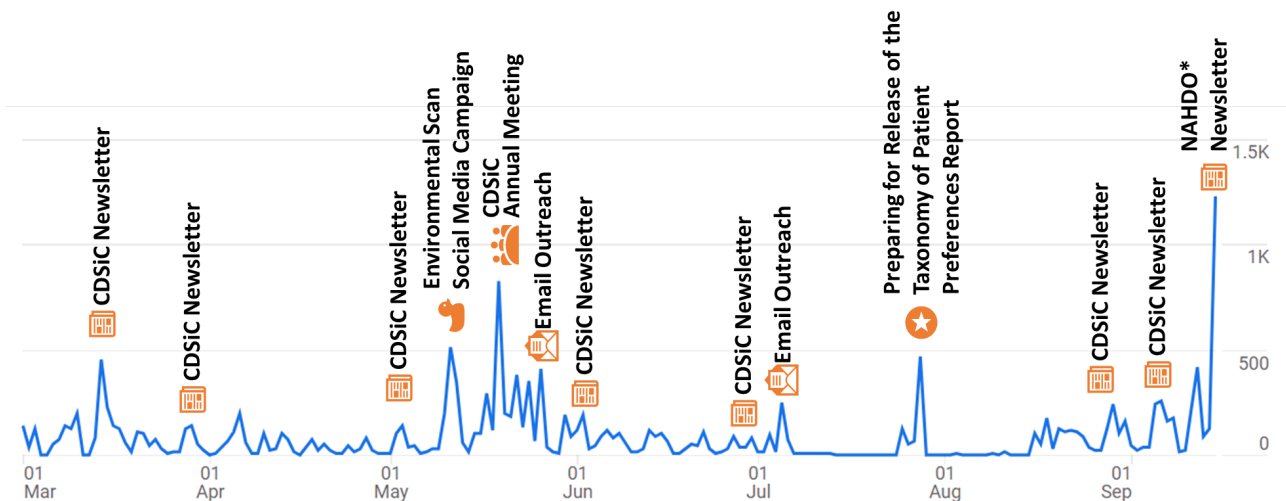
Resource Type	Number	Resource Titles
Peer-Reviewed Manuscript	6	<ul style="list-style-type: none"> • A Lifecycle Framework Illustrates Eight Stages Necessary for Realizing the Benefits of Patient-Centered Clinical Decision Support • The Technical Landscape for Patient-Centered CDS: Progress, Gaps, and Challenges* • Challenges and Opportunities for Advancing Patient-Centered Clinical Decision Support: Findings from a Horizon Scan* • The Technology Landscape of Patient-Centered Clinical Decision Support – Where are We and What is Needed?* • Integrating a Patient Engagement App into an Electronic Health Record-Enabled Workflow Using Interoperability Standards* • Lessons Learned from a National Initiative Promoting Publicly Available Standards-Based Clinical Decision Support* <p><i>*Indicates manuscript was produced under another AHRQ-funded project.¹⁹</i></p>
Framework	2	<ul style="list-style-type: none"> • Infographic: Analytic Framework for Action • Infographic: Patient-Centered Clinical Decision Support Explained
Vignette	1	<ul style="list-style-type: none"> • Real World PC CDS: Patient-Centered CDS for Postpartum Hypertension Monitoring
Project Document	1	<ul style="list-style-type: none"> • CDSiC Project Summary
Charter	7	<ul style="list-style-type: none"> • Charters for the Operations Center, Stakeholder Center, and Innovation Center • Charters for each of the four Stakeholder Center Workgroups
Operational Framework	3	<ul style="list-style-type: none"> • Operational Frameworks for the Operations Center, Stakeholder Center, and Innovation Center
Stakeholder Center Workgroup Product	9	<ul style="list-style-type: none"> • Standards and Regulatory Frameworks Workgroup: Environmental Scan • Outcomes and Objectives Workgroup: Taxonomy of Patient Preferences • Trust and Patient-Centeredness Workgroup: Improving the Source Credibility of Patient-Centered Clinical Decision Support Tools • Scaling, Measurement, and Dissemination of CDS Workgroup: Approaches to Measuring Patient-Centered CDS Workflow and Lifeflow Impact • Executive Summary, Scaling, Measurement, and Dissemination of CDS Workgroup: Approaches to Measuring Patient-Centered CDS Workflow and Lifeflow Impact • Scaling, Measurement, and Dissemination of CDS Workgroup: PC CDS Planning, Implementation, and Reporting User Guide • PC CDS Planning, Implementation, and Reporting Checklist • Standards and Regulatory Frameworks Workgroup: Advancing Standardized Representations for Patient Preferences to Support Patient-Centered Clinical Decision Support • Standards and Regulatory Frameworks Workgroup: Improving Interoperability of Patient Apps with the Health IT Ecosystem

Resource Type	Number	Resource Titles
Stakeholder Center Quarterly Report	5	<ul style="list-style-type: none"> Stakeholder Center Quarterly Reports for the following periods: <ul style="list-style-type: none"> January to June 2022 July to September 2022 October to December 2022 January to March 2023 April to June 2023
Innovation Center Quarterly Report	6	<ul style="list-style-type: none"> Innovation Center Quarterly Reports for the following periods: <ul style="list-style-type: none"> January to March 2022 April to June 2022 July to September 2022 October to December 2022 January to March 2023 April to July 2023 July to September 2023

CDSiC resources and Leadership Viewpoint pieces have received keyword “tags” that allow these materials to be findable in AHRQ’s Center for Evidence and Practice Improvement (CEPI) Evidence Discovery and Retrieval (CEDAR) database. Tags indicate each item’s type (e.g., peer-reviewed manuscript, quarterly report) and the focus of its content (e.g., CDS implementation, PGHD). Along with the keyword tags, CEDAR will leverage additional metadata on each resource’s title and the description featured on its webpage.

From its launch in March 2023 through September 15, 2023, the website has been viewed more than 16,700 times by about 3,800 unique visitors. Traffic peaks (as shown in Exhibit 13) correspond with dissemination activities such as AHRQ CDSiC Insider newsletter distribution, email outreach, and social media promotion. The Standards and Regulatory Frameworks Workgroup’s Environmental Scan, the first Workgroup product released by the CDSiC, has been downloaded by 141 unique users. Additionally, 15 people have submitted “Get Involved” forms to date.

Exhibit 13. CDSiC Website Views, March 1-September 15, 2023

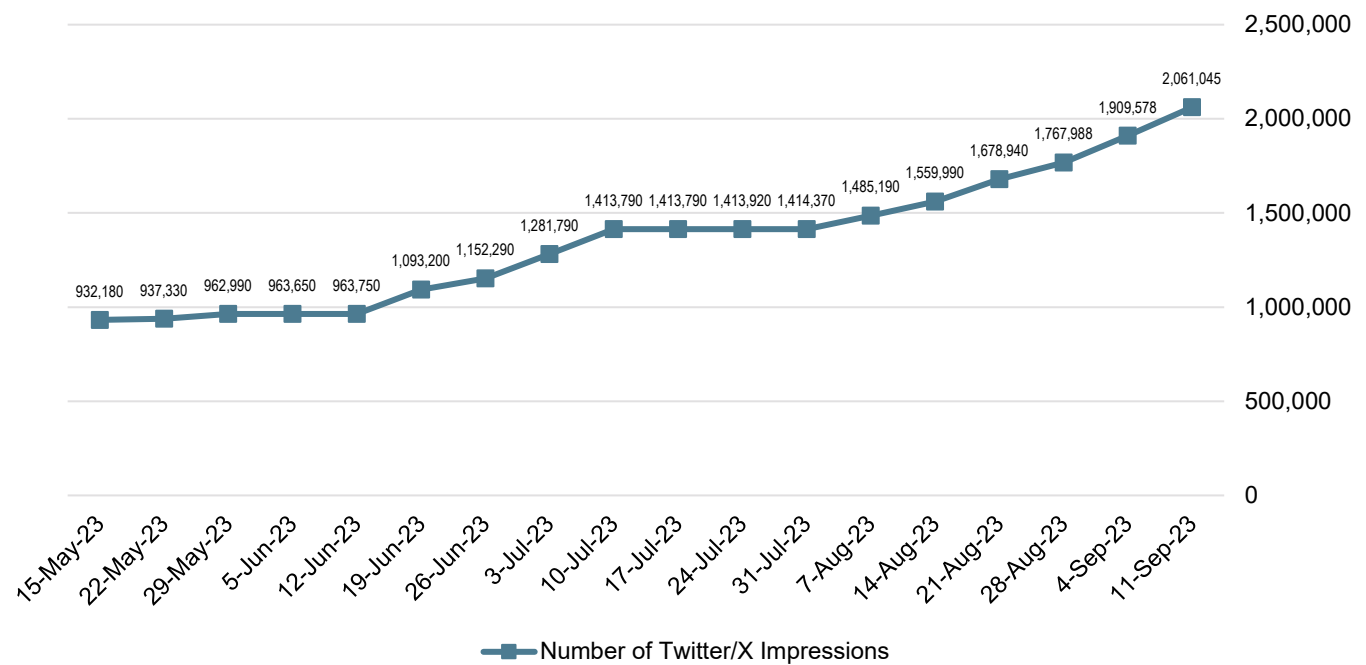


*NAHDO: National Association of Health Data Organizations

Social Media Posts

As outlined in the Outreach and Marketing Plan, social media is an important channel for dissemination. A snapshot of cumulative Twitter/X impressions for posts that leveraged the #CDSiC hashtag since the first Workgroup product was released on May 13, 2023, is shown in Exhibit 14.

Exhibit 14. Cumulative CDSiC Hashtag Twitter/X Impressions by Week¹



For each product released by the CDSiC, the team prepares dissemination language for submission to AHRQ. These packages include 20 tweets and five LinkedIn posts for priority products, and five tweets and one LinkedIn post for focused products, with social media images for both. AHRQ and the CDSiC team categorized four products as priority based on the broad applicability of the topic addressed. Once these packages are approved and the product shared by @AHRQNews, these packages are also shared with other CDSiC stakeholders such as Workgroup and Steering Committee members to encourage amplification.

Twitter/X Posts about the CDSiC 2023 Annual Meeting

- “@AHRQNews really set the tone and started Day 1 at the 1st CDSiC Annual Meeting with a Patient Roundtable...” – CDSiC Steering Committee Member
- “Leaving a great CDSiC meeting full of ideas about PC CDS...” – CDSiC Steering Committee Member

¹ Twitter/X impressions are tracked via Symplur’s Healthcare Hashtag Project, a free open platform that tracks key metrics related to registered hashtags, and are based on the use of the registered CDSiC hashtag (AHRQ does not track impressions using hashtags). Symplur’s impressions are calculated by taking the number of times an account has tweeted multiplied by the account’s number of followers repeated for all accounts, which are then added. Please note that the impressions listed are not unique.

Social media is a key driver of website traffic, and information about the CDSiC has generated more than one million Twitter/X impressions. LinkedIn has also been an important channel, reaching a combined total of more than 50,000 followers across the accounts of AHRQ, NORC, AcademyHealth, and other key members of the CDSiC stakeholder community that actively post about CDSiC efforts.²

Social media activity related to the CDSiC is most active during CDSiC events or when a new CDSiC publication is released. For example, several Annual Meeting participants shared key takeaways via Twitter/X, including overwhelmingly positive feedback. Social media activity also spiked upon the release of the Standards and Regulatory Frameworks Workgroup's Environmental Scan.

@AHRQNews tweeted 20 times about the Environmental Scan, and other external users also shared the report. Exhibit 15 shares an example of social media messaging used to disseminate CDSiC products through Twitter/X.

