EVIDENCE2PRACTICE PROGRAM EVALUATION

CENTRE FOR DIGITAL HEALTH EVALUATION

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WHV
WOMEN'S COLLEGE HOSPITAL INSTITUTE FOR HEALTH SYSTEM SOLUTIONS AND VIRTUAL CARE

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Acronyms

APQIP: Assessment Process for Quality Improvement Projects

CDHE: Centre for Digital Health Evaluation

CDS: Clinical Decision Support

CDSS: Clinical Decision Support System

CEP: Centre for Effective Practice

CHF: Congestive Heart Failure

E2P: Evidence 2 Practice

eCE: eHealth Centre of Excellence

EMR: Electronic Medical Record

HIS: Health Information System

MOH: Ministry of Health

NASSS: Non-adoption, abandonment, scale-up, spread, and sustainability

NYGH: North York General Hospital

OH: Ontario Health

OSC: Ontario Standards for Care

PAN: Patient Advisors Network

PPE: Patient Partner Evaluator

PCP: Primary Care Provider

SMGH: St. Mary's General Hospital

WCH: Women's College Hospital

Definitions

Clinical Decision Support: Any on-screen tool designed to improve adherence of clinicians to a recommended process of care[1]

Discharge Summary: A comprehensive document with literacy appropriate instructions and education materials for patients to summarize the diagnosis, medication list (reconciliation), follow-up appointments, and guidance to help the patient successfully transition from the hospital and manage their condition at home.

Dot Phrase: The keyboard terms used to prompt discharge summary to propagate into the patient's chart, for example (.cardio_CHF).

Implementers: Persons who assisted in the execution of the E2P pilot at their respective site, often in an administrative or leadership capacity.

Order Set: An order set is a form of Clinical Decision Support, a pre-defined template used within the Electronic Medical Record or Hospital Information System for providers' orders of items such as medications and care orders.

Users: Individuals, specifically physicians and nurse practitioners, who will be utilizing the E2P tools, and have the authorization and training to place orders (via order sets) and provide discharge summaries. Excludes nurses, who can view the discharge summaries and order sets, but cannot place an order.

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Executive Summary

Background

In 2021, as part of Ontario's Digital First for Health strategy, the Ontario Ministry of Health (MOH), in collaboration with Ontario Health, began development of a provincial program focused on evidence-based clinical decision support (CDS) tools called Evidence2Practice (E2P). The goals of E2P are to: (1) digitize best clinical practices and embed them into frontline clinical information systems, ensuring providers have access to CDS tools at the point of care standardized across the province; (2) improve the patient experience by supporting consistent information sharing across the circle of care; (3) reduce the cost per capita, and the cost and effort associated with synthesizing and integrating this information into clinical systems. The overarching objective of the program is to improve population health and the provider and patient/caregiver experience in alignment with the Quadruple Aim Framework.

The E2P program will be applied to five use cases starting with Congestive Heart Failure (CHF) (the focus of this evaluation), Anxiety, Depression, Diabetes, and a fifth use case which is yet to be decided. To support the program, three delivery partners (the Centre for Effective Practice (CEP), eHealth Centre for Excellence (eCE) and North York General Hospital (NYGH) are contributing to the design, development and implementation of the CDS tools in primary care and acute care settings.

Objectives

The primary objective of this evaluation was to examine the factors that will affect successful scale-up, spread, and sustainability of the E2P program. Secondary objectives of this evaluation were to evaluate early signals of the effectiveness of the implementation of the first use case, Congestive Heart Failure (CHF), and describe the provider experience with the CHF tool, including satisfaction and acceptance of the tool, as well as perceived enablers and barriers to use. Early findings from this evaluation will help support current and future implementations of E2P across Ontario and can be used to develop a summative evaluation that will focus on evaluating the impact of E2P on patient outcomes and cost across all use cases.

Methodology

Three methods were used to help evaluate the early-stage implementation of the E2P program:

1. A rapid literature review focused on electronic CDS systems, with a focus on spread, scale and sustainability within the last 5 years;
2. An analysis of adoption metrics, including a review of quality indicators outlined by Ontario Health (OH) for improved care of CHF patients, with a focus on process and outcome indicators as well as measures of implementation; and
3. Qualitative interviews conducted with key informants (N=17) who were subject matter experts (SMEs), but not E2P tool users. These SMEs included physicians, administrators, and researchers with experience in quality improvement, CDS tools, or clinical practice specific to the CHF use case. Semi-structured interviews (N=6) were also conducted with providers at two implementation sites, with a focus on barriers and facilitators of tool adoption and use, experience and satisfaction with the tool, perceived usefulness, ease of use, areas of improvement, and value proposition.

Key Findings

1. **The province-led approach of the E2P program has received an overall positive response from implementers, users and experts who have knowledge of CDS tools**. Our interview participants highlighted the benefits of the program including standardization of care pathways, increased scope for using data generated to understand population health needs, and the avoidance of duplication of efforts through multiple local efforts toward CDS tools.
2. **The complexity of the clinical conditions covered in the E2P use cases calls for extra vigilance by designers and implementers of the program.** The identified E2P use cases cover complex clinical conditions that are frequently accompanied by comorbidities. This requires extra caution and consultation with clinicians during the design, development, and implementation of the CDS tools.
3. **Clinicians are more likely to adopt the CDS tool if there are clinical champions identified for each implementation site**. Significant value was placed on the opinions of such clinical champions. The knowledge that the CDS tools have been developed in consultation with clinicians makes the tools more trustworthy and likely to be adopted. Some clinicians raised questions related to clinician liability for adverse clinical outcomes as a result of using the tools. Clinician champions may play an important role through their involvement in the E2P program from early stages, and voicing these issues so that they may be addressed by the relevant authorities.

4. **Variations in organizational readiness may impact participation in the E2P program:** Due to current resource and time shortages, some healthcare organizations may not participate in the E2P program because of the perceived burden it places on providers due to anticipated training needs. Key informants suggested that not all organizations would be receptive to adopting the CDS tool due to concerns about the time and extra resources it may require. In addition to possible increase in provider burden, resources would also be needed to maintain and update the tool at each site. However, the E2P CDS tools for acute care have been designed to seamlessly integrate with existing systems, thus reducing the time needed for providers to familiarize themselves with the updated tool, while simultaneously making tasks, such as generation of discharge summaries easier. This also emphasizes the need to make providers aware of these benefits and involve clinical champions who will vouch for the tools' low barrier to use. In primary care however, the CHF CDS tool may not be integrated as seamlessly, and may require additional time, resources and training for successful uptake.
5. **Implementation of E2P's tools in the rural and remote care setting may have challenges related to technology systems and access to care.** Providers in rural settings are less likely to have computerized systems, making widespread implementation a challenge. Further, accessibility of certain treatment options may be limited in rural areas, thus requiring flexibility and modifications in the CDS tool rollout in such settings. The circumstances and needs of patients and providers in rural areas may also differ significantly from their counterparts in urban areas, and CDS recommendations may need to be contextualized to accommodate these variations.
6. **For patients, the E2P CHF tools offer benefits related to improved quality of care and transition of care.** The use of updated standardized order sets provides the assurance of quality care that is consistent and aligned with best practices irrespective of which clinician they see. The enhanced discharge summaries offer patients a better understanding of their condition and how to manage it, in addition to improved transitions of care from the hospital setting to the community.

Limitations

The limitations of this study are listed below:

1. **Limited to data from the acute care setting**: This early-stage evaluation of the E2P CHF tool required primary care providers (PCPs) to have used the tool for at least 3 months. However, due to delays in the implementation and roll out of the tool in primary care, it was not possible to include details specific to the CHF use case in primary care in this report.

2. **Lack of patient interviews**: Given the early stage of implementation of the CHF use case, we had limited opportunity to collect data from CHF patients. Moreover, patients are likely to be unaware of the updated CDS tool, making it a challenge to interview them.
3. **Early adoption stage of the CHF tool**: The CHF tool has been implemented very recently and is still in early stages of adoption. Physician users have not had the opportunity to use the tool for a significant amount of time; hence, their inputs are based on initial perceptions and experiences, and not continued use over time.
4. **Low number of users and lack of responses**: The number of users in the acute care setting was relatively small, limiting the amount of interview data that we could collect. We also had a low survey response rate, and hence had to exclude this component of the study.
5. **Generalizability of findings**: Most of the data for the CHF use case in this report is from an acute care site that is also a delivery partner for the E2P program, limiting the generalizability of the acute care findings. Key informants also highlighted potential challenges that may be unique to remote/rural settings, and the findings from this evaluation may not be entirely applicable to those settings.
6. **Limited focus of the review**: The review undertaken for this report is not a systematic or comprehensive review; we limited our search to qualitative studies that were more likely to focus on factors relevant to the theoretical framework used for our analysis. While findings from our review are not exhaustive, they focus on policy-relevance and studies related to the spread, scale and sustainability of CDS implementations, which is a priority for the E2P program.

Recommendations

1. **Support access to the E2P CHF tool and its use by all clinicians at the point of care who have decision making responsibilities**: All clinicians who are involved in a CHF patient's care, and who have the ability to order tests and discharge a patient, should have access to the tool, and be encouraged to use it. This ensures consistency in care pathways, treatment plans and transition of care to the community setting.
2. **Ensure all users are informed of updates and changes made by the E2P CHF order set tool**: In acute care, the CHF order set rollout may be unnoticed by some clinicians as the tool has been seamlessly integrated into the existing HIS. Hospital users were typically updated via email to let them know of changes – however, it is important to include other means of communication such

as inbuilt CDS notifications, enabling users to acknowledge tool updates. This facilitates physicians' awareness of updates to clinical guidelines and implications for comorbidities.

3. **Enable flexibility and local modifications to the tool where required**: E2P CDS tools may need to be modified to accommodate variations in access to certain treatments or tests, especially in rural settings. When treating patients with complex conditions or comorbidities, providers must be provided the flexibility to decide whether to follow a CDS recommendation, with the ability to input a reason if deciding against it. This allows for flexibility, accountability, and feedback loops for possible future iterations of CDS tool development.
4. **Continue involving clinical champions in future rollouts of E2P program components across acute and primary care sites**: Clinicians value the opinions of clinical leaders who have successfully used a tool and are more likely to adopt a CDS tool if it has been vouched for by a clinical champion. Design and development of E2P tools will benefit from the continued involvement of clinical champions specific to each use case. As has been done for the CHF use case, the E2P program should continue to involve clinicians from the early stages for future use cases as well. Clarity is also needed regarding medicolegal implications of using (or not using) the tools. Clinician champions should be involved in these discussions to help ensure clinicians' concerns are addressed.
5. **Comprehensive evaluation of the CHF tool in acute care and primary care**: We recommend a comprehensive evaluation of the CHF tool in both acute care as well as primary care once it has been rolled out more widely, and there is increased uptake. The evaluation should use indicators based on Ontario's quality standards for care of CHF patients, in combination with adoption metrics, to assess levels of adoption, changes in clinician prescribing and test-ordering practices, and impact on clinical outcomes. Learnings from this comprehensive evaluation can inform development and implementation of E2P CDS tools for other use cases as well. Rapid cycle evaluations may also be employed for formative evaluations across future implementations, to provide ongoing iterative feedback to steer the program in the right direction.

1. Background

1.1 Context

As part of Ontario's Digital First for Health strategy, the Ministry of Health (MOH) and Ontario Health (OH) are working towards a provincial program, Evidence2Practice (E2P), formerly known as Ontario Standards of Care (OSC), using evidence-based clinical decision support (CDS) tools and templates. This will facilitate clinical and data standardization in alignment with provincial clinical guidelines. CDS tools are defined as any on-screen tool designed to improve clinical adherence to a recommended process of care (1), and that have the potential to improve healthcare quality by providing clinicians with timely reminders, warnings, and recommendations for treatment in alignment with evidence-based clinical guidelines (2,3).

Overview of the E2P Program

The E2P program is a centralized provincial program that aims to improve access to clinical best practices for frontline providers at the point of care. The program's goal is to digitize best clinical practices and embed them into frontline clinical information systems (e.g., electronic medical records (EMRs) and hospital information systems (HIS).

The E2P program has 3 main objectives:

1. Ensure providers have **access to provincially standardized, evidence-based decision support tools** at the point of care, leading to better patient outcomes.
2. **Improve the patient experience** by supporting seamless transfer of information across the circle of care.
3. **Reduce the cost** per capita and the effort required to synthesize information and translate it into clinical systems, realizing economies of scale through implementation at a provincial level.

The program's work started in 2021 with the development of a governance model to determine how pre-existing clinical standards tools could be incorporated into the OSC program and to develop a framework for identifying use cases. Three E2P delivery partners have also been identified: Centre for Effective Practice (CEP), eHealth Centre for Excellence (eCE), and North York General Hospital (NYGH). The lead delivery partner, CEP, is responsible for the prioritization, clinical design, and implementation, while eCE and NYGH will be involved in technical development and implementation

in primary care and acute care respectively. The translation of clinical standards began with the clinical guidelines for five use cases, starting with Congestive Heart Failure (CHF), which is the focus of this evaluation report. Other identified use cases in the pilot project include Diabetes, Anxiety, and Depression. The fifth use case will be determined at a later point.

E2P's CDS tool for the CHF use case

The translation of clinical standards based on evidence-based guidelines for the identified use cases began in January 2022. In acute care, the CHF CDS tool is comprised of an up-to-date evidence-based order set that is aligned with the latest Ontario Health Heart Failure Quality Standards (4), and enhanced patient and provider-facing discharge summaries that facilitate a successful transition of care from the hospital. The enhanced discharge summaries include a dot phrase functionality to create templates for standardized discharge summary details and instructions to patients. In primary care, the CHF CDS tool is comprised of a toolbar designed to support clinicians in the diagnosis and management of CHF using evidence-based treatment strategies for improved patient outcomes. Implementation (onboarding of sites and providers having access to the tool) for the CHF use case began in July 2022 in the acute care setting, and at the time of writing this report, two acute care sites have been onboarded: NYGH and St Mary's General Hospital (SMGH), both using Cerner systems. AT NYGH, updated order sets were rolled out in July 2022, and the enhanced discharge summary tools were rolled out in October 2022. At SMGH, both the order set as well as discharge summary tools were rolled out in October 2022. As of March 2023, there are 144 users (specialist physicians and nurse practitioners) across both sites.

Deployment of the CDS tool in primary care faced delays and began in November 2022 with approximately 20 physicians across 4 sites.

1.2 Purpose and Objectives

The purpose of this evaluation is to examine the likelihood of successful implementation of the CHF CDS tool within E2P, to collect initial measures on the effectiveness of the implementation, and to assess providers' experience using the tool.

The two main objectives of this evaluation are to:

1. Examine the factors that will affect successful scale-up, spread, and sustainability of the E2P program in Ontario.

2. Evaluate early signals of effectiveness of the implementation of the first use case (CHF), and describe provider experience with the CHF tool, including satisfaction with the use of the tool, acceptance of the tool, and perceived enablers and barriers to use.

Early findings from this evaluation will help support current and future implementations across Ontario, facilitating a higher potential for spread and scale of the E2P program, setting the stage for a summative evaluation which will focus on evaluating the impact on patient outcomes and cost across all the use cases.

