



# Exploring the Impact of the Digital Health Drug Repository (DHDR)

## Final Evaluation Report

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## ACRONYMS

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**ADE:** Adverse Drug Events

**BPMH:** Best Possible Medication History

**CDHE:** Centre for Digital Health Evaluation

**DHDR:** Digital Health Drug Repository

**NPDR:** National Prescription Drug Record

**DPV:** Drug Profile Viewer

**DUR:** Drug Utilization Review

**EHR:** Electronic Health Record

**EMR:** Electronic Medical Record

**HIS:** Hospital Information System

**LRA:** Local Registration Authority

**MOH:** Ministry of Health

**NMS:** Narcotic Monitoring System

**NMRS:** National Medication Record System

**ODB:** Ontario Drug Benefit program

**PBS:** Pharmaceutical Benefits Scheme

**PMS:** Pharmacy Monitoring System

**PEM:** Personal Electronic Medication

**SMR:** Shared Medical Record

**WHV:** Women's College Hospital Institute for Health System Solutions and Virtual Care



## OPERATIONALIZED DEFINITIONS

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**Dispensed medications:** Pharmacy claims data reflecting medication prescriptions that were dispensed and billed. In the DHDR, this includes all medication claims paid by the public payer in Ontario and all payers (private and public) for narcotic medications.

**Drug Utilization Review:** refers to a review of prescribing, dispensing, and administering of medications.

**Narcotics Monitoring System:** collection of dispensed data from all dispensaries in relation to narcotics, controlled substances, and other monitored drugs dispensed to patients in Ontario, regardless of payor.

**Ontario Drug Benefit Program:** A public drug funding system in Ontario that covers approximately 4,400 prescription drugs products contained in the provincial formulary. It includes residents who meet at least one of the following criteria: over the age of 65; live in long-term care home or home for special care; have high drug costs and receive social assistance (e.g., the Trillium Program). Claims approved by this program are contained within the DHDR.

**Prescribed medications:** Refers to all medications prescribed by a healthcare provider, which may or may not be filled by patients (and are therefore not captured in pharmacy claims data).

*Note:* The term ‘prescribed medications’ was used routinely by the providers we interviewed who defined it in this way.

**Private insurance claims:** Insurance claims for medications that are dispensed and obtained through private insurance companies and not captured within the DHDR.

**Public insurance claims:** Insurance claims for medications that are dispensed and publicly funded through the Ontario Drug Benefit Program. For the purposes of this report, this does not include federal programs and claims from other provinces.



## EXECUTIVE SUMMARY

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Centralized drug repositories can enable healthcare providers' access to components of the patient medication history to support the development of a best possible medication history (BPMH). In 2016, the Ministry of Health (MOH) developed the Digital Health Drug Repository (DHDR) to serve as a provincial repository to facilitate development of BPMH. The Centre for Digital Health Evaluation (CDHE) conducted an evaluation of the DHDR to:

- 1) Understand for which user groups the DHDR has current or future clinical value and how that value is (or might be) realized;
- 2) Identify enablers of and barriers to adoption and meaningful use among eligible users; and
- 3) Identify optimal indicators to monitor and evaluate the impact of the DHDR.

The CDHE team conducted a mixed methods evaluation using an environmental scan, healthcare provider interviews, and an electronic survey. An environmental scan, encompassing international studies, was conducted to identify key indicators to monitor and evaluate the DHDR, while the interviews and survey helped to understand the clinical value of the DHDR and identify barriers to adoption. CDHE conducted 33 interviews and surveyed 167 healthcare providers across Ontario from a range of healthcare settings.

### **Key findings:**

#### *Environmental Scan*

- A scan of the international literature showed limited evidence to support best practice indicators to evaluate or monitor the impact of drug repositories.
- Evidence suggests that access to a repository reduced inappropriate prescribing, and adverse drug events (ADE) related hospitalizations and improved medication adherence for patients.
- Drug repositories were often incomplete and contained medication omissions or discrepancies, which highlighted the need for complete and accurate records in the repositories.