Viewpoints

Leadership Viewpoint pieces serve as a method for CDSiC leadership to share their thoughts and project findings on a range of topics relevant to PC CDS, including new developments, challenges faced, and opportunities to advance the field. Three Leadership Viewpoints have been developed thus far and have been disseminated via *Healthcare IT News*, *Healthcare Innovation*, and the CDSiC website. Exhibit 16 provides more information on the focus of each Viewpoint piece.

Social Media Activity from External Users About the Standards and Regulatory Frameworks Workgroup's Environmental Scan

- The COO of Texas A&M Rural and Community Health Institute retweeted an AcademyHealth tweet about the Environmental Scan to her nearly 3,000 followers.
- A CDSiC Workgroup lead's LinkedIn post about the Environmental Scan received great engagement, including 15 unique post reactions.

Exhibit 15. CDSiC-focused Tweet Pinned by AHRQ's Twitter/X Account



² A LinkedIn follower is comparable to a subscriber, i.e., people who have chosen to follow a LinkedIn account so they receive that account's updates and posts. The number listed is an estimate of the total number of followers of accounts that have posted about the CDSiC.

Exhibit 16. CDSiC Leadership Viewpoint Pieces

Month	Viewpoint Title	Description	Outlet	Outlet Reach
November 2022	Grand Challenges and Opportunities for Patient-Centered Clinical Decision Support ²⁰	Shares findings from a horizon scan focused on challenges facing the field of PC CDS	<i>Healthcare IT News</i> ; CDSiC website	<i>Healthcare IT News</i> is part of HIMSS Media and is read by senior healthcare and technology influencers. It generates on average 645,000 monthly page views.
November 2022	The Technical Landscape for Patient-Centered Clinical Decision Support ²¹	Summarizes the main challenges and opportunities for advancing PC CDS in the United States	<i>Healthcare Innovation</i> ; CDSiC website	<i>Healthcare Innovation</i> is an award-winning media outlet reaching an audience of about 200,000 people monthly including senior leaders of hospitals, medical groups, and health systems.
February 2023	Moving the Needle on Advancing Patient-Centered Clinical Decision Support through the CDSiC's Four Workgroups ²²	Details the purpose, activities, and intended products of the Stakeholder Center's four Workgroups	CDSiC website	

3.2.3 Challenges Experienced and Strategies for Resolution

During the first 2 years of CDSiC, the CDSiC team explored AHRQ-supported platforms to develop the CDSiC website. After initial exploratory work, AHRQ and NORC determined it was best to use the Drupal platform in the Amazon Web Services cloud, hosted by the AHRQ Enclave team. Exploring these different platforms led to a delay in website deployment. However, the final platform will enable the CDSiC team to deploy new content to the website more quickly.

3.3 Task 2: Stakeholder Center

The Stakeholder Center, the Stakeholder Center Planning Committee, and its four Workgroups provide CDSiC's thought leadership—developing products that advance CDS for the broader community, guiding the overall work of the CDSiC (in partnership with the CDSiC Steering Committee), and offering input on projects the CDSiC Innovation Center develops. Critically, the Stakeholder Center includes various stakeholders in CDSiC activities, consistent with the mandate established by Section 6301 of the Affordable Care Act for AHRQ to engage and obtain feedback from diverse stakeholders.²³

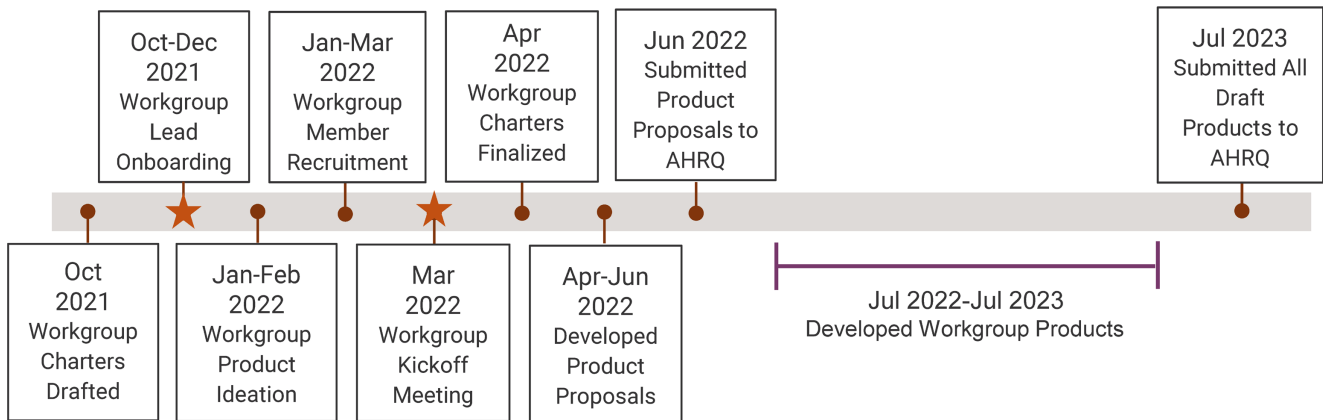
During the first 2 years of the CDSiC, the Stakeholder Center engaged a diverse array of CDS stakeholders to convene four Workgroups and develop products to advance the field of PC CDS. The

activities of the Stakeholder Center are described below, followed by the outputs and outcomes stemming from these activities. Section 3.3.3 summarizes challenges experienced over the course of this work and strategies for resolution.

3.3.1 Stakeholder Center Infrastructure and Activities

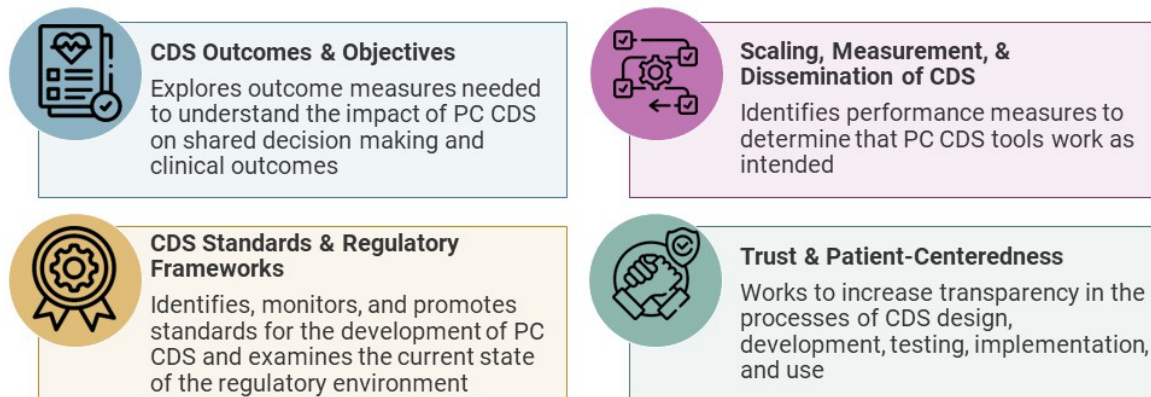
During the base period, the Stakeholder Center established infrastructure to support the operations of its four Workgroups, including a Stakeholder Center Operational Framework,²⁴ Stakeholder Center Charter,²⁵ Workgroup Charters,^{26,27,28,29} and recurring Stakeholder Center Planning Committee Meetings. In total, the Workgroups developed 12 written products including reports, resources, and tools to address gaps in the CDS landscape. Exhibit 17 provides an overview of Stakeholder Center activity milestones during the base period. These activities are described in more detail below.

Exhibit 17. Overview of Stakeholder Center Activities and Timeline



CDSiC Stakeholder Center Workgroups

The four Stakeholder Center Workgroups are the CDS Outcomes and Objectives Workgroup; Scaling, Measurement, and Dissemination of CDS Workgroup; CDS Standards and Regulatory Frameworks Workgroup; and Trust and Patient-Centeredness Workgroup. Each Workgroup comprises two Workgroup leads and between 11-14 Workgroup members, for a total of eight Workgroup leads and 49 Workgroup members. Workgroup leads and members represent a range of perspectives to ensure that CDSiC products incorporate input from stakeholders across the PC CDS community, including patients and patient representatives, informaticians, health systems representatives, clinicians, researchers, standards developers, CDS content developers, EHR developers, and Federal agencies and policymakers. The focus of each Workgroup is summarized in Exhibit 18.

Exhibit 18. Stakeholder Center Workgroups*Initial Discussions with Workgroup Leads and Workgroup Member Recruitment*

From November 2021 to January 2022, CDSiC and Stakeholder Center leadership met with Workgroup leads to discuss each Workgroup's purpose, product expectations, and Workgroup lead roles and responsibilities, and to generate potential priority topics for Workgroups. The CDSiC team met with Workgroup lead dyads a total of 11 times during this period.

Potential Workgroup members were identified by the CDSiC team, with additional input from Workgroup leads. For each Workgroup, the team generated a list of experts in the field and patient representatives to ensure a range of perspectives, experience, and expertise in each Workgroup; AHRQ approved these lists. Workgroup members include patient representatives and advocates, clinicians, informatics researchers, payers, CDS developers, and Federal regulatory agency representatives. To ensure that patient perspectives were incorporated into Workgroup products, at least one patient representative participated in each Workgroup, either as a Workgroup member or lead. The CDSiC team invited prospective Workgroup members to participate in the CDSiC via email in January 2022. In total, 54 individuals, including ten patients or patient representatives, were invited to participate in the CDSiC Workgroups as Workgroup members. Over the course of the project, 49 individuals agreed to participate as Workgroup members.

Kickoff Meeting

In March 2022, the CDSiC project team held a 2-day virtual Stakeholder Center kickoff meeting to officially welcome and orient Workgroup members to the CDSiC. The agenda and meeting materials were iteratively developed with input from Workgroup leads and feedback from AHRQ to ensure that the meeting provided a comprehensive overview of the project and dedicated time to brainstorm and prioritize ideas for Workgroup products. Meeting topics were discussed with Workgroup leads during Planning Committee meetings.

To prepare attendees for the meeting, the CDSiC team prepared Workgroup-specific packets with pre-meeting materials, including the meeting agenda, the CDSiC overview infographic, the Workgroup's

Charter, a brief description of three potential Workgroup products (developed by Workgroup leads with support from their Workgroup support team), a snapshot of the CDSiC Outreach and Marketing plan, and brief biographies and headshots of all Workgroup members and CDSiC project members. These packets were sent to participants ahead of the kickoff meeting.

All eight Workgroup leads and 37 Workgroup members attended the meeting. The meeting provided an overview of the CDSiC project and an opportunity for Workgroup leads and members to introduce themselves, and generated discussion and collaboration among Workgroup members. Each Workgroup engaged in three breakout sessions with its members, one in which they discussed the overall direction of their Workgroup, including the Workgroup's scope, goals, and objective; a second in which they discussed, refined, and prioritized product ideas; and a third in which they brainstormed dissemination strategies for their products. During breakout sessions, the Workgroups used the interactive web-based tool Miro to virtually collaborate on idea generation and prioritization.

For Workgroup members who were unable to attend the kickoff meeting, the CDSiC team held alternate orientation sessions in April 2022. These 1-hour sessions provided an opportunity to learn more about the CDSiC and its Workgroups, as well as ask questions. Three Workgroup members attended. The team also shared meeting notes and recordings with all Workgroup members.

The CDSiC team fielded a post-kickoff meeting evaluation survey that asked participants about their satisfaction with the meeting and areas for improvement. Fourteen participants completed the survey. Overall satisfaction with the meeting was positive and all respondents agreed that they were provided with adequate opportunity to provide their input and ask questions during the meeting.