2. Methodology

To explore potential factors affecting spread and scale of the program, we conducted a literature review focused mostly on review articles and qualitative studies. To better understand factors that may affect spread, scale and sustainability of the program in Ontario, we conducted interviews with senior managers and leaders, e.g., Chief Information Officers (CIOs), Chief Medical Information Officers (CMIOs) and clinical directors, across the healthcare sector. In preparation for future summative evaluation, we also worked with the delivery partners to review the metrics that they plan to collect and supplemented these with additional suggestions that may be collected in a future evaluation. Patient Partner Evaluators (PPEs) from the Patient Advisors Network (PAN) were consulted throughout the research process, and provided feedback on various components of the study such as development of interview guides and survey questions

2.1 Rapid Review of the Academic Literature

We conducted a literature review focused on electronic CDS systems, using search terms published by a recent meta-analysis (1). This resulted in a total of 24,711 articles. Limiting our search to the last 5 years and including only English articles, gave us 9,326 articles to screen. We narrowed this further by searching keywords for terms related to spread, scale and sustainability, resulting in 3,640 articles. We targeted qualitative literature (N=390) as these studies are likely to contain more information around spread, scale and sustainability, and also included all review articles (N=882) in that pool, giving us a total of 1,272 articles. Titles and abstracts of this set of articles were screened to include only those were relevant and that included spread, scale and sustainability concepts (N=150).

These methods allowed us to examine a broad scope of issues related to CDS systems, drawing on factors that can support policy-decisions and also be practically applied to implementation. Three researchers reviewed the full text of the resultant pool of articles to search for relevant information within the themes of the Non-adoption, Abandonment, Scale-up, Spread, and Sustainability (NASSS) framework. If an article did not add new information to the ongoing review it was excluded. Forty-eight articles were finally included in the review provided in this report.

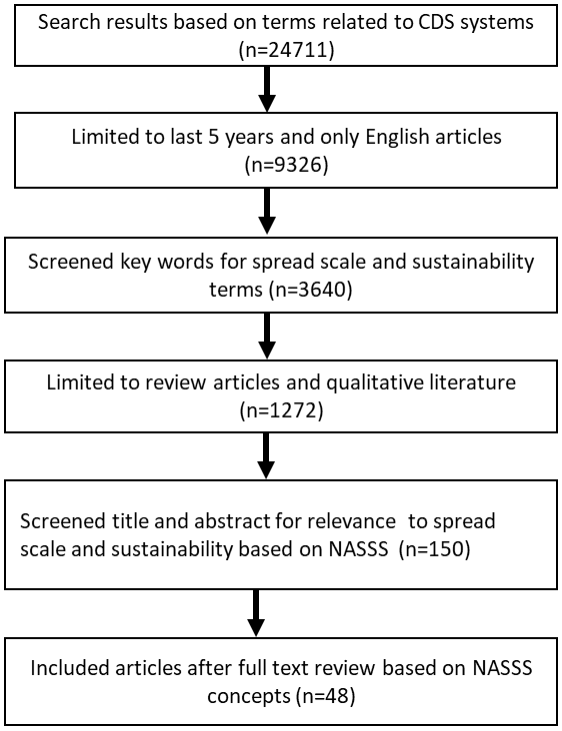

Figure 1 Screening process for literature review

2.2 Review of Evaluation Metrics

Identification of suitable metrics for evaluation of E2P's CHF tool implementation and use were informed by documents and guidelines from three sources: Ontario Health (OH), the American Heart Association (AHA), and the Canadian Heart Failure Society (CHFS).

Quality standards defined by OH provide ten quality statements for improved care of CHF patients (4). The CDHE reviewed the quality indicators outlined by OH, as well as those put forward by the AHA (5). The ten guidelines defined by OH have suggested quality indicators that may be categorized into process indicators, outcome indicators and structural indicators. We focus on the former two, as the assessment of structural indicators (such as availability of multidisciplinary care for CHF) is out of

scope for this evaluation. We also reviewed a sample CHFS order set for CHF patients (6). In addition, we included adoption metrics that relate to the implementation and use of the tool(s) in primary and acute care.

The delivery partners provided the CDHE with a list of adoption and process indicator metrics. Based on our review of existing guidelines (from OH and the AHA), we have included additional metrics to consider for the evaluation. Only metrics relevant to in-patient admissions were considered for the evaluation of the CDS tool in acute care.

2.3 E2P Program Perceptions: Key Informant Interviews

Purposive sampling was used to recruit subject matter experts (SMEs) who were not using the E2P tools, but who held positions that were likely to involve them in decisions related to program implementation at their site. Key informants were asked to participate based on their expertise in quality improvement, CDS tools, or their clinical practice specific to the CHF use case (e.g., cardiologists and internal medicine specialists). The interview guide (see Appendix A) was informed by the Non-adoption, Abandonment, Scale-Up, Spread, and Sustainability framework (NASSS) (7).

Table 1. Adapted NASSS domains guiding (interview) data analysis

NASSS Domains	Adapted NASSS subthemes
Condition	Nature of condition or illness
	Comorbidities, socio-cultural influences
Technology	Material features
	Type of data generated
	Knowledge needed to use
	Technology supply model
Value Proposition	Supply-side value (Provincial government, Organization, Provider)
	Demand-side value (patient)
Adopters	Champions, Opinion leaders
	Physicians (role, practices, identity changes)
Organization	Capacity to innovate
	Readiness for technology/change
	Extent of change to routines needed
	Work needed to implement change
Wider System	Political/policy
	Population Health
	Professional
Embedding and adaptation over time	Scope for adaptation over time
	Organizational resilience

Seventeen key informant interviews were conducted with SMEs including primary and specialist physicians, hospital administrators, informatics leaders, and researchers. Some participants held multiple roles - for example, some clinician participants held research and/or administrator roles as well. In the pool of 17 participants, there were 10 scientists and 11 administrators (quality improvement staff, CIOs and CMIOs), with some having overlapping roles. Five participants were primary care physicians, and 7 were specialist physicians; all except one of these clinicians also held scientist and/or administrator roles.

Data analysis was conducted using a deductive coding approach based on the NASSS domains, with NASSS subthemes adapted to the context of this study (see Table 1). The interviews were coded by three researchers and meetings were held to formulate the codebook, ensure good interrater reliability, and to interpret the findings.

2.4 E2P Program (CHF) Experience: Implementer Interviews and Provider Experience Surveys and Interviews

Provider experience surveys assessing satisfaction and acceptance of the tool in clinical practice were distributed amongst physicians at the two implementation sites: North York General Hospital (NYGH) and St Mary's General Hospital (SMGH). The provider experience surveys were based on validated tools namely, the Clinical Sustainability Assessment Tool (CSAT) (8), and the Unified Theory of Acceptance and Use of Technology (9). Survey information was distributed by each organization internally through purposive recruitment. The surveys were distributed to 25 users (12 cardiologists, 11 internal medicine specialists and 2 nurse practitioners) at NYGH and 6 users at SMGH. A number of strategies were employed to help enhance the rate of survey responses. Leaders at delivery sites were notified and consulted regarding potential strategies to encourage uptake. Introductory emails were sent regarding the purpose of the surveys and interviews, and remuneration was provided to respondents and interviewees. Multiple reminder emails were also sent to encourage responses. Unfortunately, due to insufficient data (only 3 survey responses), the survey component of the study has been excluded from this report.

For a more in-depth understanding of the provider experience and acceptance of the E2P program, semi-structured interviews were conducted with providers at the acute care sites: NYGH and SMGH. The interview guides for users were structured around the Theoretical Domains Framework (10), and explored barriers and facilitators of tool adoption and use (as related to the specific use case: CHF),

experience and satisfaction with tool itself, perceived usefulness and ease of use, areas of improvement, and value proposition for use.

We also interviewed Implementers (physicians and hospital informatics staff who were involved in the implementation of the program on site and making needed changes in the HIS). These interviews were semi-structured and included questions that were influenced by the NASSS framework(7). These interview guides were similar to those used for Key Informants outside the implementation sites (see Appendices B - D).

Interview information was distributed by each organization internally through purposive recruitment. A total of 6 interviews were held with implementers and users at NYGH (N=5) and SMGH (N=1), with one respondent having responsibilities that overlapped both roles (implementer and user). Interviews were coded using the same codebook that guided analysis of the key informant interviews.

3. Results

3.1 Academic Literature Review

The literature summarized in this review includes 48 articles spanning multiple countries, patient populations and interventions. Table 2 summarizes the distribution of articles reviewed.

Table 2 Countries, patient populations and intervention types covered in the literature review (n=48 articles in total)

Countries	USA (*n=19*) Multiple countries (*n=12*) UK (*n=4*) Canada (*n=2*)	Australia (*n=2*) Saudi Arabia (*n=1*) China (*n=1*) Switzerland (*n=1*)	Scotland (*n=1*) Netherlands (*n=1*) Japan (*n=1*)
Patient Population/ Conditions	General *(n=18)* In-patients being prescribed antimicrobials (*n=4*) Working adults (*n=4*) Cardiovascular patients (*n=2*) Cancer screening *(n=2)* Opioid use *(n=2*) Primary/secondary cancer prevention *(n=1)* 2-18 year olds with head trauma *(n=1)* Medical surgical ward in-patients (*n=1*) Suspected sepsis (*n=1*) Anticoagulation care *(n=1)*	Atrial fibrillation (*n=1*) Pneumonia *(n=1)* 1 or more chronic diseases *(n=1)* Neck and lower back pain *(n=1)* Diabetes (*n=1*) 16+ year olds with asthma *(n=1)* Dementia screening *(n=1)* Emergency care, aortic dissection *(n=1)* Older adults at risk of falls (*n=1*) Geriatric (65+ years) (*n=1)* Receiving vaccines *(n=1)*	

Appendix E provides our review, covering studies in primary care, hospital/emergency departments (ED), nursing as well as pharmacy settings. A summary of this review is provided in Table 3 below, categorizing facilitators and barriers to CDS adoption based on the NASSS framework.

Table 3. Summary of Literature Review

Key Findings from Literature Review
CLINICAL CONDITION: Nature of the illness and comorbidities
• CDS alerts/recommendations should accommodate case complexity and be context-specific • May not be useful in high-volume/high-severity trauma setting, as immediate decisions are required • Must address co-morbidities
TECHNOLOGY: Features of the technology, the knowledge needed for its use and data generated by it
Knowledge needed to use technology: • Training required to learn new tools • Allow and train users to control alerts Type of data generated: • Importance of usefulness, relevance, format, and conciseness • Allowing patients to update their information may improve data Features: • Integration within workflow • Reminders should be timely and appropriate to type and reason of patient visit • Minimal manual input • User-friendly with visualizations • User centred design and front-line user feedback • Automated discharge instructions
VALUE PROPOSITION: The value offered by the technology, and whether the technology is worth developing
• Efficient: saves time, user control, flexibility • Educational and expands skills • Increased confidence in provider communication with patients • Integration of care across settings • Availability of appropriate information tailored to patient needs • Tailored recommendations relevant and sensitive to patient context
ADOPTERS: Factors affecting adoption and continued use of the technology by providers
Facilitators: • Trustworthy and evidence-based recommendations • CDS allowing more physician autonomy and agency • Providers made aware of the tool and its need Barriers: • Ambiguity and disagreement with guidelines • Perceptions of reduced cognitive reflection and autonomous decision making, raising liability and medico-legal issues • Alert fatigue

Key Findings from Literature Review
ORGANIZATION : Organizational capacity and readiness for a technology; Changes needed in interactions and routines; Effort involved in technology implementation
• Ensure early involvement of clinician champions and ongoing engagement with clinicians • Need to incorporate CDS algorithms into variations of EHR platforms • Need for integration into existing workflow, facilitating team-based care and standard practice • Accommodate for ongoing adaptation to system and adjustments to workflow • Financial incentives for continued use of CDS • Lack of funding may be a barrier • Need for continued reminders about CDS tool and how it is linked to evidence • Increased training and resources where required • Take into consideration limited capacity to adopt new technologies
WIDER SYSTEM: Wider institutional and socio-cultural context that influences future spread, scale and sustainability of the technology
Socio-cultural and user needs • Increase patient engagement in the tool development and design • Consideration of clinic's unique culture around treatment and prevention • Recognize needs of business, employees, and patients Clinical professional bodies and other institutions • Provide guidelines to ensure consistent usage/adoption of the tool across sites and provider groups • Revise guidelines, policies, and professional roles as needed • Address medico-legal/ liability concerns in alignment with existing policies Policy/Regulatory context • Strong national/provincial level leadership required • Appropriate regulatory framework
ADAPTATION OVER TIME: Factors needed for spread, scale-up and sustainability of the technology
Scope of adaptation over time • Continual performance monitoring • Continual maintenance of tool (updates) • Share knowledge and leverage collective learning • Sustain relationships over time through solicitation of feedback Organizational resilience • Ability to detect critical issues and respond with coordinated action • Modifiable implementation approach for different contexts • Need for sustainable financial models for continued use of the technology

3.2 Evaluation Metrics

We identified evaluation metrics for E2P's CHF tool implementation and use by reviewing three sources: OH's Quality Standards for the care of patients with heart failure, the AHA's guidelines for the management of heart failure, and a sample CHFS Admission Order Set (4–6).

OH's Quality Standards highlight a range of clinical functions, including clinical assessment, pharmacological treatment, non-pharmacological treatment, shared decision making, self-management, ongoing monitoring, and care coordination and transitions that are associated with the quality statements for provision of care to CHF patients (see Table 4) (4). There was substantial overlap between the OH stipulated guidelines and the American Heart Association (AHA) clinical guidelines (5,11), which are categorized by clinical functions such as Initial Evaluation, Serial Evaluation, Evaluation with Cardiac Imaging, and Transitions of Care. Relevant indicators from the AHA clinical guidelines have been incorporated into the list of metrics identified for this evaluation.

Ontario's CHF Quality Standards include process metrics based on number of tests (e.g., ECGs) *ordered*, as well as number of tests *received* by patients within a recommended time frame. As the purpose of this evaluation is to assess the use of the CHF tool and how physicians adopt it, the focus is on process metrics related to measuring the various tests, medications or procedures *ordered.* Whether or not these tests or procedures are carried out may be unrelated to the use of the CHF tool, and hence, we have excluded such metrics. Where appropriate, such metrics have been modified to read as 'tests/treatments *ordered* or *provided to* patients'.

Certain options or recommendations have been excluded from the E2P CHF order set as delivery partners' consultations with clinicians indicated that they are not essential. For example, though digoxin is one of the possible listed medications for CHF patients in Ontario's Quality Standards guide, clinical SMEs suggested that this medication is not commonly initiated for acutely ill patients. We have not included indicators for such processes where it is known that the treatment/test has been excluded from the E2P CHF order set.

Most of the outcome indicators specified in Ontario's Quality Standards are patient-reported outcomes. While some of these were considered out of scope by the delivery partners, we suggest that they be included as possible metrics to be considered for future evaluations where patient reported outcomes may be included. Other outcome indicators we identified are related to the number of hospital admissions and/or readmissions, ED visits and mortality rate within a defined period following a primary care visit or hospital admission.

Table 4. Quality Standards defined by Ontario Health for CHF patients

Areas of focus defined by Quality Statements (QS) for adult CHF patients	
QS 1:	Diagnosing Heart Failure
QS 2:	Individual, Person-Centered, Comprehensive Care Plan
QS:3	Empowering and supporting people with HF to develop self-management skills
QS 4:	Physical activity and exercise
QS 5:	Quadruple therapy for people with HF who have reduced ejection fraction
QS 6:	Worsening symptoms of HF
QS 7:	Management of non-cardiac comorbidities
QS 8:	Specialized multi-disciplinary care
QS 9:	Transition from Hospital to Community
QS 10:	Palliative Care and Heart Failure

We identified metrics relevant to the implementation of the CHF use case, and the corresponding quality statement (QS) to which these metrics may be applied, for both primary care (Table 5) and acute care (Table 6).