## Online Survey & Interviews

- DHDR has clinical value among healthcare providers
  - *Acute care:* Geriatricians frequently used DHDR as they conduct a BPMH on all patients. ED physicians and surgeons used DHDR when it was unclear what medications the patient was on and to assess information on anticoagulants prior to a surgery or check for narcotic information, usually after hours.
  - *Community care:* Primary care physicians used DHDR in specific cases such as seeing a new patient, those recently discharged from hospitals, and those who are seeking antibiotics or narcotics.
- Target areas for future deployment are community pharmacists and healthcare providers in long-term care settings who currently have limited or no access. Community pharmacists would benefit from access to DHDR to facilitate medication review at the point of dispensing, providing an opportunity to identify medication errors. Healthcare providers in long-term care settings can benefit from knowledge of medication histories for complex patients and reduce potential ADEs.
- Information in the DHDR is satisfactory, but key clinical information is missing. Specifically, the absence of medication instruction (i.e. sig or dosing regimen), private insurance claims of dispensed medications, and prescribed medications prevented users from constructing a BPMH in a timely manner, thereby limiting clinical value.
- The process to obtain access to DHDR via a provincial viewer is perceived as onerous and lengthy (range 77 days to 18 months). Delays were due to communication issues, and security, and privacy assessments, which presented a significant barrier to adoption, particular among community providers.

At minimum, healthcare providers stated the DHDR would require medication instructions to optimize clinical value within the current system. Findings from the



evaluation identified several areas that could enhance DHDR adoption and use in Ontario. They include:

- Complete medication histories for all Ontario residents
- Documentation of prescribed medications
- Documentation of medication instructions
- Public and private insurance claims data for dispensed medications
- Ability to update information (i.e., allergies, over the counter medications) by patients or healthcare providers
- Integration into point of care systems (e.g., EMR, HIS, PMS)
- Patient access to medication lists (i.e., through dedicated portals)

DHDR should be accessible to all healthcare providers in all settings who have a clinical use case to view medication history to ensure continuity of care (i.e., transitioning from acute care to community care). An inclusive repository (as outlined above) has the potential to reduce inappropriate prescribing (e.g., antibiotic prescribing), medication errors, and omissions, thereby resulting in improved patient care, reduced ADE and related hospitalizations.

To work towards this goal, the CDHE recommends the following actions in the next three years:

### **1. Integration with point of care systems to enhance workflow efficiency**

Integration of DHDR into point of care systems such as EMRs, PMS, or HIS will improve the workflow of providers by making pertinent data elements (e.g., prescribed medications, allergies) available in a single location, eliminating the need for providers to search multiple systems for relevant data. This will facilitate development of BPMH, reducing the need to contact other healthcare providers. Integration of point of care systems will enable seamless access to DHDR, which will benefit healthcare providers and provide up-to-date information. Specifically, less time will be spent seeking out additional sources for BPMH and confirming clinical information and instead can be spent on patient care.

### **2. Inclusion of private and public insurance claims for dispensed medications**



Addition of private and public insurance claims for dispensed medications should be included in the DHDR. This would contribute to a complete picture of medication histories for residents and would support informed prescribing, which would be a valued investment from the perspective of Ontario healthcare providers.

### **3. Include medication instructions in the DHDR to facilitate BPMH**

Healthcare providers have access to the quantity and strength of medications dispensed but often spend time determining the medication instructions based on this data. For example, a healthcare provider may know the patient is dispensed 30 pills and a dosage strength of 100mg, but it is unclear if the medication is twice a day or once a day. Addition of this data element, from both public and private insurance claims for dispensed medications, would decrease the ambiguity and save time when developing a BPMH.