Charters and Operational Frameworks

In launching the Stakeholder Center, CDSiC leadership and Workgroup leads codeveloped an Operational Framework. This document describes the Stakeholder Center's structure and processes, including the composition of the Stakeholder Center Planning Committee and the Center's four Workgroups, as well as scheduling, reporting, and workflows of Stakeholder Center activities.³⁰ The Stakeholder Center and each of the four Workgroups also developed their own Charters to formally initiate their work.^{31,32,33,34,35} These Charters outline the purpose, objectives, outputs, potential challenges, and decision-making frameworks for the Stakeholder Center and each Workgroup.

Charters and Operational Frameworks Produced

- [Stakeholder Community and Outreach Center Charter](#)
- [Stakeholder Community and Outreach Center Operational Framework](#)
- [CDS Outcomes and Objectives Workgroup Charter](#)
- [CDS Standards and Regulatory Frameworks Workgroup Charter](#)
- [Scaling, Measurement, and Dissemination of CDS Workgroup Charter](#)
- [Trust and Patient-Centeredness Workgroup Charter](#)

Stakeholder Center Planning Committee

In January 2022, the Stakeholder Center established a Planning Committee comprised of Stakeholder Center leadership, AHRQ project officers, the CDSiC project leadership, and the eight Workgroup leads. Convening every other month in 2022 and approximately each quarter in 2023, the Planning Committee met a total of eight times during the base period to provide input on the overall strategic direction and coordination of the Stakeholder Center as well as the CDSiC as a whole. Specifically, these meetings covered topics such as guidance on developing products, preparation for Stakeholder Center kickoff and the CDSiC 2023 Annual Meeting, Workgroup product updates to identify potential areas of overlap and synergies across products, and discussion of challenges and successes related to conducting Workgroups and product development. Exhibit 19 describes topics covered at each meeting and the number of Workgroup leads who attended.

Exhibit 19. Stakeholder Center Planning Committee Meeting Topics

Meeting Date	Meeting Topics	Workgroup Lead Attendance
January 25, 2022	<ul style="list-style-type: none"> • Introduction to the CDSiC Stakeholder Center and Workgroups, including expectations, roles, and responsibilities of Workgroup leads, members, and support teams • Workgroup product idea discussion 	8
March 9, 2022	<ul style="list-style-type: none"> • Guidance for developing products • Prioritization criteria for picking three product ideas • Kickoff meeting overview and breakout session facilitation guidance • Workgroup meeting planning and preparation, including goals and meeting logistics 	7
May 2, 2022	<ul style="list-style-type: none"> • Discussion of lessons learned from the first Workgroup meetings • Product idea updates, including discussion of synergies and potential overlaps across Workgroups 	7
July 19, 2022	<ul style="list-style-type: none"> • Round robin on product updates and activity status from each Workgroup • Presentation of products mapped to the PC CDS Lifecycle • Discussion of product development roles, responsibilities, and timelines 	6
October 17, 2022	<ul style="list-style-type: none"> • Focused discussion of in-progress products from the CDS Standards and Regulatory Frameworks Workgroup and the Trust and Patient-Centeredness Workgroup <ul style="list-style-type: none"> – Depending on product timelines, discussions included product objectives and scope, preliminary drafts of organizational frameworks and conceptual models, and/or findings • Introduction to and overview of the CDSiC 2023 Annual Meeting goals, sessions, and speakers 	8

Meeting Date	Meeting Topics	Workgroup Lead Attendance
December 5, 2022	<ul style="list-style-type: none"> • Focused discussion of in-progress products from the CDS Outcomes and Objectives Workgroup and Scaling, Measurement, and Dissemination of CDS Workgroup <ul style="list-style-type: none"> – Depending on product timelines, discussions included product objectives and scope, and/or preliminary drafts of organizational frameworks • Update on CDSiC 2023 Annual Meeting planning and round robin discussion on Workgroup breakout sessions 	8
February 13, 2023	<ul style="list-style-type: none"> • Product updates from each Workgroup and discussion • Review of 2022 Stakeholder Center accomplishments 	8
August 21, 2023	<ul style="list-style-type: none"> • Review of Stakeholder Center accomplishments over the base period • Overview of option year ideas • Reflections on Workgroup experience 	6

Workgroup and Workgroup Lead Meetings

Each Workgroup met twice per month in April, May, and June 2022, and approximately once per month thereafter. As of August 30, 2023, the Workgroups collectively held 63 Workgroup meetings during the base period. To support routine Workgroup activities and advance product development, Workgroup leads and support teams regularly met biweekly, holding more than 150 internal meetings during the base period.

Workgroup Product Proposals

CDSiC Workgroups participated in a multi-step process to brainstorm ideas for potential products, whereby initial product ideas were refined during the kickoff meeting and Workgroup meetings, ultimately concluding with the identification of three discrete products per Workgroup. The products varied in terms of expected length of time and level of effort to complete based on scope, falling into one of three Levels: Level 1 projects are the largest in scope, involving significant effort; Level 2 projects involve a medium amount of effort; Level 3 projects are shorter-term activities. Across all Workgroups, four Level 1, three Level 2, and five Level 3 products were developed. Workgroups each developed one Level 1, 2, and 3 product, with the exception of the CDS Outcomes and Objectives Workgroup, which developed one Level 1 and two Level 3 products.

Each Workgroup developed a formal Product Proposal describing each of its three proposed products during the base period. For each proposed product, Workgroups described product background and context; provided an overview of product scope, objectives, need or gap identified, and potential impact; summarized the product development process; and delineated a timeline for product development. The product proposals were submitted to AHRQ in June 2022 and finalized in July 2022.

Workgroup Product Development

Workgroup product development was supported by 12 Workgroup support team members with direction from two Stakeholder Center co-leads and the CDSiC leadership team. A description of each Workgroup product, including the timeliness of the product for the field, is provided in Exhibit 20. The Workgroup support teams met internally with the Stakeholder Center co-leads on a weekly basis to support product development. These meetings provided a forum to share product development updates, discuss synergies across products, and share lessons learned applicable to all Workgroups. Each Workgroup support team also met at least once a week to discuss Workgroup-specific tasks and activities related to product development.

Exhibit 20. Workgroup Product Descriptions and Relevance for the Field

Title and Description

CDS Outcomes and Objectives Workgroup

Patient-Focused Outcome Measures for Patient-Centered CDS (Level 1)

Although a broad set of outcome measures exist for clinician-centered CDS, there is no catalog of tools for measuring appropriate outcome measures specific to PC CDS, nor a research agenda to make recommendations where improvements are needed. This product provides a discussion of outcome measures that are relevant for measuring the impact of PC CDS, including patient engagement and experience outcomes, PROs, and shared decision-making outcomes.

Integration of PC CDS into Shared Decision Making (Level 3)

Patients are increasingly using health data and tools to make decisions and inform their care; however, there is a knowledge gap in how PC CDS can support shared decision-making processes. This product provides a framework that describes the role of PC CDS in supporting each aspect of shared decision making and outlines an agenda for further research.

Taxonomy of Patient Preferences³⁶ (Level 3)

Currently, it is unclear to what extent PC CDS could support some or all aspects of a shared decision-making process (i.e., available options, the provider's knowledge and experience, and the patient's values and preferences). This product provides a taxonomy of patient preferences that are relevant to PC CDS, implementation considerations, and a research agenda to advance the use of patient preferences in PC CDS.

Scaling, Measurement, and Dissemination of CDS Workgroup

PC CDS Planning, Implementation, and Reporting Tool (Level 2)

Although there is a substantial and growing literature describing CDS implementations, inconsistent reporting on CDS interventions makes it difficult to synthesize and leverage implementation information to provide evidence-based guidance on applying CDS to improve care processes and outcomes. This product outlines a standard approach for describing how PC CDS interventions are designed, developed, deployed, used, maintained, and evaluated.

Approaches to Measuring Patient-Centered CDS Workflow and Lifeflow Impact³⁷ (Level 3)

Clinician burnout is a growing problem associated with many CDS interventions. Relatively little is known across studies about how CDS interventions affect clinical workflows, and even less is known about the impact on patient activities or "lifeflows." This product provides an overarching framework for approaches used to measure the effects of PC CDS on clinician workflows and patient lifeflows.

Title and Description

PC CDS Performance Measurement Inventory and User Guide (Level 1)

Evaluating PC CDS intervention development, implementation, and performance is key to supporting understanding and maximizing the intervention's impact. However, measures used to analyze CDS performance and implementation are not well-standardized. This product describes measures for evaluating PC CDS development and implementation to help users understand what they should measure and how they should measure it.

CDS Standards and Regulatory Frameworks Workgroup

Standards and Regulatory Frameworks Environmental Scan³⁸ (Level 1)

Development of infrastructure that supports shareable, scalable, and standards-based CDS is a necessary step in the broader transition toward value-based, person-centered care. Consistent standards are essential to ensure PC CDS is accessible wherever and whenever clinicians and patients prefer to receive it, and in a manner that is easy for both groups to understand and act upon in both clinical and nonclinical settings. This product provides a comprehensive inventory of current PC CDS standards and regulatory frameworks, as well as an action plan for addressing gaps.

Improving Interoperability of Patient Apps With the Health IT Ecosystem (Level 2)

Clinicians are increasingly recommending and prescribing apps to patients to help manage clinical conditions; however, apps' limited integration with EHRs and other technologies in the health IT ecosystem can cause issues with care quality and provider and patient burden. This product identifies and promotes necessary standards to improve interoperability between patient apps that incorporate PC CDS and the healthcare IT systems used by care teams.

Advancing Standardized Representations for Patient Preferences to Support PC CDS (Level 3)

Despite the prominent role of patient preferences in healthcare decision making, the current state of standards for electronic representation of patient preferences is not well characterized. This product summarizes the scope of current standards for electronically representing patient preferences and identifies opportunities for advancing these standards.

Trust and Patient-Centeredness Workgroup

An Introductory Handbook for Patient Engagement Throughout the PC CDS Lifecycle (Level 3)

CDS development has traditionally omitted patient perspectives, which are a critical input when creating CDS that is responsive to patient needs. This product is a practical handbook that introduces CDS artifact developers to methods and resources for engaging patients at each stage of PC CDS development.

Methods for Involving End Users in PC CDS Codesign (Level 1)

Codesign strategies are a potential model for applying patient-centered approaches to CDS design and deployment. This product outlines promising practices for engaging patients in the codesign and codeployment of PC CDS, documenting how best to engage patients across the PC CDS continuum from planning and designing, to building and testing, and through the deployment and adoption phases of work.

Improving the Source Credibility of Patient-Centered Clinical Decision Support Tools³⁹ (Level 2)

Ensuring that patients and their caregivers trust the source of information or guidance ("source credibility") is crucial to the success of PC CDS. This product identifies and defines the factors that influence source credibility of PC CDS tools to improve clinician and patient trust in these resources.

Although the product development process varied for each product, the process generally involved targeted literature searches, stakeholder input and feedback (e.g., through Workgroup engagement,

key informant interviews, focus groups, and/or technical expert panels), and analysis and synthesis. Each Workgroup product underwent a rigorous internal review process by the Stakeholder Center and NORC leadership team at the outline and draft stages to ensure that the products are high-quality written deliverables that provide substantive contributions to the CDS field.

Workgroup members contributed to product development both during scheduled Workgroup meetings and asynchronously through a variety of mechanisms, including by providing email feedback and working on draft outlines and products posted on the CDSiC SharePoint.