All process and outcome metrics will be compared with frequencies of the corresponding measurement prior to implementation of the tool(s). This will require baseline data for a duration of at least 6 months prior to the implementation of the tool. Table 5 below provides the recommended metrics for CHF in the primary care setting. Highlighted text indicates metrics added or modified by the CDHE. Evaluation metrics for CHF in the acute care setting (Table 6) include more detailed tests as well as indicators that support the transition of care when a patient is discharged from the hospital.

Table 5. Primary Care CHF Use Case Evaluation Metrics

	EVALUATION METRICS FOR CHF IN PRIMARY CARE AND CORRESPONDING QUALITY STATEMENT (QS) WITHIN OH'S QUALITY STANDARDS GUIDE		Data source
ADOPTION METRICS	Number of clinicians who have implemented the tool (access to the tool)		Standard reporting
	% Clinicians (out of those eligible) using the tool		Standard reporting
	% Clinicians (out of those eligible) receiving support (change management and training)		Standard reporting
	Number of patients on whom the tool was used*		Standard reporting
	% Patients (out of those meeting the diagnostic criteria) on whom the tool was used*		Standard reporting
	Tool feedback & Rating: Satisfaction and Acceptance*[1]		Surveys
	Tool feedback & Rating: Knowledge of provenance and impact on trust (in the tool) *[1]		Surveys
	Tool feedback & Rating: User control and flexibility*[1]		Surveys
	Tool feedback and Rating: Support and training*[1]		Surveys
	Geographical distribution of users		Standard reporting
	Number of uses of the tool (total count of how many times the tool was used)		Standard reporting
	Number of multiple uses of the tool (how many clinicians used the tool multiple times)		Standard reporting
	Number of toolbar downloads		Standard reporting
	Number of sites engaged, distribution by OH region/ OHT/ Practice type, etc.		Standard reporting
PROCESS METRICS	% Patients for whom medical history and physical exam is done* [3,4]	QS1	EMR
	% Patients with suspected HF whose initial evaluation includes an ECG and a chest x-ray	QS1	EMR
	% Patients with suspected HF whose evaluation includes an echocardiogram	QS1	EMR
	% Patients with newly diagnosed/suspected HF for whom initial laboratory investigations are ordered (CBC, Electrolytes, Serum Creatinine (renal function), blood urea nitrogen, glycated hemoglobin, Urinalysis, Glucose, Thyroid function)*[3]	QS1	EMR
	% Patients with newly diagnosed Hf who are dispensed quadruple therapy (stratified data)[3]	QS5	EMR
	% CHF patients referred to specialized multidisciplinary care*[3]	QS8	EMR
	% Patients who were hospitalized/treated in the ED for HF who are seen by a primary care physician, cardiologist, or internal medicine physician within 7 days of discharge[3]	QS9	EMR/ ICES

	% CHF patients for whom a tailored self-management program developed in collaboration with their health care provider and their caregivers is documented in their medical record*[3]	QS3	EMR
	% CHF patients (or their caregivers) who are provided information, support, coaching, and counselling about heart failure at each appointment for the first 6 months after diagnosis[3]	QS3	EMR
	% CHF patients who are offered a personalized, exercise-based cardiac rehabilitation program[3]	QS4	EMR
	% CHF patients who are provided a care plan to guide their care[3]	QS2	EMR
	% CHF patients whose care plan has been reviewed in the last 6 months[3]	QS2	EMR
	% CHF patients who report gradual, progressive, worsening symptoms who are assessed by a care provider within 48 hours[3]	QS6	EMR
	% CHF patients who report gradual, progressive, worsening symptoms and require medication adjustment, have their medications adjusted by a care provider within 48 hrs[3]	QS6	EMR
OUTCOME METRICS	% CHF patients (or their caregivers) who report that their care provider always or often gives them an opportunity to ask questions about recommended treatment*[3]	QS2	Patient survey
	% CHF patients (or their caregivers) who report that their care provider always or often involves them in decisions about their care*[3]	QS2	Patient survey
	% CHF patients (or their caregivers) who report that they have the skills and confidence to be actively involved in their own care*[3]	QS3	Patient survey
	% People with newly diagnosed HF who die within 30 days of diagnosis of HF from any cause of death		EMR/ ICES
	% People with newly diagnosed HF who die within 1 year of diagnosis of HF from any cause of death		EMR/ ICES
	Rate of hospital admissions and ED visits per 1000 person days for people for a) HF specific reasons and b) cardiovascular disease (CVD), and c) any reason(s)		ICES
	% People who were hospitalized or treated in the ED for HF who are readmitted within 30 days of discharge for a) HF specific reasons and b) any reason(s)		ICES

**Additional metrics recommended by the CDHE*

[1] *Ford et al. 2021*

[2] *CHFS Admission Order Set*

[3] *Ontario CHF Quality Indicators metrics*

[4] *AHA 2022 metrics*

Table 6. Acute Care CHF Use Case Evaluation Metrics

	EVALUATION METRICS FOR CHF IN ACUTE CARE AND CORRESPONDING QUALITY STATEMENT (QS) WITHIN OH'S QUALITY STANDARDS GUIDE		Data Source
ADOPTION METRICS	Number of sites in which the tool is implemented*		Standard reporting
	% clinicians (out of those eligible) using the tool*		Standard reporting
	Tool feedback & Rating: Satisfaction and Acceptance (Usability, User control, Alert proliferation) *[1]		Surveys
	Tool feedback & Rating: Knowledge of provenance and impact on trust (in the tool)* [1]		Surveys
	Tool feedback & Rating: User control and flexibility*[1]		Surveys
	Tool feedback and Rating: Support and training*[1]		Surveys
	Number of patient cases in which the tool was used*		Standard reporting
	Geographical distribution of implementation sites*		Standard reporting
PROCESS METRICS	% Patients for whom Heart failure admission set is ordered	QS1	HIS
	% Patients for whom chest x-ray and ECG is ordered once in the first 3 days	QS1	HIS
	% Patients for whom Echocardiogram is ordered during admission	QS1	HIS
	% Patients for whom 2DTransthoracic echocardiogram ordered if no EF documented within past 12 months*[,2,4]	QS1	HIS
	% Patients for whom daily patient weight is ordered	QS1	HIS
	% Patients for whom weight is measured daily for the first 3 days	QS1	HIS
	% Patients for whom total 24-hour fluid intake limit is specified*[2]	QS1	HIS
	% Patients for whom intake and output fluid measurement is ordered	QS1	HIS
	% Patients for whom intake and output is documented at least once a day for 3 days	QS1	HIS
	% Patients for whom low sodium intake is ordered	QS1	HIS
	% Patients for whom intravenous furosemide is ordered at least twice daily during the during the first 3 days of admission	QS1	HIS
	% Patients for whom initial lab tests are ordered (CBC, electrolytes, glucose, creatinine, PTand/or INR) within the first 24h	QS1	HIS
	%Patients for whom additional initial lab tests are ordered (Thyroid stimulating hormone, and glycated hemoglobin, Ca, Mg, Lipid profile, TSH, Urinalysis) within the first 24h*[2,3,4]	QS1	HIS
	% Patients for whom liver function tests are ordered*[4]	QS1	HIS
	% Patients for whom Anemia workup is ordered (serum iron, ferritin, transferrin saturation)*[4]	QS1	HIS
	% Patients for whom Blood urea nitrogen is ordered once during the admission	QS1	HIS
	% Patients for whom BNP is ordered once during the admission	QS1	HIS

	% Patients for whom first serum troponin is ordered within the first 24h of admission and the second troponin is ordered within 8 hours of the first	QS1	HIS
	% Patients with an ejection faction < 40% for whom Quadruple therapy is prescribed during the admission	QS5	HIS
	% CHF patients for whom Quadruple therapy is prescribed during the admission	QS5	HIS
	% Patients who are provided instructions on how to manage their CHF upon discharge	QS9, QS3	HIS
	% Patients for whom education is provided	QS3	HIS
	% CHF patients for whom Predischarge BNP or NT-proBNP level test is ordered to inform the trajectory of the patient and establish a post-discharge prognosis*[4]	QS1	HIS
	% CHF patients for whom an enhanced patient discharge summary is provided to patient/family upon discharge from the hospital	QS9	HIS
	% CHF patient cases where physician discharge summary is completed within 48 hours after discharge	QS9	HIS
	% Patients with newly diagnosed heart failure, those who have been hospitalized or treated in the emergency department for heart failure, and those with advanced heart failure (NYHA III–IV) who receive a referral for and are seen by a specialized multidisciplinary care team for heart failure*[3]	QS8	HIS
OUTCOME METRICS	% CHF patients (or their caregivers) who report that their care provider always or often gives them an opportunity to ask questions about recommended treatment*[3]	QS2	Patient survey
	% CHF patients (or their caregivers) who report that they have the skills and confidence to be actively involved in their own care*[3]	QS3	Patient survey
	% people who were hospitalized or treated in the ED for HF who have an ED visit within 30 days of discharge for a) HF specific reasons and b) cardiovascular disease (CVD), and c) any reason(s)*		ICES
	% People who were hospitalized or treated in the ED for HF who are readmitted within 30 days of discharge for a) HF specific reasons and b) any reason(s)*		ICES
	% Patients with a follow-up within 7 days of discharge *		HIS/ICES
	% Patients with newly diagnosed HF who die within 30 days of diagnosis of HF from any cause of death*		ICES
	% Patients with newly diagnosed HF who die within 1 year of diagnosis of HF from any cause of death*		ICES

**Additional metrics recommended by the CDHE*
[1]Ford et al. 2021
[2]CHFS Admission Order Set
[3]Ontario CHF Quality Indicators metrics
[4]AHA 2022 metrics

3.3 E2P Program Perceptions

This section includes interview data from 17 key informants who were SMEs having experience or knowledge of CDS tools, but who were not users of the E2P tools. These SMEs included physicians, administrators, and researchers with experience in quality improvement, CDS tools, or clinical practice specific to the CHF use case. Findings from these interviews are categorized into subsections based on the NASSS framework domains.

CONDITION/USE SPECIFIC FACTORS

At the time of interview data collection, four E2P use cases had been identified: Congestive Heart Failure (CHF), Depression, Anxiety, and Type 2 Diabetes. When asked about their opinions about the use cases chosen and how they thought this could impact the success of the program, key informants emphasized the chronic and complex nature of these diseases. Disease complexity and the presence of comorbidities meant that a standardized solution, provided through CDS tools may not always be suitable for each specific patient. Key informants also highlighted that other conditions may need to take priority or require treatment that counters a recommendation, thus forcing providers to ignore the CDS tool.

> *"[The] challenge with clinical decision support is it's often very standardized, but **patients are not widgets**. It can make it very hard to implement in real life when patients have competing demands and lots of complexity to them. Patients and clinicians can have **competing demands** and the care is so complex that isolating clinical decision support around specific conditions can sometimes be problematic…"*
> *– Key Informant 1004, Specialist Physician and QI Administrator*

Social determinants of health can affect decisions around recommendations for diagnostic testing; for example, accessibility and cost would be important considerations for certain medications or treatments. Key informants raised concerns that a CDS system may not account for different socio-economic factors that would influence the suitability of recommendations for certain patients. One respondent highlighted the constraints of location and resources that are available, and how this would be problematic when CDS recommendations may require a patient to travel for various tests and treatments, especially when travel may not be recommended or possible for the patient at the time.

> *"I deal with people on remote reserves, where you have to take a plane to get to their home. How are we going to manage that? And so, I know that from a developer's point of view, that's a nightmare, I understand that. But so… I think maybe what you do is you leave a bunch of local modification allowed."*
> *– Key Informant 1013, Primary Care Physician and Administrator*

Key informants also described challenges faced when trying to record information related to social determinants of health, as tools often do not provide the option to input such data in a structured format.

> *"I have no place to really put mental health information in a standardized way… even worse is to input social determinants of health information (…) those 12 indicators are what predicts outcome more than anything else. So I have no place to store data like that, there's no standardized field for poverty or for race or culture."*
> *– Key Informant 1017, PCP, Administrator, QI Researcher*

TECHNOLOGY FACTORS

Knowledge needed to use the technology

Key informants highlighted how providers who were not proficient in using EMRs, used them solely as an "electronic chart" rather than leveraging different capabilities, including CDS tools. Training was noted as a potential solution to address such knowledge gaps. However, key informants emphasized that due to the current workloads and stress on providers, enforcing training or new technology functions is often unreasonable. Furthermore, hospitals have limited capacity to train providers on new Health Information System (HIS) functions. A seamless CDS tool within the EMR/HIS would encourage uptake, as additional training would not be necessary.

A concern raised by specialist physicians was the challenge navigating different EMRs and HIS as they often work in multiple hospitals. This could serve as a potential barrier to workflow for providers who need to use CDS tools within multiple systems. Differences in hospital HIS platforms (e.g., Cerner, EPIC, etc.) was mentioned as a frequent issue for workflow and would require provider knowledge of technology capabilities.

> *"The other general principle is that it may not work the same way every place. So where I used to work, would require a very different approach than where I work now, just cause of the technical milia. Like my second hospital, I could probably do it myself now that I understand the system and how it works, I just didn't understand it for such a long time. It's figuring out how to get the work done efficiently within the constraints of the existing EMR."*
> *– Key Informant 1005, Specialist Physician and QI Researcher*

Technology Features

With respect to features of the technology itself, key informants emphasized the importance of reminders, while balancing concerns that reminders should not overwhelm physicians. Key Informants discussed the timing of reminders, to ensure they are both appropriate to the patient's case and user friendly (e.g., reduced number of clicks to navigate the tool). Options such as customizable defaults for providers, patient education materials, or inclusion of organization-specific capabilities were noted as a potential solution to address alert fatigue.

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*"Get people doing the work **correctly the first time** and make it easy for them to do it correctly. I'm not saying it's easy, I'm not saying that's a simple design challenge, but that **is** the design challenge… You come to me and say I need you to do some extra work, click on some extra buttons, and take some extra steps… I'm going to say, not that interested. Can you reduce my clicks? Like you could put in as many alerts as you want, but we get so many alarms going off, we're just numb to them. Now I just click ignore, ignore, ignore."*

– Key Informant 1005, Specialist Physician and QI Researcher

*"Support alerts come up for a lot of the med interactions. Most of those are useless. So, I worry that's going to be something similar (….) [we need to make sure that the] **sensitivity specificity** of these alerts are high There's a lot of false negatives or false positives for these alerts. So that there's when it fires, it's capturing things that are helpful."*

– Key Informant 1006, Specialist Physician and QI Researcher

Providing the opportunity for organization-specific capabilities within the CDS and HIS were emphasized by a remote primary care provider because depending on location and available hospital resources, not all best-practice recommendations may be achievable (e.g., screening or echocardiography for patients due to location and hospital resources). Capabilities to allow data aggregation were also highlighted by key informants as having significance for tracking population health.

VALUE PROPOSITION

Physicians and patients

According to most key informants, the most important benefit offered by a CDS tool that would increase the likelihood of adoption is that it saves providers time and effort (e.g., through reduced

number of clicks). They also highlighted that availability of educational resources such as patient handouts within the CDS tool facilitates provider efficiency, as opposed to just reminders that they need to provide patient instructions. Along the same lines, key informants stated that if the tool matched their current workflow, or if the CDS tool prompted the provider during their clinical decision-making process, it may have higher value for the physician. Key informant physicians also stated they would be more likely to use a CDS tool if they knew that it was created in consultation with their peers and other respected leaders in their profession.