### **4. Streamline the onboarding process for access to the DHDR via a provincial viewer**

Onboarding processes for DHDR via a provincial viewer should be streamlined for those working in small practices, community pharmacies, and long-term care settings. Participants experienced delays ranging from 77 days to 18 months to gain access to a provincial viewer and thereby DHDR, which pose a major barrier for adoption. Delays often include communication issues (e.g., waiting for someone to contact them or setting up meetings to deploy, etc.) and privacy and security assessments. Privacy and security assessment could be optimized depending on the healthcare setting or additional support could be given to providers to enable secure platforms for access. For example, the privacy and security assessments are the same for a large-scale hospital as it is for a small independent practice in the community. Primary care, community care (i.e., pharmacies and mental health facilities), and long-term care settings are strong target audiences that would benefit from the DHDR and additional support during privacy and security assessments. However, if integration of DHDR into a point of care system is realized, onboarding may not be an issue

### **5. Broad promotion of the DHDR through multiple channels to improve awareness**



Poor awareness is a key barrier to broader adoption. Knowledge of the DHDR and the benefits from access to information contained in the repository should be widely circulated among healthcare provider organizations such as the Ontario Medical Association, Ontario Pharmacists Association and the Registered Nursing Association of Ontario. Access to a provincial viewer could be provided to all providers (including clinicians, pharmacists, nurses etc.) as an outcome of licensure to improve awareness and streamline access.

In addition, we recommend:

**1. Evaluate the validity of the DHDR to increase healthcare provider confidence in the repository**

The environmental scan indicated that most drug repositories are incomplete; as such, they often contain medication errors, or omissions. To increase confidence in the DHDR and assure quality, MOH should evaluate the completeness of records by comparing multiple sources of BPMH (i.e., patient interview vs pharmacy record vs DHDR record) and document the number of medication omissions, inappropriate prescribing, and discrepancies to validate DHDR. The impact of DHDR on patient care can be assessed by examining relevant healthcare system outcomes such as ADE-related hospitalizations and ED visits. Knowledge that DHDR is accurate and complete will increase uptake.



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# 1. INTRODUCTION

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Adverse drug events (ADEs) lead to avoidable health system utilization and increased costs and are often a result of inaccurate medication histories.<sup>1</sup> Discrepancies in patient medication lists are frequent, with at least one unintended medication discrepancy reported in 53.6% of complex hospital patients (i.e. on >4 regular prescription medications).<sup>1,2</sup> Of these, the rate of omission for regularly used medications was 46.4%.<sup>1</sup> A study conducted at the University Health Network in Toronto found similar rates, with 41.3% of patients admitted to the general internal medicine service having at least one unintentional medication discrepancy at discharge.<sup>3</sup>

The majority of adverse events in hospitals are medication-related,<sup>4</sup> and patients presenting to the emergency department for an ADE are almost two times higher (\$325 CAD per patient) compared to those presenting for other reasons (\$96 CAD per patient).<sup>5</sup> ADEs cost the Canadian healthcare systems \$2.2-5.6 billion annually, with at least half being preventable.<sup>6</sup>