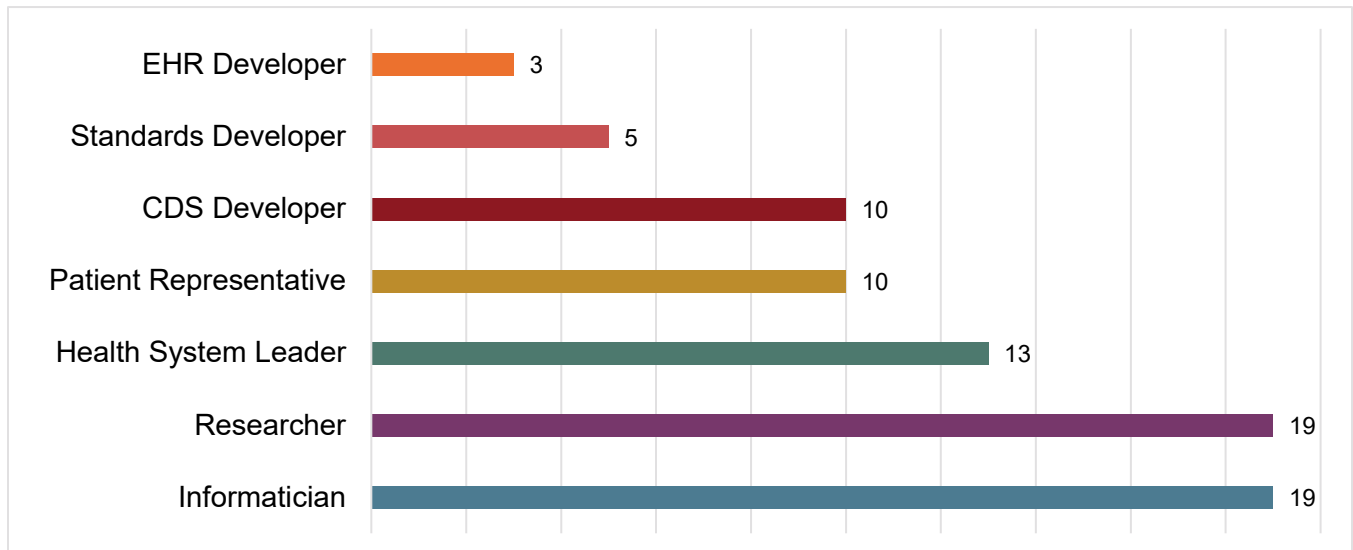
Workgroups collectively screened over 3,300 resources and synthesized 1,056 (note: count not de-duplicated) peer-reviewed and grey literature resources in their products. Exhibit 21 describes the literature synthesized for each product.

Exhibit 21. Literature Synthesized for Workgroup Products

Workgroup Product	Literature Synthesized
CDS Standards and Regulatory Frameworks: Environmental Scan (Level 1)	58 peer-reviewed publications and 132 grey literature resources
CDS Standards and Regulatory Frameworks: Improving Interoperability of Patient Apps with the Health IT Ecosystem (Level 2)	37 peer-reviewed publications and 57 grey literature resources
CDS Standards and Regulatory Frameworks: Advancing Standardized Representations for Patient Preferences to Support PC CDS (Level 3)	138 peer-reviewed and grey literature resources
CDS Outcomes and Objectives: Patient-Focused Outcome Measures for Patient-Centered CDS (Level 1)	31 systematic reviews
CDS Outcomes and Objectives: Taxonomy of Patient Preferences (Level 3)	168 peer-reviewed publications
CDS Outcomes and Objectives: Integration of PC CDS into Shared Decision Making (Level 3)	16 peer-reviewed publications and 10 grey literature resources
Scaling, Measurement, and Dissemination of CDS: PC CDS Performance Measurement Inventory and User Guide (Level 1)	62 peer-reviewed publications
Scaling, Measurement, and Dissemination of CDS: PC CDS Planning, Implementation, and Reporting Tool (Level 2)	62 peer-reviewed publications
Scaling, Measurement, and Dissemination of CDS: Approaches to Measuring PC CDS Workflow and Lifeflow Impact Interventions (Level 3)	62 peer-reviewed publications
Trust and Patient-Centeredness: Methods for Involving End Users in PC CDS Codesign (Level 1)	86 peer-reviewed publications
Trust and Patient-Centeredness: Improving the Source Credibility of PC CDS Tools (Level 2)	35 peer-reviewed publications
Trust and Patient-Centeredness: An Introductory Handbook for Patient Engagement Throughout the PC CDS Lifecycle (Level 3)	71 peer-reviewed publications and 31 grey literature resources

Across the 12 products, Workgroups collectively conducted 59 key informant interviews with 62 experts (five informants were engaged in paired interviews) and one focus group with three patient representatives; four to nine experts participated in interviews/focus groups for each product. Additionally, one Workgroup convened a technical expert panel with 14 experts, which met three times. Exhibit 22 describes the expertise of the 79 experts engaged via key informant interviews, focus groups, and technical expert panel meetings.

Exhibit 22. Number of Stakeholders Engaged in Key Informant Interviews, Focus Groups, and Technical Expert Panel Meetings, by Stakeholder Type



3.3.2 Stakeholder Center Outputs and Outcomes

During the base period, the four Workgroups collectively completed 12 products for AHRQ. As of September 15, 2023, four of the products were published. Information about the reach of each product is provided in Exhibit 23.

Exhibit 23. Published Stakeholder Center Products and Reach*

Title and Description	Publication Date	Reach
<i>CDS Outcomes and Objectives Workgroup</i>		
<u>Taxonomy of Patient Preferences</u> ⁴⁰ (Level 3)	July 2023	567 views, 34 unique downloads
<i>Scaling, Measurement and Dissemination of CDS Workgroup</i>		
<u>Approaches to Measuring Patient-Centered CDS Workflow and Lifeflow Impact</u> ⁴¹ (Level 3)	September 2023	231 views, 11 downloads

Title and Description	Publication Date	Reach
CDS Standards and Regulatory Frameworks Workgroup		
<u>Standards and Regulatory Frameworks Environmental Scan</u> ⁴² (Level 1)	June 2023	2,028 views, 141 unique downloads
Trust and Patient-Centeredness Workgroup		
<u>Improving the Source Credibility of Patient-Centered Clinical Decision Support Tools</u> ⁴³ (Level 2)	July 2023	210 views, 19 unique downloads

*The views and number of unique downloads reported in this table are tracked using Google Analytics. Between July 10-24 and July 31-August 16, the Google Analytics dashboard was not fully tracking metrics from the website; thus, the metrics reported in this table are likely an underestimate of the actual views and downloads of each resource.

The CDSiC team also developed four conference abstracts that summarize Workgroup and Stakeholder Center findings. The CDSiC team presented findings from Workgroup activities at two conferences in June and July 2023. Additionally, the CDSiC team prepared and submitted two abstracts for presentation at the 2023 AMIA Annual Symposium, to take place in November 2023. Exhibit 24 summarizes these presentations.

Exhibit 24. Stakeholder Center Conference Presentations

Workgroup	Title	Description	Setting, Date
CDS Standards and Regulatory Frameworks	Advancing Standards for Patient-Centered Clinical Decision Support: Challenges and Opportunities for Patient-Provided Data	Poster Presentation	AcademyHealth Annual Research Meeting, June 2023
CDS Outcomes and Objectives Workgroup & CDS Standards and Regulatory Frameworks Workgroup	Integrating Patient Preferences in Patient-Centered Clinical Decision Support: Where Are We Now and Where Do We Go Next?	Panel	2023 AMIA Annual Symposium, November 2023
Center-wide	Patient-Centered Clinical Decision Support – Where are We and Where to Next?	Presentation	MedInfo 2023, July 2023
Center-wide	Using A Stakeholder Driven-Process to Advance Patient-Centered Clinical Decision Support: Visual Framework for Clinical Decision Support Innovation Collaborative (CDSiC) Efforts	Poster Presentation	2023 AMIA Annual Symposium, November 2023

Qualitative Feedback Received about Outputs

While dissemination of Workgroup products is still underway and the CDSiC team is in the early stages of the dissemination process, the team has already received qualitative feedback on publicly posted

products. Sources of qualitative input on completed products include social media and emails sent directly to the CDSiC team. Thus far, the feedback points to the value of these products to the PC CDS field (Exhibit 25).

Exhibit 25. Feedback Received on Workgroup Products to Date

Workgroup Product	Source	Description of Feedback
CDS Standards and Regulatory Frameworks: Standards and Regulatory Frameworks Environmental Scan	CDSiC 2023 Annual Meeting	<ul style="list-style-type: none"> One representative from the Office of the National Coordinator for Health Information Technology (ONC) commented that findings from the Standards and Regulatory Frameworks Environmental Scan “struck all the right chords.”
Non-specific	CDSiC 2023 Annual Meeting	<ul style="list-style-type: none"> Participants in one breakout discussion identified the CDSiC itself, and its varied products, as a key strength of the field of PC CDS. A participant in another breakout session stated the CDSiC products are foundational work for introducing the concept of PC CDS to the field.
CDS Outcomes and Objectives: Taxonomy of Patient Preferences	LinkedIn	<ul style="list-style-type: none"> One Workgroup member reposted the NORC Health Implementation Science Center’s initial post of the product, commenting, “So glad this report has made it to publication!” Two external individuals reposted AHRQ’s post on the product, commenting on the utility of the report and the importance of patient preferences generally and in relation to CDS. <ul style="list-style-type: none"> “Empowering the patient [is] an essential element of an organization’s culture for safe, quality care.” “This is an interesting take for us that work in CDS and with artifacts. Patients first! #patientcenteredcare” One person commented on AHRQ’s post two separate times. In their first post they wrote, “I started to review the report last night. I think it is a good resource to remind us of patient-centered care. I plan to promote this resource. #collaborateforhealth #patientexperience.” Their second post noted, “I am reading about each domain every week and I am excited to share the information I am learning with others. It is a good time to pause and consider how we are creating patient experiences and promoting evidence-based practices to empower patients to lead their teams.”

3.3.3 Challenges Experienced and Strategies for Resolution

The CDSiC has engaged with enthusiastic expert stakeholders through the Stakeholder Center Workgroups. However, the project team has also needed to develop strategies to adapt to several challenges.

Sustained Workgroup member engagement and participation. Due to the voluntary nature of Workgroup member involvement, not all Workgroup members engage equally with the ongoing product

development process. It can occasionally be challenging to get widespread feedback and input from Workgroup members due to competing demands and limited bandwidth. Throughout the base period, the CDSiC team identified several strategies that can improve engagement:

- Develop discussion questions for Workgroup meetings to focus feedback on critical areas and send questions ahead of meetings to prepare Workgroup members.
- Allow Workgroup members to provide input through multiple avenues, including synchronously during Workgroup meetings and asynchronously via email or SharePoint.
- Identify areas where Workgroup member input is most needed, make discrete asks of Workgroup members, and solicit volunteers to sign up for action items.
- Send out meeting notes following meetings with clear action items and timelines.

Addressing the needs of different stakeholders and varying perspectives. With several Workgroup members providing input on product content and development, differences in suggestions or desired directions sometimes arose. Workgroup leads and support teams ultimately decided what Workgroup member feedback to incorporate. To navigate conflicting feedback, Workgroup leads and support teams adopted the following strategies:

- Focus discussions on substantive areas to advance product development and guide conversations so that Workgroup member input was within the product's scope.
- Provide direction by synthesizing Workgroup member feedback, determining next steps, and communicating how Workgroup member feedback was incorporated into products.
- Balance a pragmatic approach with scientific rigor in developing products, ensuring that approaches addressed concerns of Workgroup members to create both rigorous and practical products.