> *"I think a guiding principle has to be a clinician's time is a precious, non-renewable resource (…)I don't want to be reminded when I finished my note that I should talk to the patient about sodium intake. I rather have a note available to me that includes a heading called sodium counselling and gives me links to what I need to say to the patient, and even better, just gives me the information, that I have to hand over to the patient."*
> *– Key Informant 1005, Specialist Physician and QI Researcher*

Key informants also mentioned that patient outcomes were a top priority. Interviewees stated the potential for improving patient outcomes and ensuring that patients receive consistent care that follows best practices across the system would certainly increase uptake of the tool. They also acknowledged the value of having meaningful patient facing documents ready for providers (through the dot phrase template available for the discharge summary tool). Not only did this make tasks easier for providers, but it also facilitated consistent and effective patient education and communication.

> *"Patient care is **not** dependent on who they happen to see that day, but rather based on **best available** practice that exists."*
> *– Key Informant 1007, QI Researcher and Administrator*

Organization

Our interview findings indicated that the effort and resources required to translate clinical guidelines into practice via CDS tools often poses a barrier to implementation. With the CDS tools already developed through the E2P program, they are readily available to be integrated into HIS/EMR systems with considerably less effort. For organizations, this provides significant value as it reduces the

number of resources required to implement CDS tools. Hospitals also benefit by creating customized and pre-established order sets, as this improves workflow efficiency and consistency in care.

> *"From an informatics side, standardization of terminology, standardization of a pathway, is going to be hugely beneficial because it certainly saves organizations from having to hardwire it (…) If you are **decreasing the work required** for organizations to adopt something, it is certainly going **to increase the chances** it will get adopted."*
> *– Key Informant 1001, Administrator*

A notable benefit that a specialist physician mentioned was the potential to have aggregated patient data through the E2P program, that is otherwise not readily available to providers. With an embedded CDS system, it may be easier to aggregate data to track population health to help guide future clinical decisions. Currently the program is still in its early stages, and these capabilities are yet to be fully leveraged. The type of data that these systems output may be useful for comparing clinical indicators collected between sites and could aid in introducing consistent terminologies across the health care sector.

> *"Resources and structures to **actually collect** that data and feed it **back** to the programs.. I think one of the challenges has been in Ontario that there isn't a lot of data collection that happens, and not a lot of return to the frontline care providers and institutions who are collecting the data… I can speak from mental health like we provide a lot of information, and we never get any information back from the Ministry of Health about what's been done with the data, and what we've accomplished."*
> *– Key Informant 1012, Specialist Physician and QI Administrator*

ADOPTERS

As previously discussed, key informants emphasized that it is critical that the recommendations provided by the CDS tools are clearly coming from respected leaders in their field, and medical societies that are well recognized by users. Generally, physicians said that they would only adopt guidelines from a trusted information source. Some physicians suggested that they are very unlikely to switch their usual care and start prescribing a medication that is not familiar to them only because

it is recommended within their hospital HIS system. They highlighted that more meaningful shifts in the way they practice are usually influenced by local champions and opinion leaders whom they trust as a knowledge source.

> *"So, if the cardiologist I admire stands up in front of me and says this is how I do the work here at this hospital using your EMR and it's, it's, it's **effective**, it's high quality, but it's also efficient and pleasant. I'm **going to do it for sure**.*
> *– Key Informant 1005, Specialist Physician and QI Administrator*

Key Informants also expressed concerns that the use of CDS tools may be perceived as taking away the clinical autonomy of the physician. Ultimately, there needs to be the recognition that the tools, while complex, are developed not to replace the provider, but to support the provider.

Inappropriate timing and excess number of alerts were challenges highlighted by key informants, that often result in these alerts being ignored by providers. In addition to the issue of 'alert fatigue', one respondent discussed how CDS tools can result in physicians having to put in more effort to complete simple tasks. For physicians who are not well-versed with technology, the very use of a technology platform proves to be difficult compared to their previous paper-based workflows and clinical algorithms, due to more work or mouse-clicks to perform certain tasks.

> *"[It] takes away my autonomy and ability to make decisions otherwise, plus then you add to that like alert fatigue and everything else (…) Click fatigue is a disaster. I can't tell you the number of clicks I have to make to order a simple drug that I used to just squiggle across a piece of paper and then initial and somehow the pharmacist knew what I wanted, and the nurses knew what I wanted. It was great. Whereas now it's like 12 clicks to order the same drug.*
> *– Key Informant 1009, Specialist Physician and QI Administrator*

> *"Although the intent is to have these systems provide that kind of just-in-time decision making, I think what we often see is that they can actually be a nuisance if [alerts are] coming up at the wrong time or if clinicians just tend to bypass them."*
> *– Key Informant 1007, QI Researcher and Administrator*

ORGANIZATIONAL FACTORS

Respondents discussed organizational factors that could influence the success of E2P such as change management, integration of CDS tools into organizational workflows, and organizational readiness for change. Organizations' limited capacity to take on new projects, given the current strain on the healthcare system after COVID-19, was mentioned as a potential barrier to adoption and growth of the E2P program. One hospital employee also highlighted the challenge of different levels of HIS adoption within their organization. They mentioned that some departments at their organization were still using paper charts, despite the hospital being a large urban center hospital. Another provider from a rural setting mentioned that many providers in northern or rural areas still rely on the use of paper charts, so E2P tools would be perceived as useful for them.

The introduction of new EMR/HIS tools requires training users on the newly introduced tools and participants spoke about the barriers associated with the ability of hospitals to provide that training. CDS hospital leadership participants said they have little to no capacity or staff that can provide training on new tools at their hospital, and they had concerns about the need for ongoing maintenance for such a tool, adding to responsibilities to already overwhelmed staff.

> *"If it's an obstacle to physician wellness... if this just adds that feeling [that] it's more paperwork, more boxes to check, check and then it's more screens to flip through before I can be done, my clinical encounter won't be received well."*
> *– Key Informant 1004, Specialist Physician and QI Researcher*

A concern amongst many key informants was disruptions to workflow. E2P's CDS tools would need to be embedded into the pre-existing workflow at each respective organization, without adding burden to physicians by increasing the number of alerts. Ensuring the appropriateness of prompts and alerts would help with adoption of the E2P tool. Key informants highlighted that if providers need to make significant changes to their behavior and clinical process, the implementation of the E2P tool could be more troublesome.

> *"You have to make the right thing to do, the only thing to do."*
> *– Key Informant 1014, Specialist Physician and Administrator*

WIDER CONTEXT: POLICY, PROFESSIONAL RESPONSIBILITIES AND POPULATION HEALTH

Key Informants, regardless of their role as administrators, researchers, or physicians, expressed the need for a province-wide EMR. EMR platform variations across organizations was viewed as a barrier to providers' workflow and efficiency, potentially impeding the process of treating patients. In addition, key informants highlighted that a standardized EMR could make maintenance easier for organizations, and adoption would be considerably higher. While all key informants agreed that CDS can be helpful to providers, they had reservations as to whether the E2P program would improve patient care and address significant gaps in care. Several key informants mentioned the stresses placed on providers and felt that CDS could not make-up for systemic issues facing the provincial health system. However, they also felt a province-led approach would reduce redundancies and efforts compared to an organization-led initiative, especially considering the limited capacity of hospitals.

"What would be more helpful would be, how do we actually set up the system to support those best practices, especially around discharge? Maybe patients aren't getting perfect care in hospitals right now. We know that lack of nursing staff means one of the big challenges is getting daily weights in the hospital [for CHF]. It's the bane of every physician's existence because it's so hard to get nurses to document the way it's in a consistent place… so like I just don't know how E2P order sets are going to change the system problems as to why we don't have the basic tools to provide guideline concordant care."
– Key Informant 1004, Specialist Physician and QI Researcher

"My concern is that we've chosen what's easy and not necessarily what's meaningful and what's meaningful is actually where the tough work is."
– Key Informant 1008, Specialist Physician and Administrator

From a physician perspective, key informants reiterated concerns that CDS would affect clinical autonomy of physicians and would reduce the value of physicians' comprehensive assessments. Another respondent discussed issues related to medical liability, saying that if providers relied too much on the E2P system, they would be facing more medical legal liability, as opposed to not using the system at all. Safe and effective use of the CDS tool would require that it be updated frequently to ensure that it is always aligned with current clinical guidelines.

"If [decision support] ends up becoming what's implemented broadly, then we've completely devalued what a comprehensive assessment is, into a self-report tool that doesn't even require a physician."
– Key Informant 1008, Specialist Physician and Administrator

"The centralization of updating [guidelines] is [a] really important piece because when doctors go look, if I'm using a new tool, that presents me with medical legal liability. I'd rather not have any tool."
– Key Informant 1017, PCP, Administrator, QI Researcher

SPREAD, SCALE AND SUSTAINABILITY

With respect to spreading the program to new geographical regions, rural key informants noted that the type of resources in their regions may be different from urban settings, and thus, the context in which they work needs to be taken into consideration. For instance, patients in rural or remote regions may live far away from diagnostic testing centers or hospitals making it unreasonable or possibly even medically unsafe to travel far to get tested often. In order to tailor the tools to local context, participants highlighted the importance of engaging with existing regional committees and working groups. One key informant noted their region just started utilizing clinical boards that promoted standardization of care by making unified decisions on how clinicians would approach common conditions.

Key informants mentioned concerns around sustainability of the program, especially relating to maintaining updated guidelines and recommendations in the CDS. Resource management was a common concern amongst administrator and physician key informants, given the shortages and limited resources of healthcare organizations. Ongoing management and updates of the tool would be an added responsibility for these organizations and could result in abandonment or inadequate maintenance of the tool.

Another sustainability approach was the potential reduction of reminders (if used in the CDS) as users learn and adapt to the new ways of practicing and show evidence of adoption of the new behavior. Also, a participant (hospital CMIO) noted that at their hospital, physicians can make custom changes to order sets and modifications that may be counter to the clinical guidelines. These can then become embedded in the system for this user, resulting in mistakes being perpetuated.

"From my perspective, if you're asking me right now, and even in this next year, ***there is a serious limit, to how much can be rolled out*** *in an organization. The fact that there are structures in place does not mean that it is easy to actually do. There are so* ***many still competing priorities with COVID recovery*** *(…) we don't* ***even have enough people to man an ED*** *(…) to* ***keep services running to standard****. Forget new standard, just standard."*

– Key Informant 1001, Administrator

"Who is responsible for updating them ***when the guidelines change****, because guidelines change all the time, right? So there needs to be a central kind of way of updating every EMR the moment the guideline or the practice I guess whatever changes, it can't be a one and done."*

– Key Informant 1017, PCP Administrator, and QI Researcher

3.4 Implementer Experience

This section includes key findings from our interviews with E2P CHF CDS tool implementers. These implementers were individuals in an administrative or leadership capacity who assisted in the execution of the E2P'S CHF pilot at their site.

All three participants who were interviewed as 'implementers' of E2P's CHF use case highlighted the value of the program for the organization, providers, and patients as well as barriers to adoption and considerations for future success. The ability to have standardized, evidence-based decision tools at the point of care across the province was seen as a major benefit of the program. Though this evaluation did not include patient interviews or surveys, program implementers highlighted benefits for patients including easier accessibility to information across hospitals or providers as they would be linked.

Rollout of the CHF tools require implementers at local sites to review their CHF order sets and discharge summaries, to determine what aspects of the tools are most relevant for their specific context. Two participants highlighted the benefit of examining their order sets and engaging in a comprehensive review of current processes, as this provided thoughtful engagement and feedback. Participants also mentioned the efficiencies made possible by using the tool and valued the ability to measure the uptake of tools for the CHF use case. Efficiencies highlighted included saving providers time, reducing the amount of manual work they previously had to do, being user-friendly and allowing for flexibility within the tool.

Barriers to implementation included change management and the need for ongoing support during implementation and ongoing monitoring. Additionally, the burden of time and energy for both organizations and providers during implementation were discussed.

> *"I think some of the barriers relate to time and energy. I think that there's generally interest expressed by sites for the project. Whether or not they have the dedicated time and resources, especially as we've been emerging from the COVID pandemic, that has been somewhat of a barrier for some sites. Meaning that they don't have the time resources or necessarily the energy at this point in time to participate, even if there is initial interest expressed."*
> *Participant 004, Implementer*

One participant mentioned that organizations need to ensure they have sufficient resources and capacity to guarantee successful implementation. Finally, technology was highlighted as a barrier such that implementation would be challenging without sufficient resources and structures in place.

> *"From a technology standpoint, despite there being only three major HIS vendors, everyone is on a different instance, everyone has their local processes and informatics resources. The question still remains that even if we get sites on board, how are we going to be able to sustain this project in terms of technical resources, updates to order sets, etcetera, which I would still see as technical on the informatics side. What structure would be in place going forward, I think that that is also not clear."*
> *Participant 004, Implementer*

In thinking about the future success of implementation, participants mentioned that clinicians' perspectives must be included, and their workflow must be considered. Additionally, it is important to maintain and update both the quality standards and the technology itself.

3.5 Provider Experience

Four clinician participants who discussed their experiences with the heart failure admission order set and the dot phrase template spoke of the perceived benefits of the tools, barriers to uptake, and suggestions for increased engagement. All four clinicians highlighted the efficiencies achieved by using these tools, such as being easy to learn and use, saving time, and being flexible. One physician mentioned approximately 10-minutes saved per patient discharge. This was due in large part to the

simplicity, flexibility, and user-friendliness of the tools. Additionally, one user mentioned that these tools simplify his workflow and eliminate the need to type up notes manually.

Flexibility was an important feature, as one provider discussed the benefit of being able to use the information as a “guide” or “toolbox” which helped him make decisions, without being too rigid. This flexibility was also an important feature when he made decisions for more complex patients.

> *“I use the order set, but sometimes because people come in with other things - they have heart failure or, and say, you know an infection or what not. So, it's like a toolbox. I don't always use everything in the order set every time... So, if someone comes in with another problem that may go to the HF order set, then tag it along with a different order set, then combine them.”*
> *Participant 005, User (Physician)*

Participants highlighted the importance of having access to the most up-to-date evidence and guidance available to treat their patients. In addition, they felt that the information being provided was vetted and trustworthy, thus increasing their likelihood of engagement. A drawback of the tools was the amount of detail they included. One participant mentioned that when new information is added, it may be irrelevant to providers. Additionally, the participant mentioned new users of the tool may find so much detail overwhelming, noting the importance of regular training so that important features of the tools are not missed.

Though patients were not interviewed, our interviews with users highlighted benefits for patients as well. High quality discharge summaries and improved transition of care were two key patient benefits that participants discussed. Participants emphasized the importance of having tools which contained evidence-based information that they could trust. Providers felt that patient care was positively impacted by having simplified and vetted information upon discharge.

> *“Because we’re providing them with standardized evidence-based guideline recommendations. And a lot of that is glossed over or forgotten in the mix of an inpatient acute hospitalization and older patients may not remember. And so, when you provide them with vetted material that is not on Google, but it’s vetted, it’s simplified for them, it’s always a reference for them (…) it improves the quality of care, it definitely does.”*
> *Participant 001, User (Physician)*

Two notable barriers to physician engagement were highlighted: physician skepticism and lack of knowledge about updates to the tool. First, participants discussed physicians' skepticism that the tools would provide actual benefit to their patients, raising doubts regarding the sustainability of the program. To address this barrier, it is important to incorporate input from topic experts, and engage physicians by having champions who can vouch for the benefits of the tool. Second, participants noted that updates made to the CHF order set tool may be unnoticed by providers, resulting in them being unfamiliar with the changes. Physicians may need additional training opportunities and continued workflow changes to allow for increased uptake.

A respondent from the second implementation site (SMGH) also mentioned that while the order set tool was used by specialists as well as nurse practitioners, the new CHF discharge summary tool was used only by specialists, as nurse practitioners already used a custom discharge summary tool which they had created previously. As specialists were already using the standard HIS template, they were more open to using the enhanced version of the same template.