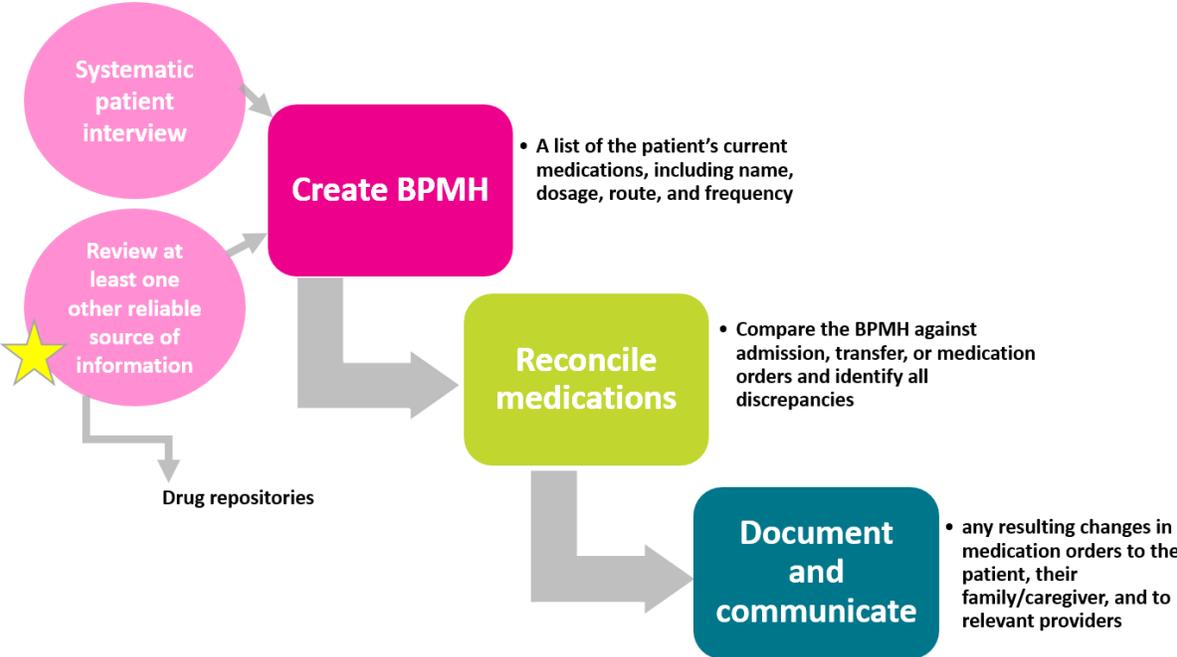
To ensure accurate medication lists in an effort to prevent ADEs, conducting a best possible medication history (BPMH) is recommended. This involves a formal process in which healthcare providers work together with patients, their families, and other providers to ensure accurate and comprehensive medication information.<sup>7</sup> Two systematic reviews including 27 primary studies demonstrate the positive impact of BPMH on reducing the frequency of medication discrepancies and consequent ADE-related hospital visits (Figure 1).<sup>8,9</sup>

Conducting a BPMH can be cumbersome and challenging, especially for complex patients on multiple medications as it requires information be obtained through numerous sources.<sup>10</sup> The development of electronic systems that document the transfer of medication histories and prescription information at intersections of healthcare have the potential to improve this process and provide seamless pharmaceutical care, which in turn would lead to positive downstream effects on patient outcomes while minimizing the costs of preventable ADEs.<sup>1</sup>

In 2016, the Ministry of Health (MOH) launched the Digital Health Drug Repository (DHDR) to facilitate the development of BPMH for healthcare providers. The DHDR is

available through the two provincial clinical viewers (*ConnectingOntario* and *ClinicalConnect*).

**Figure 1. Best Possible Medication History process**



## 2. CONTEXT

The Centre for Digital Health Evaluation (CDHE) at the Women's College Hospital Institute for Health System Solutions and Virtual Care (WIHV) was contracted by the MOH to conduct a third-party evaluation of the current iteration of the DHDR. The overarching purpose of this evaluation was to understand real-world adoption, utilization, and perceived clinical value of the DHDR, and to provide recommendations on how to improve adoption, prioritize future deployment, and inform implementation priorities.

### 2.1 Objectives

The objectives of this evaluation were to:

1. Understand for which user groups the DHDR has current or future potential clinical value and how that value is (or might be) realized;
2. Identify enablers of and barriers to adoption and meaningful use among users; and
3. Identify optimal indicators to monitor and evaluate the impact of the DHDR.

### 3. METHODOLOGY

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A mixed methods approach was utilized to gain insight into our objectives. An environmental scan was conducted to identify optimal indicators to evaluate drug repositories. Semi-structured interviews were conducted to understand the clinical value of the DHDR across healthcare settings. Lastly, an electronic survey was conducted to understand satisfaction with the DHDR and its impact on the development of a BPMH. Detailed methods and approach are outlined in [Appendix 1](#), and are described here briefly.