Timeline management. Finally, to develop three products per Workgroup, the CDSiC team has had to work efficiently to translate product proposals into final products on a rapid timeline. To support Workgroups in producing high-quality products within the designated timeline, the CDSiC team employed the following strategies:

- Strong project management with detailed timelines and routine check-ins between Workgroup leads, Stakeholder Center co-leads, and support teams (either weekly or biweekly) to keep product development on track and mitigate issues as they arose.
- Workgroup leads and support teams focused on the utility of the product to the end user as the “north star” to support uptake of products from the start of development, reducing the need to later rework product content for dissemination.
- Workgroup support teams met internally on a weekly basis to share resources and lessons learned and discuss strategies for advancing product timelines.

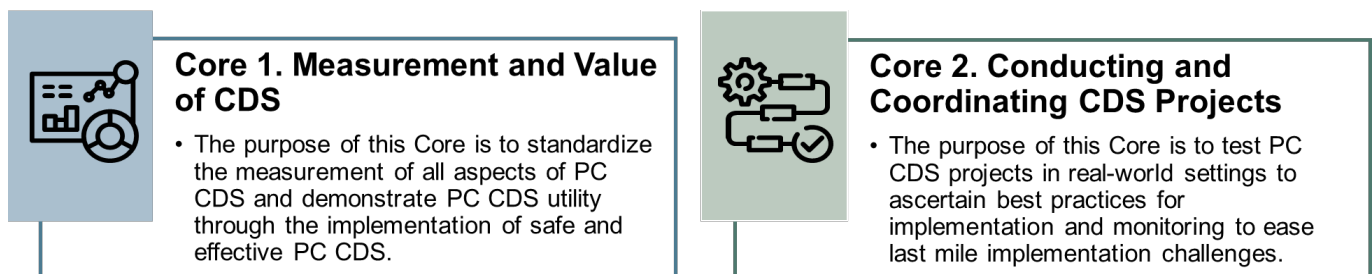
3.4 Task 3: Innovation Center

The Innovation Center is the research and development hub for the CDSiC. It focuses on facilitating real-world PC CDS measurement and testing projects, improving CDS usability and acceptability via improved design and implementation, and translating PCOR into clinical practice using CDS to improve patient and clinician decision making. The activities of the Innovation Center are described below, followed by the outputs and outcomes stemming from these activities. Section 3.4.3 summarizes challenges experienced over the course of this work and strategies for resolution.

3.4.1 Innovation Center Infrastructure and Activities

During the base period, the Innovation Center established a Planning Committee and two Cores (Exhibit 26) that engage stakeholders, including clinicians, informaticians, researchers, payers, and patients, in designing and conducting projects that address key challenges to widespread use of PC CDS. The Cores were tasked with developing and completing three projects that advance PC CDS research during this period.

Exhibit 26. The Innovation Center Cores



Planning Committee

The Innovation Center Planning Committee provides input on the overall strategic direction and coordination of the Innovation Center Cores, while coordinating with the CDSiC as a whole, integrating input from the Stakeholder Center Workgroups, the Steering Committee, and AHRQ. The Planning Committee is comprised of seven thought leaders in the field of CDS, including health systems leaders, CDS developers, informatics researchers, clinicians, and patient partners. The Planning Committee met quarterly in Year 1 (2022) and once in Year 2 (2023). All seven Planning Committee members participated in each meeting.

The Planning Committee held its kickoff meeting on April 7, 2022. Topics for the kickoff meeting included the importance of PC CDS and an overview of the Innovation Center and its Cores, including proposed prototypes for Core 2. At the July and October 2022 quarterly meetings, the CDSiC project team provided progress updates and requested feedback on Core 1 and Core 2 projects. At the 2023 meeting, the project team provided demonstrations of the Core 2 projects and further refined the

workflow execution model. Planning Committee meeting dates, topics, and attendance are summarized in Exhibit 27 below.

Exhibit 27. Planning Committee Meetings, Topics, and Attendance

Meeting Date	Meeting Topic	Planning Committee Member Attendance
April 7, 2022	Kickoff Meeting, including introductions, the importance of PC CDS, overview of the Innovation Center, and project discussions	7
July 28, 2022	Update on Core 1 and Core 2 project progress, with feedback from Planning Committee members	7
October 18, 2022	Discussion of Core 2 dashboard/app design considerations and Core 1 PC CDS workflow execution model	7
February 16, 2023	Demonstration of Core 2 dashboard/app projects and discussion of Core 1 PC CDS workflow execution model	7

Charter and Operational Framework

The work of the Innovation Center is guided by its Operational Framework, developed by the CDSiC's leadership and the Innovation Center Planning Committee.⁴⁴ The Operational Framework describes the Innovation Center's structure and day-to-day processes, including the composition of the Planning Committee, the processes for coordinating across the Cores, and the mechanisms for scheduling, tracking Core activities and progress, and reporting. The Innovation Center was formally initiated with the ratification of its Charter.⁴⁵ The Charter describes the purpose, objectives, outputs, and outcomes, as well as potential challenges and decision-making frameworks for the Innovation Center.

Charters and Operational Frameworks Produced

- Innovation Center Operational Framework
- Innovation Center Charter

Innovation Center Project Proposals

The Innovation Center Cores are tasked with developing and completing three projects of varying levels (i.e., Level 1, 2, or 3) that advance PC CDS research. Level 1 projects are the largest in scope, involving significant effort; Level 2 projects involve a medium amount of effort; Level 3 projects are shorter-term activities. Based on discussions with AHRQ and the Planning Committee, Innovation Center leadership identified three projects aimed at both addressing gaps in measuring and monitoring PC CDS performance and creating real-world, forward-looking measurement tools to advance the field:

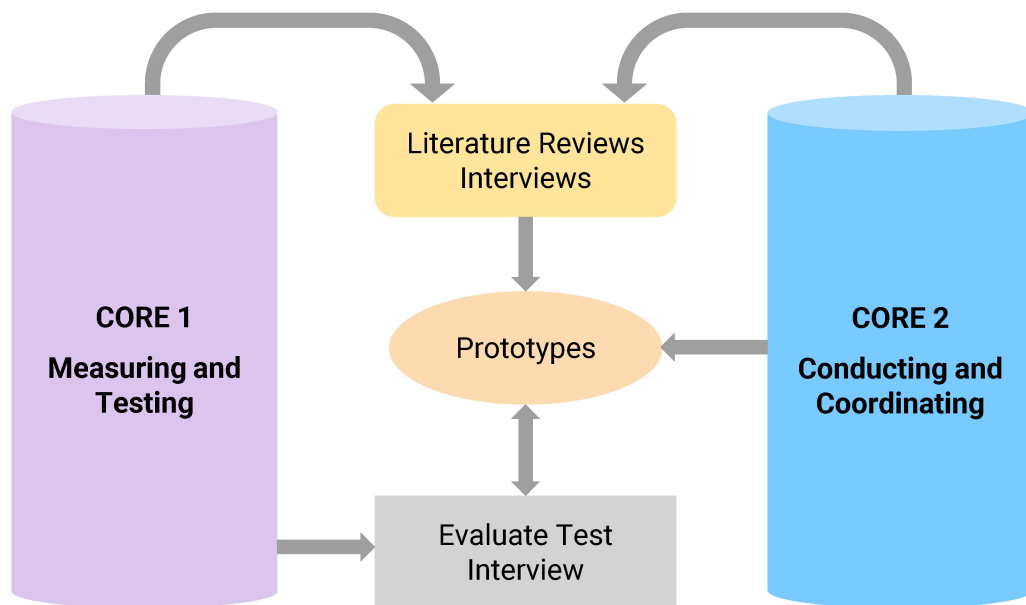
- 1) Core 1: Development of the Unified PC CDS Measurement Framework (Level 1)
- 2) Core 2: Development of a Prototype PC CDS and PRO Performance Dashboard (Level 2)

3) Core 2: Development of a Prototype that Implements Best Practices for Presentation and Analysis of Selected Types of PGHD (Level 3)

The overarching goals of these projects were to develop a comprehensive performance measurement framework along with measurement and monitoring prototypes to help patients, clinicians, and CDS developers understand real-world implementation and measurement considerations for PC CDS and any unintended consequences.

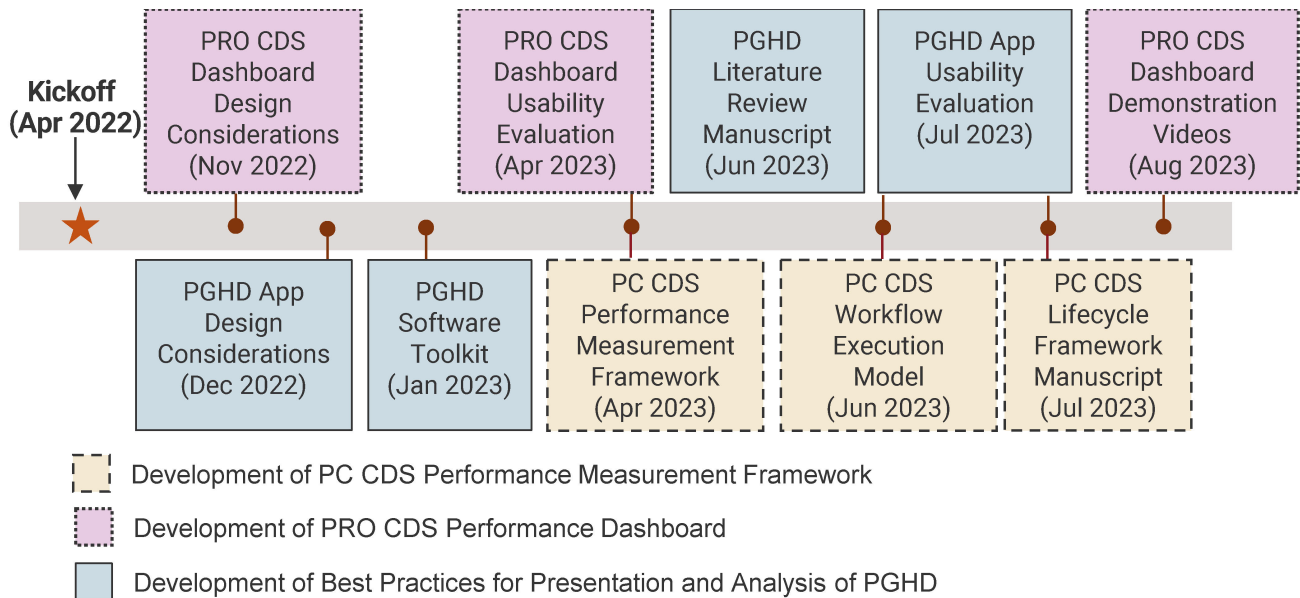
Prior to implementing these projects, the Innovation Center team developed a document outlining project objectives, methods, and timelines to identify how the two Cores could work collaboratively to merge the expertise of Core members with key findings from the peer-reviewed scientific literature, grey literature, and interviews with key stakeholders (Exhibit 28). The projects were conducted concurrently and in an iterative manner, with findings from each project being incorporated as relevant into the others to enhance and refine outputs.

Exhibit 28. Model of Collaboration between Innovation Center Cores 1 and 2



The three projects for Core 1 and Core 2 ultimately produced 10 deliverables between April 2022 and August 2023. Exhibit 29 shows the timeline for each deliverable.