4. Discussion

4.1 Key Findings

The purpose of this study was to understand factors influencing the successful scale-up, spread and sustainability of the E2P program in Ontario, and to evaluate early signals of effectiveness of the implementation of the CHF use case.

Strengths of a province-led approach: The province-led E2P program offers advantages related to CDS tool implementation, credibility and standardization of care pathways and treatment options. Our findings indicated that most respondents welcomed the capabilities offered by a CHF CDS tool that is up to date with current guidelines on care for CHF patients. CDS offers opportunities for improved population health by using analytics to identify high-risk patients and meet health quality requirements (12). The prospect of a tool that is provincially implemented rather than requiring multiple isolated efforts provides the potential to generate data that can be leveraged to better understand and cater to population health needs. CDS tools can face barriers related to implementation (e.g., variations in EHRs and HIS) as well as adoption (e.g., issues related to technical competency, professional autonomy, acceptability of the CDS tool, etc.) (13–17). While having a standardized provincial EHR would make implementation of CDS tools easier, E2P's approach of having a province-led CDS tool

offers benefits including standardization of care pathways and easier collection and comparison of data related to clinical processes and outcomes.

For patients, use of updated standardized order sets provides the assurance of quality care that is consistent and aligned with best practices irrespective of which clinician they see. The enhanced discharge summaries aim to offer patients a better understanding of their condition and how to manage it, in addition to improved transition of care from the hospital setting to the community.

Consideration of case complexity: An important concern raised by interview respondents was that the specific use cases identified for the E2P program were complex conditions with high likelihood of comorbidities. Adoption of CDS tools in such cases faces the challenge of conflicting recommendations and difficulty knowing when to prioritize treatments or recommendations for other conditions (18,19). Effective treatment for one condition may be dependent on addressing symptoms of another underlying comorbidity, emphasizing the fact that there is no 'one size fits all' approach to CDS tools, and it is not always possible to treat patients without contextual awareness of their other existing conditions.

Variations in organizational readiness may impact participation in the E2P program: Key informants indicated that despite the benefits of the program, and various organizations' interest in using the tool, there may be limited uptake by organizations due to resource and time constraints. This is echoed in existing literature as well (7,12). Technology limitations are also a factor; not all providers use EMRs, and even within a single hospital, different departments may have different levels of EMR uptake, as evident from our interview data. Given that EMR/HIS usage is a pre-requisite of the CHF CDS tool, there will inevitably be some providers who will not regard the program useful (e.g., rural providers using paper charts). However, the E2P program is still in its early stages, and it would be useful to assess uptake once there are more acute and primary care sites onboarded.

The E2P program must promote the benefits of the tool to alleviate organizations' concerns. E2P'S CHF order set and enhanced discharge summaries are intended to ease provider burden by standardizing treatment options and pathways, making it simpler for clinicians to make decisions and generate clear instructions for patients after being discharged. Further, these CDS tools are seamlessly integrated into providers' systems in acute care, reducing the need for separate training sessions on how to use tool, enabling clinician users to use the updated order sets and discharge summary tools immediately. In primary care, however, the integration of the CDS tools into physicians' EMRs may not be as seamless, as it will involve introduction of a new toolbar to the user interface and may require more training and support for users.

Influence of champions and opinion leaders: Interview respondents indicated that they were more likely to use a CDS tool and adhere to clinical guidelines if they knew that the guidelines had been developed in consultation with clinicians and that the CDS tool was being successfully used by clinician champions and opinion leaders. It is not uncommon for clinicians to raise concerns related to the diagnostic decision-making choices available to them, and whether they have the autonomy to decide whether or not to accept CDS tool recommendations (13). While reliance on computerized tools poses questions related to trustworthiness of CDS recommendations, over-dependence on CDS, and possible reduction of clinician cognitive reflection, not following CDS tool recommendations may also result in clinicians being held accountable for any adverse clinical outcomes (20–22). Further, key informants suggested that if the tool is not updated correctly, it increases clinicians' liability, making them likely to not use the tool at all.

These liability concerns may be alleviated if there is strong support of the tool by clinician champions, and physician users are aware that the tools have been developed in consultation with clinicians (19,22). In cases where clinicians determine that the appropriate clinical decision is not aligned with clinical practice guidelines (as suggested by a CDS), the Canadian Medical Protective Association (CMPA) recommends consultations with clinical colleagues to validate such decisions, and documentation of the rationale behind the decision taken (23). Key informants, users and implementers all discussed the importance of clinician involvement in the development of clinical guidelines as well as CDS tools. The E2P program delivery partners have involved clinicians in the design of the updated order set and discharge summary tools, and implementers or champions have been identified and engaged at the implementation sites. User interview data includes references to experiences shared by clinical champions and how such accounts make clinicians more inclined to use the CDS tools.

Efficiency and workflow: A concern cited by several key informants was the challenge of irrelevant or untimely alerts and reminders generated by CDS tools. While alert fatigue is often discussed in the context of CDS tools (13,24), one key informant (KI 1009) mentioned the prevalence of ‘click fatigue’ as providers spend significant time navigating various platforms and tools with multiple clicks to perform their tasks. However, as the CHF order-set and discharge summaries being implemented do not include such reminders, this was not an issue faced by the implementers and users we interviewed. Physician users confirmed that the updated CHF order set improved their efficiency by saving time, and appreciated the flexibility offered by tool when treating complex cases that had comorbidities present.

The dot phrase template made it easier and quicker for clinicians to provide vetted information to their patients which may be particularly beneficial to patients who find it difficult to recall instructions, often resulting in them searching for unverified information from other sources. While there was no noticeable barrier to using these discharge summary templates, even modifications in simple tasks require changes in practice, according to one user respondent. At one site, nurse practitioners continued using a previously developed custom discharge summary template which met requirements, even though the enhanced discharge summary tool was available to them. To ensure consistency it is advisable for both physicians as well as nurse practitioners to provide discharge instructions using the same standardized template provided by E2P's tool. This will help plug gaps and replace outdated tools, facilitating streamlined clinical processes that are aligned with current clinical guidelines. As these are early stages of implementation, it may be a matter of time before these changes can be fully incorporated into clinicians' workflows. Once uptake of the CHF tool increases, it would be useful to assess if users report significant time savings and ability to navigate their workflow with improved ease.

4.2 Limitations

This report has a number of limitations as listed below:

7. **Limited to data from the acute care setting**: This evaluation intended to analyze early-stage implementation and adoption of E2P's CHF CDS tool in both acute care as well as primary care. However, the E2P program encountered implementation delays and roll out of the CHF tool among primary care providers took place later than anticipated. This early-stage evaluation of the CDS tool for the CHF use case required providers to have used the tool for at least 3 months. As deployment of the CHF tool in primary care began only in November 2022, we were unable to include details specific to the CHF use case in primary care.
8. **Lack of patient interviews**: As the CHF use case was in early stages of implementation, there was limited opportunity to conduct data collection among CHF patients. It is also likely that patients are unaware that providers are using an updated CDS tool, making it challenging to interview them, as they would not be familiar with the updates and the implications of E2P's CDS tools.
9. **Early adoption stage of the CHF tool**: The CHF tool has been implemented very recently and is still in early stages of adoption. Physician users have not had the opportunity to use the tool for a significant amount of time, hence their inputs are based on initial perceptions and experiences, and not continued use over time.

10. **Low number of users and lack of responses**: The number of users in the acute care setting was relatively small, limiting the amount of interview data that we could collect (6 implementer/user interviews in contrast to 17 key informant interviews). Further, due to lack of survey responses from our first data collection site (NYGH), we distributed the survey to users at SMGH as well. Despite this, we were unable to collect a significant number of survey responses and had to exclude this portion of the study. It would be useful to conduct further evaluations once the program is more established and more sites have been onboarded.
11. **Generalizability of findings**: Most of the data for the CHF use case in this report is from an acute care site that is also a delivery partner for the E2P program, limiting the generalizability of the acute care findings. Once the E2P program is implemented across more locations and more acute care sites are onboarded, it would be useful to explore potential barriers of the tool in different clinical contexts and regions, as there may be variations in the setup of care. Key informants also highlighted potential challenges that may be unique to remote/rural settings, and the findings from this evaluation may not be entirely applicable to that setting.
12. **Limited focus of the review**: The review undertaken for this report is not a systematic or comprehensive review. The literature on CDS tools is vast, and we limited our search to qualitative studies that were more likely to focus on factors relevant to the NASSS domains. We acknowledge that while findings from our review are not exhaustive, they focus on policy-relevance and studies related to the spread, scale and sustainability of CDS implementations, which is a priority for the E2P program.

4.3 Recommendations

1. **Support access to the E2P CHF tool and its use by all clinicians at the point of care who have decision making capabilities**: Measures should be in place to ensure that all clinicians at a site have access to the tool and use it, to ensure consistency in care pathways, treatment plans, and transitions of care to the community setting. For instance, if a site has physicians as well as nurse practitioners who order tests or issue discharge summaries, both groups of providers should be encouraged to use the CDS tools.
2. **Ensure all users are informed of updates and changes made by the E2P CHF order set tool**: The CHF order set rollout may go unnoticed by some clinicians, as the tool has been seamlessly integrated into the existing HIS. While the absence of alerts and reminders may be appreciated by clinicians who prefer not to be distracted by possibly irrelevant notifications, it is important that

clinicians are aware of the changes made to the CHF order set. Not only does this inform them of updates to clinical guidelines, but treatment of patients with complex conditions and comorbidities requires close attention to details to ensure there are no conflicts with other treatments or medications. We encourage implementers to notify clinicians of the changes in order sets if the tool does not already have an inbuilt notification that is generated when a clinician uses the updated order sets for the first time.

3. **Enable flexibility and local modifications to the tool where required**: E2P users appreciated the flexibility and ease of use of the CHF CDS tool. Key informants emphasized the importance of ensuring that CDS tools are tailored to organizational needs and workflows, and that providers are given flexibility in how they use the tool. The circumstances and needs of patients and providers in rural settings is also very different from those in more urban settings. As a result, E2P CDS tools may need to be modified to accommodate variations in access to certain treatments or tests. When treating patients with complex conditions or comorbidities, providers must be provided the flexibility to decide whether to follow a CDS recommendation, with the ability to input a reason if deciding against it. This facilitates flexibility in tandem with accountability, while also providing feedback and learning for possible future iterations of CDS tool development.
4. **Continue involving clinical champions in future rollouts of E2P program components across acute and primary care sites**: Clinicians value the opinions of clinical leaders who have successfully used a tool and are more likely to adopt a CDS tool if it has been vouched for by a clinical champion. Design and development of E2P tools will benefit from the continued involvement of clinical champions; knowing that a clinical tool has been developed in consultation with fellow clinicians improves clinician trust in the provenance of the tool, resulting in increased adoption and usage rates. As has been done for the CHF use case, the E2P program should continue to involve clinicians from the early stages for future use cases as well. Further, authorities need to provide clarity regarding medico-legal implications of using (or not using) the E2P CDS tools, highlighting who is accountable should there be any adverse event as a result of following the CDS tool's recommendations. Involving clinical champions in these discussions would help ensure that clinicians' concerns are addressed, emphasizing that CDS is, as the name states, a support tool that is not meant to replace clinical judgement or dictate clinical decisions (21).
5. **Comprehensively evaluate the CHF tool in acute care and primary care**: As the E2P program has been rolled out very recently for the CHF use case, this report is limited to reporting early indicators of success of the program. We recommend a comprehensive evaluation of the CHF

tool in both acute care as well as primary care once it has been rolled out more widely, and there is increased uptake. The evaluation should use indicators based on Ontario's quality standards for care of CHF patients in combination with adoption metrics, to assess levels of adoption, changes in clinician prescribing and test-ordering practices, and impact on clinical outcomes. Learnings from this comprehensive evaluation can inform development and implementation of E2P CDS tools for other use cases as well.

5. Conclusion

The CDHE conducted an evaluation of early-stage implementation of the E2P program's CHF CDS tool to describe the level of adoption, facilitators and barriers to adoption, and provider experience with the tools.

The E2P program offers significant value to providers by facilitating standardization of care using evidence based CDS tools that are aligned with current provincial clinical guidelines. Key benefits of the E2P program related to standardization of care processes, ease of generating relevant and vetted information in discharge summaries, and the potential for comparison of processes and outcomes across care organizations once uptake has increased. Providers found significant value in the use of standardized processes that are evidence-based and aligned with current clinical guidelines. As the program has only recently been rolled out, it is too early to observe the impact on patient outcomes; however, our findings suggest that there is perceived value for patients also, as care pathways will be standardized and the transition from hospital to community care will be made easier.

Findings from this evaluation indicate that while the E2P program has received an overall positive response, the program must consider flexibility of the tool, involvement of clinical champions, and provider awareness of the tool accompanied by training where needed. Extra caution will be required in the development of the CDS tools, given the complexity of the conditions in the identified use cases, and the likelihood of comorbidities. Measures should also be in place to facilitate centralized updates of the CDS tools' recommendations, to ensure consistency with changes in clinical guidelines, and to minimize maintenance efforts on the part of individual organizations.

Implementation of the CHF CDS tools may not be as seamless in primary care as it has been in acute care, and it is likely that primary care physicians will need additional training and support for optimal

uptake. The E2P program must also consider the unique needs and limitations of providers in rural and remote settings.

This report provides insights and recommendations for future directions for this provincial program and serves as a base for further summative and comprehensive evaluations that may be conducted at a later point.

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Appendices

Appendix A: Key informant interview guide

Thank you for taking the time to speak with me. My name is [insert interviewer name] and today I'm interested in learning about your perspectives of the Evidence 2 Practice (E2P) program, formerly known as Ontario Standards for Care (OSC). We have reached out to you, because we believe you have expertise in clinical decision support tools, quality improvement or are somebody who works in one of the clinical fields that have been chosen to be the starting focus of the E2P program. If you have not heard about the E2P program we will describe to you the overall goals and approach and would be interested to hear what your initial thoughts on this approach are. Do you have any questions before we begin?

Let's begin.

1. Have you heard **about the Evidence 2 Practice (E2P) program**?
   Probes:
   a. If yes, can you let me know what you know about it and how you heard about it?
   b. If no, describe the program:

   The E2P program will take clinical practice guidelines or quality standards and translate them into decision-support tools and templates that could be incorporated into the range of frontline clinical systems used in Ontario. Five use cases are being developed, starting with CHF, then moving on to Anxiety disorders, Depression and Diabetes.

   We recognize that you do not know many details about the program, so our goal is to explore what are some of your initial thoughts on a program like that and to explore some potential challenges that implementers may face when deploying the program across Ontario.

2. What value such a program holds for the **wider system**?
   a. Do you think that such a program is needed in Ontario? What are the benefits?
   b. What will make the program successful/unsuccessful?
   c. Do you think that the province is the right body to direct the design and implementation of clinical guidelines decision support tools at healthcare organizations?

3. The **Value Proposition**
   a. Do you think providers will see value in embedding clinical practice guidelines developed by the province into their EMRs? (what will make them use the technology, especially for primary care providers who need to use a distinct system)
   b. Who can benefit the most from such system? Are there certain sectors where clinicians can benefit the most?
   c. What value does such a program hold for the hospital sectors? What about the primary care sector?

4. How easy will the program be to implement?
   Probes:
   a. What makes the program easy/not easy to implement?
   b. Is the program easy to learn and accessible?
      Probe cues: implementation, delivery, and administrative processes

5. What steps do you think an **organization** needs to take to address potential barriers providers may experience when engaging in the program?
   Probes:
   a. What kinds of supports will be needed to help providers learn and use the technology, for example?
   b. How could the program be improved to better meet the unique needs of providers?
   c. Will workflow routines need to be adapted significantly?
   d. What kind of staff capacity and infrastructure do you think will an organization need to be able to deploy such a program?