#### 3.1 Environmental Scan

A broad and rapid scoping review of the academic and grey literature was conducted for drug repositories in Canada, Sweden, Finland, Denmark, United States, Taiwan, and Australia. The environmental scan of Canadian drug information systems is available in our previous report (Digital Health Drug Repository Interim Report: Environmental Scan April 10<sup>th</sup>, 2019).

#### 3.2 Interviews

Semi-structured interviews were conducted with DHDR users and non-users to explore barriers and enablers to adoption and meaningful use ([Appendix 2, 3](#)). Purposive and snowball sampling strategies were used to capture a diverse group of healthcare providers across the healthcare spectrum. The interview explored the following concepts:

- Current methods for accessing the DHDR
- Features and functions of the technology
- Interest, need, and likelihood of use of data elements
- Barriers and enablers to adoption

- Potential impact on processes and health outcomes
- Potential use cases and fit into clinical practice or workflow

### 3.3 Online Survey

An online survey was conducted to understand how DHDR users and non-users across multiple healthcare settings utilize data within the repository and their understanding of its features and access requirements ([Appendix 4](#)). Non-users of the DHDR were individuals who are eligible for DHDR access but have not been issued secure credentials to access one of the provincial viewers. Non-eligible users and non-English speakers were excluded. The survey asked participants to evaluate:

- The usefulness of the DHDR data in making clinical decisions
- The quality of data contained in the DHDR
- Implementation and training for the DHDR
- Overall satisfaction
- Perceptions of efficiency

## 4. RESULTS

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### 4.1 Environmental Scan Findings: National and International Drug Repositories

Various drug repositories have been implemented and allow access to public and private insurance claims for dispensed medications, Drug Utilization Review (DUR) alerts and electronic prescribing information (e.g., EMRs or other point of care systems), depending on the province or territory. Alberta, Saskatchewan, Quebec, Prince Edward Island, and the Northwest Territories have the most functional repositories, which enable real-time documentation of prescribed and dispensed drug information from private and public insurance claims. Access to these centralized drug repositories varies across provinces, but Ontario, British Columbia, Quebec, Prince Edward Island, and Nova Scotia systems were the most inclusive with pharmacists and hospitals having access. See [Appendix 5](#) for details on each provincial/territorial drug repository, and [Appendix 6](#) for a summary of evaluation studies for each provincial system.

In Australia, three drug repositories were identified, *Medicine Information View*, *Medview*, and *SafeScript*. *Medview* and other such repositories are mandatory in parts of Australia to regulate, manage, and monitor narcotics prescribing. The first two repositories contain information on prescribed and dispensed data, and allow patients to access their medication information via a mobile application. The latter repository functions as a monitoring program for prescribed and dispensed controlled substances, and alerts healthcare providers to excessive doses or multiple visits to other providers. No evidence was found on the impact or effectiveness of these drug repositories ([Appendix 7](#)).

The *Shared Medication Record (SMR)* in Denmark is embedded within a patient's electronic health record (EHR). The EHR is available to all healthcare providers in the country and patients can access via dedicated portals. Observational studies suggest that the *SMR* is perceived by healthcare providers as a useful resource for BPMH and integrates well into current workflow practices.<sup>11,12</sup> Other research shows the repository is often incomplete with multiple medication discrepancies such as drug omissions or incorrect dose, of which 46% were deemed clinically significant ([Appendix 7](#)).<sup>13</sup>

In Sweden, the *National Prescription Drug Record*, was identified as the primary drug repository. It contains dispensed medication data that is accessible to pharmacists and healthcare providers. Patients can access their medication history through a dedicated portal. Several studies suggest that the repository contains multiple discrepancies such as inactive or discontinued drugs, duplicate, or missing prescriptions compared to other sources such as an EHR, and as such it is not deemed as a reliable source by healthcare providers ([Appendix 7](#)).<sup>14,15</sup>