Exhibit 29. Timeline of Innovation Center Deliverables



Innovation Center Project Development

Core 1 delivered one Level 1 project by developing a comprehensive PC CDS measurement framework that provides a basis for consistent measurement and evaluation of PC CDS design, development, implementation, use, and evaluation. The aim was for the framework to be extensible and adaptable to different healthcare settings, patient populations, and CDS developers. This project spanned three separate deliverables: a PC CDS Lifecycle Framework Manuscript, a PC CDS Workflow Execution Model, and a PC CDS Performance Measurement Framework. These deliverables are described in greater detail in Section 3.4.2 Innovation Center Outputs.

Core 2 developed two dashboards and two applications (apps) intended to operationalize the PC CDS Performance Measurement Framework developed by Core 1. The dashboards provided easy-to-use, succinct views of metrics related to the measurement domains and subdomains in the framework.

While several common strategies were employed to develop these deliverables (e.g., literature

About the Core 2 Dashboards

- The **PC CDS PRO Performance Dashboard** is focused on presenting aggregate data to a clinical leader or informatician to facilitate a better understanding of PC CDS performance and use. The development of this dashboard included three separate deliverables: a Dashboard Design Considerations document, a Dashboard Usability Evaluation Report, and a Dashboard demonstration slideshow.
- The **PGHD Visualization App** is focused on presenting individual patient data to support patient and clinician shared decision making. The development of the apps included four separate deliverables: a PGHD Visualization Literature Review, an App Specifications Document, the app software toolkit, and an App Usability Evaluation Report.

reviews), methods ultimately differed based on scope and goals. Each deliverable involved varying levels of stakeholder engagement via Planning Committee meetings, key informant interviews, and usability testing. Brief summaries of the methods employed for each deliverable are provided in Exhibit 30.

Exhibit 30. Research Methods Employed for Innovation Center Deliverables

Innovation Center Deliverable	Research Methods Employed
PC CDS Lifecycle Framework Manuscript	The team synthesized 44 peer-reviewed and grey literature resources in a targeted literature review and relied on author experience and knowledge to develop the framework. Authors met virtually to discuss development and used meeting minutes to iteratively refine the framework. The framework was then vetted by CDSiC stakeholder groups, including the Innovation Center Planning Committee, the Steering Committee, and the Stakeholder Center Workgroups.
PC CDS Workflow Execution Model Report	The team synthesized 47 peer-reviewed and grey literature resources in a targeted literature review and relied on author experience and knowledge to develop the framework. The team also conducted six key informant interviews with three clinicians, two informaticians, and one device and remote monitoring platform developer focusing on current policies, practices, and approaches healthcare organizations use to receive, curate, and manage PRO and PGHD data.
PC CDS Performance Measurement Framework	The team developed an initial framework based on a targeted literature review of 132 existing CDS and health IT measurement frameworks and measurement-related publications, as well as publications covering specific measurement concepts and the relationship of measurement concepts to PC CDS. The team then conducted six key informant interviews with CDS developers, clinicians, informaticians, and measurement experts to elicit feedback on the framework. The team conducted a thematic analysis of interview data to identify refinements.
PRO CDS Dashboard Design Considerations Document	The team reviewed literature, consulted with stakeholders, sought feedback from the Innovation Center Planning Committee, and engaged in extensive discussions with Innovation Center leadership.
PRO CDS Dashboard Usability Evaluation Report	The team conducted a heuristic evaluation tailored to dashboard visualizations to identify potential usability problems. The team then conducted think-aloud tests with a representative sample of five users (four clinicians and one health IT analyst) and administered a post-test questionnaire to assess users' perceptions.
PGHD Visualization Literature Review	The team performed a scoping review of PGHD dashboards that involved users in design or evaluations. The team reviewed 468 publications, ultimately identifying 15 studies that met the inclusion criteria.
PGHD App Specification Document	The team leveraged the scoping review described above, consulted with stakeholders, sought feedback from the Innovation Center Planning Committee, and engaged in extensive discussions with Innovation Center leadership.

Innovation Center Deliverable	Research Methods Employed
PGHD App Usability Evaluation Report	The team conducted two key informant interviews with patient stakeholders to elicit feedback on an initial prototype of the patient app. The team then conducted a heuristic evaluation of both apps tailored to dashboard visualizations to identify potential usability problems. Lastly, the team conducted think-aloud tests with a representative sample of three clinician users and administered a post-test questionnaire to assess users' perceptions.

Exhibit 31 provides further detail about the stakeholder types that participated in key informant interviews for the Core 1 and 2 deliverables described above. In total, the team conducted 14 interviews with 14 key informants.

Exhibit 31. Innovation Center Key Informant Interviews Conducted by Stakeholder Type

Stakeholder Type	Number of Interviews Conducted
Clinicians	5
Device and remote monitoring developer	1
Informaticians	4
Measurement experts	2
Patient advocates	2

3.4.2 Innovation Center Outputs

In completing the three projects, the Innovation Center developed 10 separate deliverables for AHRQ, including two public-facing resources and two peer-reviewed journal articles (Exhibit 32).

Exhibit 32. Innovation Center Deliverables

Core	Deliverable Title	Description
Core 1	PC CDS Lifecycle Framework Manuscript	This manuscript outlines a three-phase lifecycle of PC CDS. The goal of this new model is to highlight the numerous 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 desired health outcomes.
	PC CDS Workflow Execution Model	This paper details PC CDS workflow execution models intended for use across the CDSiC, particularly the Workgroups, to inform the development of measures that assess workflow impact. The paper describes the relationships among the numerous workflow components in three common PC CDS scenarios: 1) collection and use of PRO data, 2) collection and use of PGHD, and 3) encouragement and facilitation of a shared decision-making session.

Core	Deliverable Title	Description
	PC CDS Performance Measurement Framework	This framework details the measure domains and subdomains that CDS developers, clinical informaticians, clinical leaders, and others should use to assess PC CDS performance across the PC CDS lifecycle. The ultimate goal of the framework is to develop a consistent approach to evaluating the effort involved in implementation, the performance and impact of PC CDS, and the factors affecting performance, which should encourage wider adoption of PC CDS.
Core 2	<i>Project 1: PRO CDS Performance Measurement Dashboards</i>	
	Dashboard Design Considerations Document	This document describes the overall design, including functional specifications and design requirements, of the two PC CDS clinical performance dashboards. The document includes sections on the purpose of the dashboards, including potential users and use cases, and specific dashboard requirements as defined through a literature review, consultations with stakeholders, and feedback from the Innovation Center Planning Committee. The document also outlines the general design principles to be followed and the data elements and measures to be displayed on the dashboards. Finally, the document includes a discussion related to user authentication and security.
	Dashboard Usability Evaluation Report	This report describes the methods and findings from two usability assessments of the dashboards. The findings were used to iteratively refine the dashboard. The heuristic evaluation involved experts assessing multiple factors relevant to dashboard design and providing recommendations to fix identified usability problems. All problems identified with the highest severity ratings were resolved. The think-aloud tests, in which five stakeholders verbalized their thoughts and actions as they navigated the dashboard, identified other usability improvements. The dashboard was iteratively modified to improve usability after each round of think-aloud tests.
	Dashboard Demonstration Slideshow	After the two dashboards were built and fully operational, a demonstration slideshow was created to explain and visualize how they work. The slideshow uses screenshots of hypothetical data to show aggregate views of completion flow (number of invitations to complete the questionnaire, number completed on the portal vs on a tablet, number viewed and not viewed by the provider), responses to items on the survey, overall assessment scores, and equity data (stratified by gender, race, disability, and non-English speaking). The slideshow also shows the graphs for various decision support alerts and a table of patient-level data for questionnaire responses and actions taken.
	<i>Project 2: PGHD Apps</i>	
	PGHD Visualization Literature Review	This is a scoping literature review of existing patient-collected physiological measurements and visualization techniques. The literature findings were described in a manuscript summarizing best practices and challenges for presentation of PGHD data.
	App Specification Document	This document specifies the functional and non-functional requirements and overall design of the PGHD visualization apps. The document describes the goals of the apps, including potential users and use cases, and the functional, security, and interoperability requirements as defined through the literature review and feedback from the Innovation Center Planning Committee. The specifications include the types of visualizations and the different types of PGHD supported by the apps.

Core	Deliverable Title	Description
	App Software Toolkit	The app software was made available in January 2023 as open-source published via GitHub here and will be updated regularly as improvements are made to the contents. Documentation for use of the apps will be included with the open-source software. The software comprises libraries for incorporating visualizations in PC CDS apps for patients and clinicians, a prebuilt demonstration app for patients, containing visualizations of blood pressure data from a FHIR server, and a prebuilt demonstration app for clinicians, containing visualizations of PGHD. The app can integrate with EHRs using Substitutable Medical Applications, Reusable Technologies (SMART) on FHIR.
	App Usability Evaluation Report	Two usability assessments of the PGHD apps were conducted like the evaluation of the PRO dashboards. The heuristic evaluation and think-aloud assessments identified areas of improvement for usability, such as condensing information to ease cognitive load and providing the ability to correct errors in patient readings. Knowledge gained from this assessment was used to revise the app and software.

Four of the deliverables are public-facing resources. To date, one manuscript has been published and one is undergoing the peer-review process. The other public-facing resources are a demonstration slideshow showcasing the PRO performance measurement dashboards and an open-source software on GitHub, where viewers can download and request changes to the code. Reach of the two currently published public-facing outputs as of September 18, 2023 are detailed below (Exhibit 33).

Exhibit 33. Reach of Innovation Center Public-Facing Outputs and Peer-Reviewed Articles

Title	Description	Where published	Reach
“A lifecycle framework illustrates eight stages necessary for realizing the benefits of patient-centered clinical decision support” ⁴⁶	The Core 1 team developed a commentary describing the PC CDS lifecycle for developing, deploying, and evaluating PC CDS.	Journal of the Medical Informatics Association (JAMIA)	The manuscript was viewed 1,427 times and was downloaded 337 times . JAMIA promoted the publication on Twitter/X, where it received 1,556 views, 14 likes, and 6 reposts, and LinkedIn, where it received 56 likes, 14 reposts, and 2 comments. It was listed as the fourth “most read” article on JAMIA’s homepage in August 2023.
PGHD App Software Toolkit	The Core 2 team published the code for the PGHD app software toolkit on GitHub to share the development of a FHIR-enabled clinical app.	AHRQ CDS Connect GitHub page ⁴⁷	Between 9/05/23 and 9/18/23, the Elimu Informatics GitHub page for the software toolkit had 18 unique visitors and 17 unique cloners . [*] Since publication in January, the page has received 190 commits , indicating activity on the open-access page.

***Note:** GitHub metrics are limited to a 2-week time window. Cloners refers to people who have cloned or downloaded a copy of the code.

In addition, three abstracts were accepted for presentation at the 2023 AMIA Annual Symposium (Exhibit 34). The meeting will take place in New Orleans, LA, in November 2023.

Exhibit 34. Planned Innovation Center 2023 AMIA Annual Symposium Presentations

Project	Presentation Title	Description
PRO Performance Measurement Dashboards	Lessons Learned from Real-World Implementation of Patient-Centered Clinical Decision Support	Poster presentation on the lessons learned when developing and conducting the usability assessment for the PRO dashboards.
PGHD Data Visualization Apps	A Dashboard for Shared Decision Making: Putting Patient-Generated Health Data and Clinical Decision Support Together	Poster presentation on the design, development, and lessons learned from the usability assessment of the clinician-facing app.
PC CDS Workflow Execution Models	Challenges and Opportunities Identified from Workflow Execution Models for Advancing Patient-Centered Clinical Decision Support	Poster presentation on the lessons learned from developing the workflow models.

Qualitative Feedback Received about Outputs

The team received feedback from social media, email, and audience question and answer (Q&A) sessions at the CDSiC 2023 Annual Meeting following dissemination of project materials. Exhibit 35 describes the feedback received on each product.