6. **Technology**
   a. Acute care: The clinical practice guidelines in acute care will be mostly embedded into order sets, discharge forms, patient transition guidance. Is that the best approach? Do you see any challenges that providers may face with such an approach? Are there things that need to be taken into account when expanding and making changes to such HIS components?
   b. Primary care: In primary care the tool will be set as a separate toolbar that providers need to open within their EMR. The vision is that providers will be opening it for all patients. Do you see any challenges that providers may face with such an approach? Are there things that need to be taken into account when expanding and making changes to such EMR components?

7. What structures, resources, or processes are needed to ensure long term continuity and integration of the E2P program into routine care? (**Embedding and adaptation over time**)
   Probes:
   a. What strategies on the back end of the technology are implemented to encourage sustained use (e.g., push notifications, text message reminders)?
   b. How much effort has been committed to ensure enough resources are available to provide (1) training for staff, (2) technical support, and (3) frequent monitoring to ensure the program remains up to date?
   c. Do you think the program has been beneficial to patients? To providers? Please elaborate
   d. Do you think there are certain providers that will benefit more from the E2P program than others? If so, why?

8. **Condition**
   a. Do you see any specific challenges around the use of DSTs in the context of the conditions/use cases chosen (CHF, anxiety, depression, diabetes)?

Appendix B: User interview guide for Implementers

Thank you for taking the time to speak with me. My name is [insert interviewer name] and today I'm interested in learning about your perspectives of the Evidence 2 Practice (E2P) program, formerly known as Ontario Standards for Care (OSC). We have reached out to you, because we believe you have been involved in supporting the implementation of the program at your site.
Have you reviewed and completed the consent form? Do you have any questions about your participation? Can we record the interview for data analysis purposes.
A reminder that participation is voluntary, you can withdraw at any time, you can choose not to answer some or all questions. Finally if you want to stop the interview, you can do so at anytime.
Do you have any questions before we begin?

Let's begin.

1. What value does the program hold for the **wider system**?
    a. Do you think that such a program is needed in Ontario? What are the benefits?
    b. What will make the program successful/unsuccessful?
    c. Do you think that the province is the right body to direct the design and implementation of clinical guidelines decision support tools at healthcare organizations?

2. The **Value Proposition**
    a. Do you think providers will see or have seen value in embedding the Ontario Health Clinical Standards into their EMRs?
    b. What value does such a program hold for your organization?

3. How easy was the program to implement?
    Probes:
    a. How were clinical standards implemented before the E2P program? What were some of the challenges with that approach?
    b. How easy/not easy was it to implement the standards through the E2P program?
    c. Is what was provided to you as a package easy to learn and accessible for your staff?

4. What steps do you think an **organization** needs to take to address potential barriers providers may experience when engaging in the program?
    Probes:
    a. What kinds of supports will be needed to help providers learn and use the technology, for example?
    b. How could the program be improved to better meet the unique needs of providers?
    c. Will workflow routines need to be adapted significantly?
    d. What kind of staff capacity and infrastructure do you think will an organization need to be able to deploy such a program?

5. **Technology**
    a. Did you have to make significant changes/customization to the EMR updates that were provided by the E2P program for your EMR system?
    b. Did you have the necessary resources to make those changes?

c. Do the new EMR components (e.g. toolbar, or the order set updates or whatever the use case updates made are) present a significant change in how the EMR system is currently used by providers?

6. What structures, resources, or processes are needed to ensure long term continuity and integration of the E2P program into routine care? (**Embedding and adaptation over time**)
   Probes:
   a. What strategies on the back end of the technology are implemented to encourage sustained use (e.g., push notifications, text message reminders)?
   b. How much effort has been committed to ensure enough resources are available to provide (1) training for staff, (2) technical support, and (3) frequent monitoring to ensure the program remains up to date?
   c. Do you think the program has been beneficial to patients? To providers? Please elaborate
   d. Do you think there are certain providers that will benefit more from the E2P program than others? If so, why?

7. **Condition**
   a. Do you see any specific challenges around the use of DSTs in the context of the conditions/use cases chosen (CHF, anxiety, depression, diabetes)?

Appendix C: User interview guide for Dot Phrase

Thank you for taking the time to speak with me. My name is [insert interviewer name] and today I'm interested in learning about your perspectives of the Evidence 2 Practice (E2P) program, formerly known as Ontario Standards for Care (OSC). We have reached out to you, because we believe you have using some of the tools at your site.
Have you reviewed and completed the consent form? Do you have any questions about your participation? Can we record the interview for data analysis purposes.
A reminder that participation is voluntary, you can withdraw at any time, you can choose not to answer some or all questions. Finally if you want to stop the interview, you can do so at anytime.
Do you have any questions before we begin?

Let's begin.

1. How familiar are you with the current OH Heart Failure Quality Standard?
2. How familiar are you with the **dot phrase (macro phrase) template**?
3. Do you use the **HF admission order set**? If yes…..review the HF admissions order set guide or combine questions to ask for both.
4. Did you know that the template was made to align practice with the current HF quality review standards?

Nature of the behaviour

5. Do you use the dot phrase (macro phrase) template? What are some of the benefits and costs of using the template?
6. If you don't, why not? what needs to happen for you to start using it (if you think you may in the future)?

Skills/Beliefs about capabilities

7. Do you feel like you need some additional guidance in order to start using the template, and if so, what sort of guidance do you need?

Beliefs about consequences

8. Do you think that this template is the best approach to help patients transition out of acute care? If not, what approach would be best?
9. Do you think that the dot phrase template improves the quality of care you provide?
10. Does using the dot phrase template save you or waste time? In what way?

Social Influences

11. Do others you work with think you should use the dot phrase template?

Behavioural regulation

12. Do you think the dot phrase template should be used for all HF patients, or only a particular subset of HF patients? If so, which ones?
13. Is there anything else you would like to add?

Appendix D: User interview guide for Order Set

Thank you for taking the time to speak with me. My name is [insert interviewer name] and today I'm interested in learning about your perspectives of the Evidence 2 Practice (E2P) program, formerly known as Ontario Standards for Care (OSC). We have reached out to you, because we believe you have using some of the tools at your site.
Have you reviewed and completed the consent form? Do you have any questions about your participation? Can we record the interview for data analysis purposes.
A reminder that participation is voluntary, you can withdraw at any time, you can choose not to answer some or all questions. Finally if you want to stop the interview, you can do so at anytime.
Do you have any questions before we begin?

Let's begin.

1. How familiar are you with the current OH Heart Failure Quality Standard?
2. Do you often use the HF admission order set? What are some of the benefits and costs of using it?

There were some updates done to the HF admission order set last summer. The changes included:

- Added quadruple therapy: ARB, ARNI, SGLT2 inhibitor (new classes of medications)
- Updated some reference links
- Removed oral diuretics
- Updated bnp disclaimer
- Added fluid restriction of 1.5L/24h

3. Did you notice these changes?
4. Did you know that these changes were made to align practice with the current HF quality standards?
5. **Before the implementation of these changes** at your hospital, to what extent did you use the Heart Failure Quality Standard? What do you think made it easy or difficult to follow?
6. Do you currently prescribe quadruple therapy to HF patients regularly? If yes, what prompted you to start? If not, why not?
7. Do you have any comments about other changes made in the HF order set (those outside the newly added quadruple therapy)?

Nature of the behaviour

8. Do you use the HF admission order set in your practice?
9. If you don't, why not? What needs to happen for you to start using it, if you think you may in the future?

Skills/Beliefs about capabilities

10. Do you feel like you need some additional guidance in order to start using the HF admission order set, and if so, what sort of guidance do you need (e.g. talk to other physicians)?

Beliefs about consequences

11. Do you think that updating the HF admission order set is the best approach to help you align with the new quality standards? If not, what approach would be most helpful to you?
12. Do you think that the updated HF admission order set improves the quality of care you provide?
13. Does using the updated HF admissions order sets save you or waste time? In what way?

Social influences

14. Do others you work with think you should use the updated HF admissions order set?

Emotion

Begin with open question and give examples if required, try to use both positive and negative examples where possible)

15. We know that clinicians' emotion can affect their practice. For example, you might feel irritated that a machine is telling you what to do. Or, you may be happy because you find the suggestions helpful. How do you feel about having new recommendations appear in the HF admissions order set?

Behavioural regulation

16. Do you think the HF admissions order set should be used for ALL HF patients or only a particular subset of HF patients? If so, which ones?
17. Is there anything else that you would like to add?

Appendix E: Literature review

The below table provides a literature review on CDS implementations based on domains from the NASSS framework.

Table E1. Academic literature review

	PRIMARY CARE	HOSPITAL CARE/ED	GENERAL	NURSING AND PHARMACY
CONDITION				
Nature of condition	• Case complexity (geriatric patients) (18)	• Diagnostic uncertainty (25) • Appropriate patient identification (26) • CDS tool may not be useful in a high-volume, high-severity trauma setting where immediate clinical decisions are made (27)	• Complexity of real world clinical management (28) • Alert tiered according to severity (i.e., order of importance) to ensure only important or relevant interactions or allergy alerts are presented (24)	*Pharmacy context:* • Opioid prescribing (29)
Comorbidities	• Must accommodate comprehensive care that addresses co-existing conditions (30)	• Recommendations may be rejected when alternative diagnoses and additional patient information used for decision-making not extracted by tool – must capture full complexity and context of clinical cases (25)	• Should be patient-specific and include multimorbidity conditions (19,31)	*Not available*
TECHNOLOGY				
Knowledge needed to use	• Training is needed to learn new systems (32) • Must be Easy to use with visualizations (13,14,33,34) • Barrier: technical issues (35)	• Improve usability (20,36,37) • Clearer training on how to automatically include the tool output into notes, and how to manually activate CDS alerts if not triggered automatically (27)	• Easy to use and familiar tool (19,38) • Must enable and train users to tailor or control alerts (24) • Barrier: Specialist training not included (39)	*Not available*

	PRIMARY CARE	HOSPITAL CARE/ED	GENERAL	NURSING AND PHARMACY
Type of data generated	• Data must be structured in a useful way (12) • Need to reduce invalid, irrelevant or oversensitive reminders (32) • Allowing patients to update their information may improve the data (32,40)	• Recommendations that pull patient specific data are more likely to be used (41) • Barrier: Insufficient clarity, accessibility and applicability of guidelines (37) • Must use more data inputs (36) • Barrier: Inaccurate or missing information in the EMR (25) • Family-friendly visualizations and output to support clear end-user communication with family (27) • Automated discharge instructions (27)	• Data exploration and visualization (16) • Automated anomaly detection (16) • Associated clinical measures with CDS performance (16) • Importance of usefulness, relevance, format and conciseness (42)	*Nursing context:* • DS systems algorithm must be properly defined and up-to-date with evidence based practice(43) • Barriers: Lack of interoperability, and inaccurate or missing information in the EMR(43) *Pharmacy context:* • Methods for capturing source data, ensuring its quality and availability, specifying the data format, facilitating patient matching, reading/writing relevant data from/into records and visualizing relevant data can be restrictive or limited (29) • Improve data integration by defining data and interoperability requirements tied to their clinical application (29) • Improve data quality by allowing patients to update their own data (29)
Features	• Reminders should be appropriate to the type(33,34) and reason (32) of patient visit, and provide added context if needed • Reminders should occur at a suitable time during the visit, and can also be timed to occur only at certain times of year (32) • Easy visibility and access to information (14) • Systems should be fully functional and user friendly (32)	• Time reminders at appropriate visit stage (44)	• Order sets: high level of motivational control and performance expectancy, low level of effort expectation (38) • Automatic prompts, minimal manual input (28) • Advice for patients as well as providers (28) • Evaluated by the developers (28) • Ability to control alerts and modify when a patient does not meet a specific diagnosis (45); require reasons why recommendations were not followed (28) • Should not interfere with patient-clinician communication (19) • Performance feedback (19) • Presentation: simple, readable, meaningful colours, bold/bigger icons, standardized terminology (46)	*Nursing context:* • Need for integration within work flow, as switching between tabs is time consuming and creates cognitive burden (47) • CDS alerts must be timed and appropriate to reduce alert fatigue(43)

	PRIMARY CARE	HOSPITAL CARE/ED	GENERAL	NURSING AND PHARMACY
			• Updated CDS recommendation with justifications, additional resources, alternative recommendations (46) • Alerts should be specific, timely and tiered based on level of importance, and should be reduced to ease clinician burden (24) • User centered design and front-line user feedback (16) • Human and technical resources to build and customize CDS (16)	
VALUE PROPOSITION				
Patient	• Integration of care across different settings(22) • Patient engagement (22) • Availability of appropriate information tailored to patient/clinician needs (22)	• Educational for patients (27)	*Not available*	*Not available*
Provider	• Condition/problem is relevant for their setting (e.g. lots of patients with specific diagnosis) (12,48) • Information generated was valued and helpful(32,49) • Improved work efficiency (18) and saves time(22,49) • Information may be more valued with unfamiliar patients (32) • Perceived usefulness of the tool (34) • Professional development credits for system use (34) • Balancing the amount of information given (14)	• Increased attention to recommendations when higher risk (41) • Relevance and timeliness of the recommendation (17) • Clear description of the intent of the tool (17) • Variable perspectives between and within providers at different sites regarding the relevance of the tool (27) • Reusable knowledge asset and relevant for the development of a future toolkit of CDS resources (27) • Educational for providers: residents, nurse practitioners, physician assistants (27)	• CDS useful for skill expansion (19) • Supports shared decision making (19) • Saves time (19) • Barrier: Laborious data collection (19)	*Pharmacy context:* • Potential motivation to use opioid prescribing CDS to avoid regulation-related, penalties, lawsuits, maintain licensure, etc. (29)

	PRIMARY CARE	HOSPITAL CARE/ED	GENERAL	NURSING AND PHARMACY
	• Recommendations relevant and sensitive to the patient context (13) • PCPs as gatekeepers: some patients at low risk, don't need referral (50) • User control and flexibility (13) • Barriers: Adding time burden (12) and alert fatigue (13)	• Greater confidence in provider communication with family members (27) • Greater comfort with discharge and provided reassurance about clinical judgment (27)		
Organization	*Not available*	*Not available*	• Alignment between CDS team and organizational goals (16)	*Pharmacy context:* • Barrier: cost of implementing solutions; financial ROI case for the needed CDS and other HIT solutions, but such information may not be clear or available (29)
Province	*Not available*	*Not available*	*Not available*	*Pharmacy context:* • Federal and state entities can support and incentivize CDS solutions (29) • More research to identify and mitigate unintended consequences (29) • Linking merit-based payments to quality measures, desired outcomes, the use of evidence-based practices, and/or the integration of CDS systems will establish a clear ROI for using CDS (29)
ADOPTERS				
Provider	• Trustworthy recommendation content and availability of evidence underpinning it; barrier of recommendation disagreements guideline ambiguity (13,14,30,33–35,48–50)	• CDS can reduce physicians' cognitive reflection and autonomous decision making, and raise new medico-legal issues(20,37) • Not obscuring the physician's autonomy(17) • Adapt to the local needs(36)	• Use a logic model tying goals to plans to actions (51) • Providers need to believe that the CDS will improve their job performance (38) • Build confidence using the tool through training (19) • CDS allowing more physician autonomy and agency are better adopted (31,38)	*Nursing context:* • Trust in the content and recommendations (57) • Knowledge of background and development of CDS system makes it more trustworthy (58) • Sufficient education opportunities for clinicians (58)

	PRIMARY CARE	HOSPITAL CARE/ED	GENERAL	NURSING AND PHARMACY
	• Age (younger physicians more likely to use CDS) and individual consultation styles influence adoption (32) • Too much reliance on systems is considered dangerous(32) • Identify barriers to adopting guidelines before implementing CDS (34) • Physician autonomy (13,14) • Helpful to use CDS at the broader practice level when controlled by practice or physician; generate lists of possible missed diagnoses or patients to be screened for particular conditions (13) • Increased work efficiency (18)	• Unnecessary systems for experienced physicians (20) • Presence of approachable clinical champion and strong perception of CDS tool critical for adoption and implementation (27) • Barrier: time consuming (37)	• Present pertinent and transparent information supporting autonomy of decision making (52) • Increasing the sensitivity and specificity of CDS alerts can positively influence system use and increase alert acceptance (24) • Provide monthly feedback of use rates to managers and users(28) **Challenges:** • Different levels of trust or confidence in the knowledge base underlying the CDS (28,31,51,53,54) • Lack of buy in of providers (28) • Providers' fear of doing harm (28) • Limited awareness or need of the tool (19) • Alert fatigue: key barrier to achieving an effective CDS (46) • Clinician's perceptions of system bias toward types of treatment (55) • Perceived reduction in clinician autonomy (56)	Barriers: • Negative attitudes leading to non-acceptance of new systems (47) • Manual input, incorrect format(43) • Usability/CDS inefficiencies (43) *Pharmacy context:* • Mistrust with the information given by the system (59) • Users of CDS platforms could help define desired/needed enhancements and join together in asking for those enhancements; incentives to develop more effective CDS are needed. (29) • Emerging efforts to address trust for shared CDS will help support the expanded use of shareable CDS. (29) • Clinician's response to medication alerts decreases as the total number of inappropriate alerts increases (24)
ORGANIZATION				
Capacity to innovate	• Other pressing organizational priorities(12) • Capacity of the organization to act on additional measures or newly identified cases(12) Limited physician capacity to adopt new technologies (33)	Potentialize synergies with other IT projects (44)	• Successful implementation supported by technical and organizational infrastructure (38) • Champion presence (19) • Continuous integration of user input, clinical data, and organizational knowledge into CDS (Learning Health System Model) (16)	*Nursing context:* • Support from management and technical staff required (47) *Pharmacy context:* • Organizational culture, norms, values, and beliefs of staff affect implementation (59) Align the intervention with the overall goals of the organization (59)

	PRIMARY CARE	HOSPITAL CARE/ED	GENERAL	NURSING AND PHARMACY
Readiness for this technology	• Technical feasibility/capacity to build tools in-house(12) • Incorporating CDS algorithms into variations of EHR platforms: support staff needed during development and implementation for troubleshooting (15) • How does the technology fit with the rest of the technologies being used in each setting (13)	*Not available*	• Availability of IT resources to implement the change (53) • Alert information technology teams well in advance of required implementation needs; allow for appropriate prioritization (53) • Defined governance group and stakeholders required (16)	*Not available*
Nature of adoption/ funding	• Lack of data: difficult to predict uptake, use, and impact of the technology and investment needed to get (and keep) it up and running (7) • Lack of money to support the program(7) • Support team-based care (52) • Institute incentive programs for continued use (15)	*Not available*	• Provide financial incentives to use CDS and follow recommendations (19,28,52)	*Not available*
Extent of change needed to routines	• Need to integrate into pre-existing workflows and systems to avoid disruptions (12,14,15,18,22,30,33,35, 50) • Barrier of too many reminders and alerts (24,32) • Team-based care can be facilitated by making the	• Integration into workflow(17,20,26,27) • Understand the treatment process (26)	• Consider how users interact with EMRs, as general frustration maybe with EMR and not CDS (51) • Offer CDS at appropriate times (28,51) (28) • Need to reduce general alert fatigue and mismatch to workflow (19,28,31,51) • Automatic provision of CDS as part of workflow (28) • Take into account the complex sociotechnical environment of the real world clinical setting (28)	*Nursing context:* • Need to establish standard practice (47) • Ongoing adaptation to the system and adjustment to workflow required (47) *Pharmacy context:* • Integrate with workflow (59) • The entire team should be engaged in the implementation, not just the clinicians (59)

	PRIMARY CARE	HOSPITAL CARE/ED	GENERAL	NURSING AND PHARMACY
	CDS target the team not the provider(12) • Reminders may be part of routine; physicians assess them ahead of consultations(32) • Entire team should be considered; receptionists may make longer appointments for patients likely to have more CDS reminders (32)		• Desire for staff and clinics to control/personalize their own workflow and integration (53) • Create new teams and use a team approach (19,45,53) • Develop notes and communication templates (53) • Upstream/downstream barriers to following CDS recommendations (19) • Interruptive alerts only for high-risk situation (24)	• Overwhelming number of inappropriate DDI and drug-allergy alerts (i.e. alert fatigue) that are received during prescription increases override rate (24)
Work needed to implement change	• Continued reminders about the tool and how it is linked to evidence (12,32) • Early and ongoing engagement with clinicians (22) • Offer in-person training (15,33), more clinician education and resources(13,35) • Before implementing, adapt and customize to unique local site needs (15,22) • Consider rural populations and clinic resources in rural regions (15) • Time investment may exceed perceived benefits (18)	• Availability of tech support and training(17,44) • Institutional investment in user training (27)	• Awareness and training of providers (19,28) • Be aware of new administrative workloads added as a result of the CDS (53) • Centralize technical assistance (53) • Early adopter demonstration (53) • Trialability and customization (53) • User-centered design approach (53)	*Nursing context:* Training (43)
WIDER SYSTEM				
Socio-cultural	• Lack of patient engagement in the development of CDSS (30) • Lack of patient-centered CDS design (30)	• Social comorbidities such as homelessness and mental illness (25) • Fit with organizational culture and clinical workflows (27)	*Not available*	*Pharmacy context:* • Needs of the business, employees, and patients recognized and prioritized by the organization (59)

	PRIMARY CARE	HOSPITAL CARE/ED	GENERAL	NURSING AND PHARMACY
	• Patient insurance coverage may pose a limit depending on recommendations (33,34) • Consider each clinic's unique culture around treatment and prevention (15) • Regional differences in perceptions of facilitators to CDS usage (18)			• Account for local factors: business needs, practice settings, clinician types, patient populations, workflow approaches, documentation templates, and local resources (29)
Professional	• Risk of overreliance on computer systems if insufficient experience (22) • CDS should be patient informed and not patient led (22) • Some perceived physician judgment was better than a CDS tool (18)	• Lack of clarity about which provider should complete the tool and variation across sites regarding which providers completed the tool (27)	• Create new guidelines, update policies, and revise professional roles (53)	*Pharmacy context:* • Professional societies to develop and clinically endorse guidelines and encourage widespread adoption of an appropriate technical framework to support interoperable CDS based on guidelines (29)
Policy (Regulatory/Legal)	• Need for a strong national/provincial level leadership (22) • Program staff changes at the government level are a barrier (22) • Concerns about safety and privacy of patient data (30) • Reminders for safety are considered more than reminders that affect missed opportunities or cost savings for patients (e.g. lower cost drug recommendations) (32)	*Not available*	• Regulatory framework to achieve balance between promoting technology innovation and protecting patients(28) • Software as medical device regulations (SaMD) data privacy considerations (28) • Alignment with national payer and guideline metrics (52) • Need to establish human factors based design standards to guide the design, development, implementation, and customization of CDSS (46) **Challenges:** • Some centers may not allow pharmacists or nurses to make evidence-based medication changes (53) • Some EMR updates are accessible only through EMR vendors(51)	*Pharmacy context:* • National authoritative body to promote guidelines and fund research on best implementation strategies (29) • Consensus on documentation templates/expectations to be developed by an authoritative body (29) • Need government funding, a set of consolidated requirements specifications for interoperability, and research on visualization of best practices to support clinician and patient decision making (29) • Challenge: Differences in state-level regulations on allowed use of prescription drug monitoring program

	PRIMARY CARE	HOSPITAL CARE/ED	GENERAL	NURSING AND PHARMACY
			• Medico-legal concerns: Reluctance to remove alerts due to fear of being held accountable if patients are harmed in the absence of a warning (24)	data and prescribing of controlled substances (29)
ADAPTATION OVER TIME				
Scope of adaptation over time	• Different conditions can interact with the organization to create new barriers (60) • Delays in keeping CDS up-to-date (30) • Continual monitoring and maintenance of CDS performance is required (15) • Gain front-line key informant input early; sustain relationships through routine solicitation of feedback (15) • Prepare for continual adaptation and take feedback seriously (15)	• User participation at the individual patient level to generate continuous feedback supports effective adaptation (25) • Plan ahead for maintenance, adaptation and related financial challenges (44)	• Scheduled performance evaluation and update (52) • Share local knowledge and leverage learning collaborative (53) • Develop and organize a quality monitoring system (53) • Maintaining staff skill (19) • Adopt socio-technical model, five rights of CDSS, and Lean, when analyzing, improving, and redesigning CDSS alerts (24) • Process analysis can identify process efficiency, problems, and automation potential to improve the process (24) • "Zonal to proximal" development using a maturity model framework(16) • Ability to compare CDS metrics to different organizations (16)	*Pharmacy context* • Reach agreement on a vision of CDS at scale and develop specifications and implementations to reach this goal (29) *Pharmacy context:* • Engaging users in the specification, design, and implementation of CDS systems, creating publicly shareable success stories, and conducting research on factors that contribute to CDS efficacy and dissemination of CDS success stories can improve CDS implementations (29)
Organizational resilience	• Absence of sustainable financial models(60) • Modifiable implementation approach for different contexts (60) • Barrier: variations in guideline translation (30) • Medium/long-term feasibility of continuing to adapt the technology and the program (7) • Ability to detect and respond to critical issues (7)	*Not available*	• CDSS are difficult to build and maintain; formal models needed for knowledge maintenance (51) • Access new funding (53)	*Not available*

Appendix F: Key Informant Interviews - Themes and quotes

Theme	Quote
CONDITION OR USE CASE SPECIFIC FACTORS	
Complexity	"I think that in healthcare we tend to want to standardize things too much sometimes and it would be nice if life was like that and you could, you know, fit it all into that box. But when the disease or the condition requires more adaptability, I think it's just important that that decision support tool allow for that flexibility." – Key Informant 1007, QI Researcher and Administrator
Co-morbidities	"To work with complicated people and to figure out what to prioritize at any given visit… oh, this person also has diabetes and all of a sudden I have all of these interventions I need to make in a 10 or 15 minute appointment…." – Key Informant 1012, Specialist Physician and QI Administrator
TECHNOLOGY	
Knowledge needed to use the technology	"Then to figure out how to implement it in Cerner hospitals, versus the EPIC hospitals, versus Meditech hospitals… and whatever else. So it shouldn't be a lot of training for the clinician. It's just more of turning on of a switch. But if there's 6 new tick boxes that they're not used to seeing there before, then they will need training, and that's always a little tricky" – Key Informant 1004, Specialist Physician and QI Researcher
Technology features	"I don't want to be reminded when I finished my note that I should talk to the patient about sodium intake. I rather have a note available to me that includes a heading called sodium counselling and gives me links to what I need to say to the patient, and even better, just gives me the information, that I have to hand over to the patient." – Key Informant 1005, Specialist Physician and QI Researcher " You can build in the logic so the system can look for a previous vaccine or current level of medication or last HBA1C etc., and then only prompt you with the reminders for what you need to do. So the toolbar is a place where all this stuff sits, but the most important part is what action comes from using that toolbar." – Key Informant 1017, PCP Administrator, and QI Researcher
Type of data generated	"Standardization of terminology, standardization of a pathway is going to be hugely beneficial (…) To be able to hardwire it into an HIS (…) so that ultimately from an outcome we can all be talking apples to apples. And at an aggregate level, we know how care for a population is improving or not improving" – Key Informant 1001, Administrator "Resources and structures to actually collect that data and feed it back to the programs, because I think one of the challenges has been in Ontario that there isn't a lot of data collection that happens, and not a lot of return to the frontline care providers and institutions who are collecting

	the data… I can speak from mental health like we provide a lot of information, and we never get any information back from the Ministry of Health about what's been done with the data, and what we've accomplished." – Key Informant 1012, Specialist Physician and QI Administrator
VALUE PROPOSITION	
Physician or provider	"So this is part of my clinical decision making is looking at this information. It's feeding it into me at the right time when I need to make the decision then for sure this is going to make sense. So that workflow question comes in, I think when you're looking at different clinicians and the way that they interact with the technology and when they make decisions." – Key Informant 1002, QI Researcher
Patient	"So, what's nice is that from a value proposition (…) it brings us all to a standard that I'm going to presume is evidence-based, right. And it means the patient can go into any hospital and pick it up at whatever trajectory of care" – Key Informant 1001, Administrator "Sure, it's a patient facing document (patient discharge forms). I'm just not sure it's a meaningful patient facing document…" – Key Informant 1008, Specialist Physician and Administrator "We want to ensure that people don't fall between the cracks, and that we can ensure that they move from one care environment to another when they need, and more of that is automated." – Key Informant 1017, PCP Administrator, and QI Researcher
Organization	"What's nice is that from a value proposition, it not only offers savings from an organizational effort to duplicate all of this, but brings us all to a standard that I'm going to presume is evidence-based right (…) a pathway that's been vetted because I am going to trust that the province would go further in partnering with patients and families than some organizations might do." – Key Informant 1001, Administrator "The biggest advantage is that it eliminates the need for every institution across the province to do its own pilot, and instead to get a sort of user guide, and be able to move it forward with a few local tweaks for implementation, instead of solving all the problems… if the province is going to continue to have like 50 different EMRs, then yes we need something like this." – Key Informant 1008, Specialist Physician and Administrator "Is the problem that we see complex chronic disease handled poorly by clinicians, meaning they're not doing the right things at the right time, and therefore patients are sicker than they need to be, or end up in the hospital more often? Or is the problem that we just simply want to automate as much as we can to make sure that we can get data for it, and you know, have some sense of control?" – Key Informant 1017, PCP Administrator, and QI Researcher
ADOPTERS	
Champion Leader or Opinion Leader	"What I noticed in the Health Quality Ontario (HQO) original guidance, the ones that were created by respected and real leaders, or commonly accepted leaders within the fields, definitely had more weight to adoption." – Key Informant 1001, Administrator