Exhibit 35. Qualitative Feedback on Innovation Center Products as of August 9, 2023

Project	Source of Feedback	Description of Feedback
PC CDS Lifecycle Framework Manuscript	Twitter/X ⁴⁸	<ul style="list-style-type: none"> One person tweeted, “A framework for developing and implementing the Clinical #Decision Support with the patient at its center. An ideal that healthcare systems should aspire to.” Six people retweeted JAMIA’s tweet promoting the publication.
PC CDS Lifecycle Framework Manuscript	LinkedIn ⁴⁹	<ul style="list-style-type: none"> Two people commented on JAMIA’s post about the manuscript: <ul style="list-style-type: none"> “A comprehensive and aspirational framework. The emphasis on patient/caregiver involvement throughout the lifecycle (a high bar) is admirable.” “...Highly relevant and aligned framework for the work we’re doing at [company name].” One person reposted JAMIA’s post and said, “Each of these eight stages are critical and indispensable in implementing any CDS tool. But I find the aspects of evaluating patient behaviors and recalibrating with aggregate data are often overlooked. This overlap between clinical and population health informatics is clearly an emerging need.”
PC CDS Lifecycle Framework Manuscript	Email	<ul style="list-style-type: none"> A cloud-based health record management app emailed the team to congratulate them on the publication and expressed interest in collaborating.

Project	Source of Feedback	Description of Feedback
PRO Performance Measurement Dashboards	CDSiC 2023 Annual Meeting Audience Q&A	<ul style="list-style-type: none"> • Meeting participants discussed the importance of providers viewing and discussing PROs with patients to support patient-centered care. • Participants discussed ways to improve use of PROs among clinicians through training, linkage to quality measures, integration with other clinical data, leveraging artificial intelligence/machine learning to analyze correlations, and incorporating peer comparisons.
PGHD Data Visualization Apps	CDSiC 2023 Annual Meeting Audience Q&A	<ul style="list-style-type: none"> • Meeting participants discussed several challenges with using and visualizing physiologic PGHD, including high volume, high variability, low quality, and gaps in data in the EHR (e.g., more inpatient than outpatient data). • Participants noted challenges for patients related to providing PGHD, such as the cost of some PGHD devices.
PC CDS Measurement Framework	CDSiC 2023 Annual Meeting Audience Q&A	<ul style="list-style-type: none"> • Meeting participants were interested in the measurements and wanted to know how to disseminate them to reach patients. They discussed process measures for two-sided engagement, partnering with community engagement organizations and community health workers, working with vendors to integrate patient data with EHR data, and providing guidance for frequency and interpretation of measures.

3.4.3 Challenges Experienced and Strategies for Resolution

As the research and development hub of the CDSiC, the Innovation Center has been on the cutting edge of PC CDS. However, the innovative nature of this work posed some challenges. The team had to ensure that key informants were adequately primed on PC CDS definitions and research before meetings. To address this, the team developed several background documents describing PC CDS and shared materials with informants in advance of calls.

Similarly, it was difficult to identify key informants for the Core 1 workflow models and framework. The team needed to identify key informants who were familiar with and/or implementing PC CDS in their health systems and who could provide real-life examples of successful workflows and measurement strategies. The team addressed this by soliciting recommendations from CDSiC members, using industry connections, and using a snowball recruitment technique (i.e., asking key informants to identify additional informants with whom it would be appropriate to speak).

Additionally, given the large number of deliverables across the two Cores, the team needed to be intentional about maintaining alignment across projects and deliverables as intended. To do so, the Innovation Center team met every 2 weeks to discuss project progress. In addition, the leads for each project reviewed all Innovation Center interim deliverables as a way to stay engaged with the overall work of the Innovation Center.

3.5 Cross-CDSiC Outcomes

This section describes outcomes that reflect broader adoption of CDSiC outputs by CDS stakeholders and broader awareness of PC CDS overall, including citations referencing PC CDS and hashtags related to PC CDS and the CDSiC. Although we have limited data as of September 2023, we anticipate that the available data for these outcomes will increase over the next years of the CDSiC, ultimately enabling us to track the awareness of PC CDS and usage of CDSiC outputs over time.

As of September 15, 2023, 16 manuscripts on the National Library of Medicine’s PubMed search engine⁵⁰ referenced either “Patient-centered clinical decision support” or “Patient-centered CDS.” Fourteen of these were published within the last 5 years (2018-2023), and six were written by CDSiC team members during prior AHRQ PC CDS Initiatives and during the CDSiC’s base period (Appendix B).^{51,52,53,54,55,56} To date, manuscripts on PC CDS written by the CDSiC project team have been collectively cited by nine external manuscripts.

4. Discussion

Over the first 2 years of the CDSiC, the team developed the operational infrastructure for the CDSiC’s three Centers and engaged over 100 CDS stakeholders in discussions around the current state and future promise of PC CDS. In doing so, the CDSiC developed over 30 resources for the CDS community that provide concrete recommendations and guidance for advancing the scalability, quality, and effectiveness of PC CDS.

The CDSiC’s efforts have yielded several lessons learned about implementing a large-scale collaboration to advance PC CDS, discussed in greater detail below. The CDSiC has worked to develop foundational work for the field of PC CDS to further build on to increase patient and caregiver engagement in healthcare. This work has required substantial strategic planning, both within and across Centers, as well as frequent realignment as the project progressed. Furthermore, the team has kept its pulse on the PC CDS landscape to ensure the CDSiC builds on recent work without duplicating it, deliberately incorporated the perspectives and experiences of patient representatives and advocates, utilized strategies for engaging a wide array of stakeholders both synchronously and asynchronously, maintained competing timelines, and employed flexibility and adaptability in translating project plans into outputs.

4.1 Lessons Learned

In establishing the CDSiC and managing the collaborative through its first 2 years, the team has consistently reflected upon its processes, achievements, and challenges. This has afforded the team frequent opportunities to identify successful strategies for advancing the field of PC CDS through the work of the CDSiC, while navigating and adapting to difficulties that have arisen. Key takeaways are highlighted below.

Reflections on advancing the field of PC CDS

To meaningfully advance the state of PC CDS through the development and dissemination of over 30 innovative resources, the CDSiC has operationalized the following lessons:

Ensuring coordination across the Workgroups and Innovation Center is essential so that the whole is greater than the sum of its parts. Each of the four Workgroups was charged with developing three products, while the Innovation Center developed 10 project deliverables, yielding 22 outputs during the first 2 years. Maintaining alignment across the Workgroups and Innovation Center was essential to ensure that they worked collaboratively to inform each other's work, created outputs that would build on previous work, and ultimately furthered the CDSiC's goals to advance PC CDS and shared decision making.

To prevent silos, the CDSiC held frequent cross-task leadership meetings to calibrate and strategize how the Centers could collectively advance the science and practice of PC CDS. Moreover, comprehensive product and project proposals were developed in the first 9 months of the CDSiC to support a holistic view of the CDSiC's outputs and how they interrelate. This process required significant deliberation to ensure that all CDSiC outputs were complementary without being duplicative. For example, CDSiC leadership thoughtfully considered the scope and purpose of each of the six measurement products developed by the Scaling, Measurement, and Dissemination Workgroup and Outcomes and Objectives Workgroup, along with the Innovation Center's Performance Measurement Framework. Planning and cross-pollination among Workgroups and the Innovation Center were crucial to ensure that the outputs aligned with a shared vision of PC CDS, while addressing distinct needs in the PC CDS landscape. In addition, some Workgroup products directly informed the development of subsequent Workgroup products. For example, the Outcomes and Objectives Workgroup developed a taxonomy of patient preferences relevant to PC CDS, which was then used by the Standards and Regulatory Frameworks Workgroup to characterize the current state of standards for electronically documenting patient preferences as well as future opportunities.

The importance of strategic planning, given the size and scope of the collaborative. The CDSiC comprises three Centers spanning over 20 project staff, a 26-member Steering Committee, four Workgroups comprising two Workgroup leads and 11-14 members each, and two Innovation Center Cores, including a seven-person Planning Committee. Strategic planning has been imperative to ensure that all of these components work together smoothly and toward one shared vision of PC CDS. For example, CDSiC leadership engaged with AHRQ and CDSiC members within the first 3 months of the contract award to discuss the purpose, goals, and processes of each Center and all four Workgroups, formally capturing this information in the Operational Frameworks and Charters shared with the CDSiC community.

Furthermore, the CDSiC held frequent meetings, in both large and small forums, to assess the CDSiC's progress and plan for short- and long-term goals and milestones. In addition to the regularly scheduled Steering Committee meetings and Stakeholder Center and Innovation Center Planning Committee meetings, the CDSiC team held frequent internal calls, both scheduled and ad hoc, including internal Operations Center calls (weekly), internal Stakeholder Center calls (weekly), internal Workgroup support

calls (weekly), calls between Workgroup supports and Workgroup leads (weekly or biweekly), Innovation Center calls (biweekly), and calls between AHRQ and project leadership (biweekly). Additional calls were scheduled as needed, such as to discuss Annual Meeting planning, conference presentations, Workgroup product development, or dissemination.

The necessity of keeping a pulse on the PC CDS landscape. Staying informed of recent developments in the CDS landscape was critical to prevent the replication of previous work and to ensure the CDSiC built on the innovative and helpful work of other experts in the field of CDS. The CDSiC project team has kept a pulse on relevant publications for PC CDS, highlighting these in a “What We’re Reading” section of the AHRQ CDSiC Insider newsletter. The team has identified relevant initiatives and invited speakers to present at the bimonthly Steering Committee meetings. In addition, the team frequently exchanges relevant resources internally to facilitate product development and attends AHRQ CDS webinars and health IT conferences including AMIA, HIMSS, and the AcademyHealth Annual Research Meeting to stay up to date on the PC CDS landscape.

Ensuring that we are deliberate in engaging our patient stakeholders. PC CDS incorporates patient-centered factors into CDS tools. Meaningfully advancing the field of PC CDS requires that patients be involved in all stages of the PC CDS lifecycle. The CDSiC team sought to consciously engage patients in various aspects of the CDSiC’s operations to ensure that the CDSiC’s outputs ultimately benefit patients by incorporating their needs, values, and preferences. This included embedding patient advocates and representatives within the Steering Committee and Workgroups and engaging patient representatives via key informant interviews, focus group meetings, and technical expert panels, while developing Workgroup products and the Innovation Center’s PGHD’s Dashboard. Furthermore, the CDSiC sought to amplify patient voices more broadly, such as in the AHRQ CDSiC Insider Newsletter, to encourage the CDS community to engage patients, patient representatives, and caregivers when creating CDS standards, resources, and tools. Finally, patient perspectives anchored the CDSiC’s 2023 Annual Meeting, with the kickoff plenary session featuring a roundtable discussion with patient advocates, and a patient advocate serving as the Annual Meeting’s keynote speaker. These sessions were rated by attendees as some of the most meaningful and impactful sessions at the Annual Meeting.

Strategies for operating a successful collaborative comprising a broad range of stakeholders

To operate a successful collaborative that had the necessary infrastructure in place to generate innovation in the field of PC CDS, the CDSiC team identified the following important lessons:

Maintaining stakeholder engagement and participation. The work of the CDSiC depended on the continued engagement and input of over 70 busy CDS stakeholders. These individuals represented developers, clinicians, researchers, patient representatives, payers, and Federal regulatory agency representatives living across the United States. The scope and geographic dispersion of the CDSiC community required the use of deliberate strategies to maintain participation in CDSiC activities and solicit feedback:

- Used Zoom annotation and polling features to obtain input from stakeholders in an interactive and engaging manner during Steering Committee and Workgroup meetings.
- Developed and disseminated targeted discussion questions to attendees ahead of Steering Committee and Workgroup meetings. This allowed CDSiC stakeholders to prepare for discussion questions in advance, facilitating substantive conversations. A secondary benefit of this was that Workgroup and Steering Committee members were able to email their thoughts on discussion questions if they were unable to attend the meetings live.
- All Steering Committee and Workgroup meetings were recorded and posted to the CDSiC's SharePoint so that stakeholders unable to attend were able to watch the recorded meetings at a convenient time.
- The CDSiC team took meeting minutes for all meetings and shared these with all meeting invitees following the meetings. These notes highlighted key takeaways and action items to provide stakeholders with the most important information at a glance.

Finally, the CDSiC's SharePoint site provided an essential foundation for stakeholder engagement. All Charters, Operational Frameworks, product proposals, meeting agendas, meeting recordings, and meeting minutes were posted to the CDSiC's SharePoint on an ongoing basis to provide a hub for all relevant CDSiC materials. The SharePoint also hosted draft products so that Workgroup members could review and provide feedback on products asynchronously at key times. Ultimately, the SharePoint allowed all CDSiC team members, including Workgroup leads, Workgroup members, Core leads, and Steering Committee members, to share and collaborate on documents simultaneously, regardless of their schedules and external commitments.

Maintaining competing timelines. Each Workgroup completed three products: one Level 1 product (long-term effort), one Level 2 product (moderate effort), and one Level 3 product (short-term effort). To maintain momentum and hit target deadlines, each of the Workgroups developed and revised two or three products simultaneously. Each product had a detailed internal timeline spanning all tasks required for product development, and Workgroup support teams needed to be thoughtful about sequencing product timelines to ensure minimal overlap between key informant interviews and the review windows of Workgroup members, Workgroup leads, and project leadership. In addition, Workgroup support teams often needed to identify how to divide tasks efficiently across team members to sustain product development.

Furthermore, Workgroup support teams employed specific processes to solicit and rapidly incorporate Workgroup member feedback into products, while maintaining products' scopes and timelines. These processes involved: 1) providing both synchronous and asynchronous opportunities for feedback, 2) incorporating 1- to 2-week Workgroup review periods and subsequent revision periods into product detailed timelines from the outset, 3) signaling review timelines to Workgroup members in advance so that Workgroup members could anticipate and plan for requests, 4) providing targeted requests for written feedback to enable Workgroup members to focus their attention on substantive areas, 5) proactively planning for Workgroup meetings to ensure the Workgroup support team was able to obtain needed

feedback for product development, and 6) holding regular meetings between Workgroup leads and support teams to synthesize Workgroup member input and identify how best to incorporate it into each product.

Being adaptive and flexible. Finally, the CDSiC team remained nimble to adapt project plans to real-world constraints. For example, when AHRQ and NORC determined that the original environment planned for the CDSiC website was not viable for a public website, the team pivoted to migrate the website to a different environment. To disseminate information about PC CDS and the CDSiC while the website was being deployed on a new platform, the CDSiC launched the AHRQ CDSiC Insider newsletter, sending out eight newsletters to over 500 subscribers from June 2022 through March 2023, when the website launched. Similarly, although the Stakeholder Center kickoff meeting was initially proposed to take place in person, due to COVID-19, the kickoff meeting was ultimately held virtually over a 2-day period, engaging 45 Workgroup representatives and employing different practices for virtual collaboration, such as breakout rooms, interactive web-based tools, and subsequent report-outs. Finally, the Stakeholder Center Workgroups and Innovation Center Cores relied on the broader CDSiC team and CDS community to identify expert key informants in emerging areas that have had limited work to date (e.g., PGHD/PRO visualization, patient preference standards), using industry connections and snowball sampling to identify appropriate informants.

4.2 Conclusion

The CDSiC aims to advance the development, testing, implementation, tracking, and measurement of PC CDS by creating publicly available resources and serving as a proving ground of innovation for PC CDS concepts. Comprised of three Centers—the Operations Center, Stakeholder Center, and Innovation Center—the CDSiC has mobilized and engaged diverse CDS stakeholders with a range of perspectives to establish a collaborative network focused on advancing the science and practice of evidence-based, shareable, interoperable, and publicly available PC CDS.

During the first 2 years of the CDSiC, the CDSiC convened and sustained the CDSiC Steering Committee, four Workgroups that collectively developed 12 public-facing products, and two Innovation Center Cores that developed 10 deliverables, while pushing the current limits of PC CDS to develop new concepts and technologies. During this period, the CDSiC engaged 93 experts through key informant interviews, focus groups, and technical expert panels, and disseminated PC CDS resources and CDSiC outputs through various channels, including scientific journals, conference presentations, newsletters, viewpoint pieces, social media, and the CDSiC website.

The accomplishments of the CDSiC to date have hinged on strategic planning and coordination within and across tasks, staying up to date on PC CDS developments, identifying strategies for meaningfully engaging stakeholders—including patient advocates, managing competing timelines, and by flexibly in adapting to unforeseen challenges. In the future, the CDSiC will continue to engage patients, clinicians, researchers, developers, payers, and federal agency representatives to identify additional gaps and opportunities in the PC CDS landscape, develop pragmatic resources and guidance for PC CDS, and encourage the widespread use of PC CDS tools to improve the health of all patients.

Appendix A: CDSiC Progress Assessment Framework

Domain	Activities	Outputs	Outcomes
Definition	<p>Actions carried out in implementing the CDSiC</p> <p><i>Development and sustainment of CDSiC infrastructure</i></p>	<p>Products of CDSiC activities</p> <p><i>Written products and presentations, as well as dissemination activities to share this work</i></p>	<p>Engagement of CDS stakeholders and reach and adoption of CDSiC outputs</p> <p><i>Reach of CDSiC outputs and engagement of the broader CDS community, adoption of CDSiC outputs by CDS stakeholders, and broader awareness of PC CDS</i></p>
Operations Center	<ul style="list-style-type: none"> • Development of Charter and Operational Framework • Development of CDSiC Visual Identity Guidelines • Development of CDSiC Outreach and Marketing Plan • Steering Committee activities • External SharePoint development 	<ul style="list-style-type: none"> • Newsletters • Supporting Materials • Social Media Posts • Blog posts/Viewpoints • Annual Meetings • Website pages 	<ul style="list-style-type: none"> • Newsletter engagement • Social media metrics (likes, shares, comments) • Annual Meetings (attendees/feedback) • Website (visitors, views, downloads) • Media pickup*
Stakeholder Center	<ul style="list-style-type: none"> • Development of Charters and Operational Framework • Planning Committee activities • Workgroup activities 	<ul style="list-style-type: none"> • Workgroup products • Additional outputs (publications, conference presentations) 	<ul style="list-style-type: none"> • Product downloads and views • Peer-reviewed article metrics (citations, Altmetrics)* • Attendance by CDS stakeholders at presentations* • Secondary dissemination* • Qualitative information received about outputs
Innovation Center	<ul style="list-style-type: none"> • Development of Charters and Operational Framework • Planning Committee activities • Core activities 	<ul style="list-style-type: none"> • Innovation Core deliverables • Additional outputs (publications, conference, presentations) 	<ul style="list-style-type: none"> • Downloads/views of public-facing resources • Peer-reviewed article metrics (citations, Altmetrics) • Attendance by CDS stakeholders at presentations* • Secondary dissemination* • Qualitative information received about outputs

Domain	Activities	Outputs	Outcomes
Cross-CDSiC	<ul style="list-style-type: none">Description of how CDSiC structure and activities support alignment and collaboration among Centers	<ul style="list-style-type: none">Timeliness of products and projects for CDS field	<ul style="list-style-type: none">Inter-organizational collaboration with other CDS focused groups*Adoption of CDSiC outputs by CDS stakeholders*Citations using “patient-centered CDS” over timeUse of #PCCDS, #CDSiC registered hashtags over time*Google trends related to “patient-centered CDS” over time*

*denotes outcomes that will be assessed in future years of the CDSiC as data becomes available

Appendix B. Manuscripts about PC CDS written by the CDSiC team

From the CDSiC:

1. Sittig DF, Boxwala A, Wright A, et al. A lifecycle framework illustrates eight stages necessary for realizing the benefits of patient-centered clinical decision support [published online ahead of print, 2023 Jul 6]. *J Am Med Inform Assoc.* 2023;ocad122. doi:10.1093/jamia/ocad122]
2. Shenvi EC, Boxwala A, Sittig DF, et al. Visualization of patient-generated health data: a scoping review of dashboard designs [published online ahead of print, 2023 Sep 13]. *Appl Clin Inform.* 2023;10.1055/a-2174-7820. doi:10.1055/a-2174-7820

From prior AHRQ PC CDS Initiatives:

1. Dullabh P, Heaney-Huls K, Lobach DF, et al. The technical landscape for patient-centered CDS: progress, gaps, and challenges. *J Am Med Inform Assoc.* 2022;29(6):1101-1105. doi:10.1093/jamia/ocac029
2. Dullabh P, Sandberg SF, Heaney-Huls K, et al. Challenges and opportunities for advancing patient-centered clinical decision support: findings from a horizon scan. *J Am Med Inform Assoc.* 2022;29(7):1233-1243. doi:10.1093/jamia/ocac059
3. Dullabh P, Heaney-Huls K, Hovey L, et al. The technology landscape of patient-centered clinical decision support - where are we and what is needed? *Stud Health Technol Inform.* 2022;290:350-353. doi:10.3233/SHTI220094
4. Lobach DF, Boxwala A, Kashyap N, et al. Integrating a patient engagement app into an electronic health record-enabled workflow using interoperability standards. *Applied Clinical Informatics.* 2022 Oct;13(5):1163-1171. DOI: 10.1055/s-0042-1758736. PMID: 36516969; PMCID: PMC9750793.

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- ¹ Dullabh P, Sandberg SF, Heaney-Huls K, Hovey LS, Lobach DF, Boxwala A, Desai PJ, Berliner E, Dymek C, Harrison MI, Swiger J. Challenges and opportunities for advancing patient-centered clinical decision support: findings from a horizon scan. *Journal of the American Medical Informatics Association*. 2022 Jul 1;29(7):1233-43.
- ² AHIMA. The Five Rights of Clinical Decision Support: CDS Tools Helpful for Meeting Meaningful Use. <https://library.ahima.org/doc?oid=300027#.YL6EuPIKjIU>
- ³ Osheroff, J.A., Teich, J.A., D. Levick et al. *Improving Outcomes with Clinical Decision Support: An Implementer's Guide*. 2nd Edition. Chicago, IL: HIMSS, 2012: p. 15.
- ⁴ Dullabh P, Sandberg SF, Heaney-Huls K, et al. Challenges and opportunities for advancing patient-centered clinical decision support: findings from a horizon scan. *J Am Med Inform Assoc*. 2022;29(7):1233-1243. doi:10.1093/jamia/ocac059
- ⁵ Dullabh P, Sandberg SF, Heaney-Huls K, Hovey LS, Lobach DF, Boxwala A, Desai PJ, Berliner E, Dymek C, Harrison MI, Swiger J. Challenges and opportunities for advancing patient-centered clinical decision support: findings from a horizon scan. *Journal of the American Medical Informatics Association*. 2022 Jul 1;29(7):1233-43.
- ⁶ Agency for Healthcare Research and Quality. Patient-Centered Outcomes Research: Clinical Decision Support. Retrieved from: <https://cds.ahrq.gov/>. Accessed August 10, 2023.
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