	"The champion removes all those irritating organizational barriers. The champion says, I'm going to push this order set through the technical process for you. Just one deeply invested in the project… that's how you'll change my behaviour in a lasting way, because it's coming from an opinion leader." – Key Informant 1005, Specialist Physician and QI Researcher "You want to have someone who's a leader from the clinical point of view, people are going to listen to them, right… if they don't have the capacity to influence the people around them, then you're more likely to find barriers that are difficult to work on" – Key Informant 1010, Specialist Physician and QI Researcher "People don't feel as though they've had the opportunity to provide input, there can be disengagement. And then I think it will be really important to have local champions at each site that help the clinical teams to see what the advantages are to adopting this approach." – Key Informant 1012, Specialist Physician and QI Administrator
Providers	"We have transparency to show that, this is being used for the following reasons, not take away autonomy of the clinician, have them be in a position to decide if this set of recommendations apply to my patient or not" – Key Informant 1009, Specialist Provider and Researcher "In a highly specialized heart function clinic like where I work, where management is really top of mind, I don't think there would be a lot to be gained from that, whereas if you sort of aim for places where heart failure is not necessarily top of mind, they may be starting at a lower baseline, and they may have a higher likelihood of moving the needle. – Key Informant 1010, Specialist Physician and QI Researcher "Within autonomy, there are multiple different things that you have to kind of consider. There's a piece to it that's trust related. So how do I know what this is telling me is actually true? How do you prove it to be the right thing? (…) You want to empower clinicians to not just follow something blindly, but to be able to understand the rationale behind it." – Key Informant 1009, Specialist Provider and Researcher
ORGANIZATION FACTORS	
Readiness of the organization for this technology supported change	"It isn't about not understanding why it's important. It's that to add on right now is very challenging. And then how do you prioritize which things to add on, because the Ministry at the same time, has said you got to deal with the million people who are in backlog on surgery, at the same time we are dealing with all these closures of ED all over Ontario…So, given the many priorities in our organization, sometimes it's hard to say, OK we are going to adopt this one, but that just means the other one gets neglected." – Key Informant 1001, Administrator "Some of the challenge with this is, every organization's at a different evolution of their electronic health record (EHR), right. If you're talking about congestive heart failure, our general internal medicine group and our ICU are not fully implemented on the electronic health record. So even then, there are challenges." – Key Informant 1001, Administrator

	"I think having first of all, it's inconsistent electronic health record systems across the board. Not everybody actually uses an electronic health record system (..) Our hospitals are old, and they're being retrofitted for the current digital age. And then things like making sure you have Wi-Fi network everywhere makes a huge difference if you have dead zones that you get no access to anything. You could have the fanciest electronic health record with every sort of best practice and decision support on it, but you can't access it." – Key Informant 1009, Specialist Provider and Researcher "Ongoing commitment from all the institutions who decide to try this out, that they would need to be committed to that maintenance and sustainability phase" – Key Informant 1012, Specialist Physician and QI Administrator
Change management and training staff capacity	"Can't just do the programming, they [have to] support the hospitals probably with some boots on the ground to help with the implementation side of it." – Key Informant 1004, Specialist Physician and QI Researcher "You know, I don't want to have to go to a class to learn how to click a button (…) don't use the word training… maintenance of certification app education hours. That's a good trick. But don't say how to click this button in EMR. It's just so boring. This is how you become an expert. Click here. Do this. This is how I do it. And then people will want to do it. I want to be like that person. I want to be like the heart failure expert, I'm going to do what they're doing." – Key Informant 1005, Specialist Physician and QI Researcher
Extent of change in routine or workflow needed	"Highlighting the importance of making sure that people who are going to be directly affected by this can provide input as to how best given the solution fits their own workflow - whether the decision support pops up when you're doing your review, before you see the patient, versus when you're doing your documentation, versus strictly when you're writing prescriptions" – Key Informant 1010, Specialist Physician and QI Researcher "I find them not particularly useful, you know. If you look at the guidelines for a heart failure visit, the way these are set up, there's no structure to them. So it's a bunch of checkboxes that basically, say we want you to do this(…) I think if it was, if there's structured, to how a clinician would actually operate in their office or at the hospital for any given interaction, step wise. Or you know what first deal with these, and then go on to these. I think there's a lot of value there I think." – Key Informant 1013, Primary Care Physician and Administrator
WIDER CONTEXT	
Policy	"There's so much heterogeneity across different institutions. But to have an interface that will actually work for multiple different EMRs would be, I think, essential. So far there isn't a standardized one that's been adopted across all institutions." – Key Informant 1011, QI Researcher and Administrator "I think what the province needs to do is advocate to EHR vendors that, OK, yes, you're on separate instances of this, but you need to let them talk to each other. And then the province can start to develop guidelines and pathways and make things easier for hospitals to implement them." – Key Informant 1014, Specialist Physician and Administrator
Population Health	"It would be higher value to the system. I would like someone to solve the problem of how we're going to figure out if people receive comprehensive assessments."

	– Key Informant 1008, Specialist Physician and Administrator "Is it that we actually want to ensure that people don't fall between the cracks and that we can ensure that they move from one care environment to another when they need to and more of that is automated so that you know we're made more aware of the things we need to know rather than always thinking about the things we already know and that's kind of the whole problem in transitions people disappear whenever there's a gap." – Key Informant 1017, PCP Administrator, and QI Researcher
Professional Physician Responsibilities	"I think that there are a couple of potential concerns that might come up. You probably heard these already…like #1 is this going to impact my clinical autonomy, my ability to do what I think is best for patients." – Key Informant 1003, Primary Care Physician and Administrator "If [decision support] ends up becoming what's implemented broadly, then we've completely devalued what a comprehensive assessment is, into a self-report tool that doesn't even require a physician." – Key Informant 1008, Specialist Physician and Administrator
SUSTAINABILITY	
Adoption Over time	"What would be more helpful would be how do we actually set up the system to support those best practices, especially around discharge? (…) We know that lack of nursing staff means one of the big challenges is getting daily weights in the hospital [for CHF]. It's the bane of every physician's existence because it's so hard to get nurses to document the way it's in a consistent place… so I just don't know how E2P order sets are going to change the system problems as to why we don't have the basic tools to provide guideline concordant care." – Key Informant 1004, Specialist Physician and QI Researcher "The place where you have identified the problem, and involving the people who work in that setting, in coming up with those diagnoses and with the solutions is what sets you up for success. If a random doctor from UHN, says I have a solution for you guys in Ottawa, I'm more likely to be facing resistance as opposed to random doctor from UHN goes to Ottawa, and observed and says 'Hey guys, I noticed you do this and that. Let's work together and come up with something that makes sense'. I think that's more likely to have some degree of success… The most success I've been able to get, is not to say that this is the right way to do it, but it's when you focus your attention on the patient and patient outcomes. I think it resonates with most clinicians." – Key Informant 1010, Specialist Physician and QI Researcher
Abandonment Over time	[The] design is really important … what are the triggers that fire this decision support tool versus not? Does it have to fire every time a patient is admitted with a diagnosis of heart failure on their chart even if they're coming in for their appendicitis? All you need is a number of people having bad experiences with technology that they will then abandon it, and write it off from the beginning without giving it a chance" – Key Informant 1009, Specialist Provider and Researcher "Overload of information, and saturation of your visual field, and then you end up doing what many people do, which is just clicking OK without necessarily reading what they're doing... Involving the people who are going to be using it is important. So for example, in a teaching hospital, we have residents or fellows, and they switch every month or every two months, right? Versus if you go to

	a community hospital, and it's always the same people, they may get a little bit exhausted on seeing the same little box popping up." – Key Informant 1010, Specialist Physician and QI Researcher
Spread and scale	"From a sustainability end, if you are decreasing the work for organizations to adopt something, it is certainly going to increase the chances it will get adopted. This is going to be growing and growing a number of populations you will be working with, and evidence changes constantly. So the fact that it needs to be sustained and updated is not surprising. (…) So what could you do to help organizations? It's probably offering some sort of timeframe, from which to expect that these guidelines will be updated so there is a way to sequence this and embed it into your systems, right? It can't be every year. So then, what is it? Is it every three years? What would it be?" – Key Informant 1001, Administrator

Appendix G: User and Implementer Interviews - Themes and quotes

Theme	Quote
CONDITION OR USE CASE SPECIFIC FACTORS	
Complexity	"Of course, it's pretty much impossible to make a one-size-fits-all kind of instructions for all heart failure patients." – Participant 005, User (Physician)
Co-morbidities	"I use the order set, but sometimes because people come in with other things - they have heart failure or, and say, you know an infection or what not. So, it's like a toolbox. I don't always use everything in the order set every time... So, if someone comes in with another problem that may go to the HF order set, then tag it along with a different order set, then combine them." – Participant 006, User (Physician)
TECHNOLOGY	
Technology features	"Sometimes there's maybe too many orders or too many details in it, but I know the order set pretty well, so it's very quick. I think maybe for a new user, [it] maybe overwhelming to go through it" – Participant 006, User (Physician)
Type of data generated	"I always add a cardiology follow-up but again, I think that would be too difficult to make a uniform blanket statement (…) In the family doctor follow-up section, (…) I always add your family doctor needs to check your bloodwork because I find if we don't explicitly ask the family doctor to check their bloodwork they usually don't. And any patient after a heart failure admission needs to have bloodwork checked in a week or two. So that's one thing that I personally would add on." – Participant 005, User (Physician)
VALUE PROPOSITION	
Physician or provider	"I think the standardization, the wording. It's already been vetted for us, and it prints out nicely for the patient as well so that they have a reference." – Participant 001, User (Physician) "I would say maybe 5 minutes of dictating and another 10, 15, 10 minutes of discussing things. I would say saves me like 10 minutes each discharge." – Participant 001, User (Physician) "There is this connection between different facets of the patient's care whether it's inpatient versus outpatient. And enhancing that communication is very important so that way primary care knows what's happening in the hospital and once a patient leaves making sure that that care is picked up right where it's left off instead of reinventing things." – Participant 002, Implementer "…to have the most up-to-date evidence and guidance incorporated into order sets, such that for example, we have focused on the different therapies for heart failure that are available and up to date as they're caring for patients in real time. The focus on some quality standards related to transitions of care, for example, then would allow the generation of provider inpatient discharge summaries that are higher quality relevant to patients, based on patient feedback, and would really try to facilitate and optimize communication to primary care practitioners in a meaningful way. But also then to provide information to patients in a very specific way that will help guide them beyond their acute care stay. That focus on transitioning care in the acute care setting would then have

	benefits, too, in terms of communication to the primary care practitioners as well as in terms of providing clear guidance to patients after their acute care stay or their acute care episode is coming to a close." – Participant 004, Implementer
Patient	"The other thing is we're looking at this from a multidisciplinary perspective, so physicians, nursing, allied health, acute care, primary care, so really ensuring that this is a journey for the patient involving lots of facets and making sure that they're all connected so that things are not fragmented as sometimes we see nowadays." – Participant 002, Implementer
Organization	"But this process was like doing a comprehensive review and not just meds, not just pharmaceuticals but allied instructions and nursing care and all that stuff which just takes more time. I think, it does take a lot of time to do a comprehensive review of an order set, which is good to do every five years or so we appreciate just the effort or the focus maybe on this order set." – Participant 003, Implementer "It was nice to pause and reflect on our discharge process - how are we doing and communicating, are inpatients being discharged to the community, and let's look at that process. And I feel without something like this project coming to us, we might not look at that for five years. So, it forced us as an organization to just pause and to look at it. Accreditation has their list, and they make you pause, and you have to focus on things. But this was something that was helpful for us to reflect on as an organization how we were communicating our acute care discharges and I think that's good to do every once in a while." – Participant 003, Implementer "From a CMIO standpoint, one of the things that I find to be one of the greatest potential benefits of the project is the idea of mapping SNOMED CT terminology for the quality standards, such that we can really look at hospital or department performance related to those quality standards by pulling that terminology, and producing standardized reports, and to drive quality improvement by giving that feedback back to the hospitals. But also, if we are able to do this successfully across all vendors, then to then allow for peer hospital comparison to drive performance. That part of the project, I think we've been able to demonstrate some feasibility within the congestive heart failure use case… we've been able to demonstrate that the generation of that report using SNOMED CT terminology mapping, at least within the Cerner HIS is possible and feasible." – Participant 004, Implementer
ORGANIZATION FACTORS	
Readiness of the organization	"I said it's very important that you have program support for this because if you have digital support that's fine and that's certainly necessary. But if the program isn't … they're also seeing it as a priority that they can then free up their resources, whoever that might be, to get feedback the project won't go anywhere. And you really need the subject matter experts to drive, not drive it but really be involved and if you don't that and if you don't have the capacity in your organization to do a comprehensive review of an order set then it might not be something you want to do." – Participant 003, Implementer
Change management and training staff capacity	"I think a lot of it is just remembering. The more I use it the more I remember. And I think just for the other people it's important to constantly remind them as well (…) No one is against using it. I think it's just a matter of changing practice which is always difficult even if it's a very simple task." – Participant 001, User (Physician)

	"It's also a quality improvement program. We're trying to improve the quality of care and that's not just based on an electronic tool. It's also based on how people do things. So, there will definitely be a potential barrier there in terms of people being resistant to change, being resistant to doing things a different way than the way they've done them for years and years and years. And that does require change management support at the time of implementation and monitoring." – Participant 002, Implementer 'I think there can be some barriers in terms of trying to communicate and convince clinicians and CMIOs that this is going to provide actual benefit at the bedside, that is going to be able to be scalable, and done in a sustained manner. Meaning that the one-time update of order sets may be of benefit, but how are we going to sustain this when new evidence emerges, how are we going to develop a local process,(…) I still think that there is some skepticism on the clinician side that this is a sustainable, scalable project (…) Because again, the knowledge translation by implementation of digital tools to transform clinical care has been long promised, and it is really a big, big challenge, and there hasn't been a huge body of evidence to say that these initiatives have been successful in the past. HQO standards have been there for years, and whether they're digital standards or not, just the concept of will quality standards actually meaningfully change the behaviour of clinicians and provide benefit and help them provide care for their patients, I still think that there's a barrier in terms of skepticism if this kind of initiative will be successful and meaningful." – Participant 004, Implementer "I think [what] would be more helpful is actually an update like a talk (…) or someone can explain. I mean [not just] for me, but other people that want to use the order set, I think going through the order set, not everyone's going to read everything every time. And so the change that's made or new update it might be best to give a talk or something to read like another document circulated then just going after the order set. Yeah, cause I feel some people are going to go through it pretty quickly." – Participant 006, User (Physician) "And they may or may not notice it change, but they may not even know how important it is or how relevant it is so because they're still using the order set like, it's like almost automatic (…) [it] maybe good to [send] an e-mail or part of our grand round or something [so] that people know." – Participant 006, User (Physician)
Leadership and Innovation Capacity	"We do have a physician lead for this program who tries to engage the clinicians early on, to really speak to the clinician experience. As part of the site engagement, it's not just engaging the informatics teams, but it is engaging some physician champions and local clinicians as we are meeting with sites to say, this is the benefit, these are the potential benefits to you, what work have we done, to try to tie that work that they've already done to the work that we're doing. Then getting input early on from topic experts so that their feedback and what they identify is important, and incorporating that into the planning early on. Early and sustained engagement, I think is really important, and it has been part of the strategy." – Participant 004, Implementer
WIDER CONTEXT	
Population Health	"In terms of its purpose, updating and digitizing quality standards so that the use cases are being managed in an up-to-date fashion (…) Patients are being managed with the up-to-date evidence-based care. And also, that aligns a lot of these facilities and centres across Ontario so no matter

	where patients go, they should be able to get the similar high-quality care regardless of their location. So, I think that's a very important aspect of this is that it's aligning care across the province." – Participant 002, Implementer
SUSTAINABILITY	
Adoption Over time	"Once these tools are implemented, we can also measure and see what type of uptake there is and what types of success there is and what areas are not being met and then, do a deeper dive into why certain things aren't being done and reacting to those. So, I think that's also, something that's going to be nice that's going to be built into this is that measurement-based care, being able to identify barriers which we may not have thought about early on. So, lots of opportunity to sort of intervene and reassess things after implementation as well." – Participant 002, Implementer I think there is going to need to be some sort of way to maintain and update quality standards because the day will change obviously as we develop, create new information or new studies and things like that, that might become available. The standards will change and there has to be an easy way to implement and update the things that we've done so that we can keep up. So, there is going to need to be an easy and efficient maintenance aspect to this program as we move forward. Each site will have their own technical support as there may be technical changes, updates to the information systems, the EMRs and things like that in order to be able to address any technical glitches and issues." – Participant 002, Implementer