The primary drug repository in the Netherlands is the *National Medication Record System (NMRS)* and captures dispensed medications from all pharmacies nationwide. It is accessible to pharmacists and healthcare providers who have received patient consent. A prospective study revealed only 17% of patients captured in the *NMRS* had a complete BPMH, with most discrepancies being over the counter medicines, discontinued therapies, or incorrect dosing schemes ([Appendix 7](#)).<sup>16</sup>

Lastly, *PharmaCloud* is the national primary drug repository in Taiwan. This repository was established by the National Health Insurance Administration, and gives all

authorized healthcare providers (i.e., nurses, pharmacists, physicians, and other authorized staff within their organization) access to patient medication records. Similar to other drug repositories, *PharmaCloud* was found to be incomplete and users rated their satisfaction as low-moderate.<sup>17</sup> However, another study showed that pharmacists were early adopters and self-efficacy and perceived usefulness were moderating factors to their adoption.<sup>18</sup> Since its implementation, an economic study suggests that Taiwan has saved \$100-250 million USD due to fewer medication duplications ([Appendix 7](#)).<sup>19</sup>

#### 4.1.1 Environmental Scan Summary

Overall, the environmental scan provided information on national and international drug repositories, such as what data elements were captured by these systems, and accessibility among healthcare providers. While there were relatively few evaluation studies on the impact of the repositories on clinical care or value for money, several studies showed reduction in inappropriate prescriptions, reduced ADEs (due to alerts), and improved medication adherence due to the drug.<sup>20,21</sup> A common problem was the completeness of the drug repositories, many of which contained medication omissions and discrepancies. Canadian drug repository evaluation studies found a large number of patient profiles had at least one discrepancy (range 84.3% to 10%), suggesting the repositories are often inaccurate and vary between different provincial repositories.<sup>10,22-24</sup> In the international drug repositories, medication discrepancies ranged from 46.6% to 17%.<sup>13,16</sup> Discrepancies were due to medication omissions, duplications, and over the counter medications. A drug repository, which contains valid and reliable information, will likely be more useful to healthcare providers. One approach is to look at the comprehensiveness of the data contained in the repository and compare it against patient health records and patient reported medication use. While none of the repositories identified were optimal, several features and attributes were identified that could be used to enhance the DHDR in Ontario. The table below outlines the features and attributes of the identified drug repositories (Table 1).



**Table 1. Features and attributes of drug repositories**

<b>Inclusive</b>	<ul style="list-style-type: none"><li>• Capture medication information for all residents</li><li>• Patient access to medication histories via dedicated portal/ or mobile applications</li><li>• Accessible to all healthcare providers with a clinical use case to access medication information</li></ul>
<b>Functional</b>	<ul style="list-style-type: none"><li>• Integration of the drug repository to the provider’s EMR, or other point of care system</li><li>• Capture prescribed and dispensed medication information</li><li>• Track medication compliance</li><li>• Drug decision support tools (e.g., DUR)</li><li>• Quick upload and download speeds</li></ul>
<b>Adaptable</b>	<ul style="list-style-type: none"><li>• Ability to input allergies, intolerances, or clinical conditions</li><li>• Ability to input over the counter medications</li></ul>
<b>Accurate</b>	<ul style="list-style-type: none"><li>• Ensure accuracy of the medication information contained in the repository</li><li>• Validation of repository to understand its completeness by comparing multiple sources for BPMH on:<ul style="list-style-type: none"><li>○ Documentation of number of medication omissions</li><li>○ Documentation of the number of inappropriate prescriptions (whether dispensed or not)</li><li>○ Documentation of the number of medication discrepancies (i.e., over the counter)</li></ul></li><li>• Examination of healthcare system outcomes<ul style="list-style-type: none"><li>○ ADE-related hospitalizations</li><li>○ ADE-related ED visits</li></ul></li><li>• Examination of process outcomes</li></ul>

**Abbreviations:** ADE adverse drug events, BMPH best possible medication history, ED emergency department events, DUR drug utilization review

## 4.2 Interviews

Thirty-three healthcare providers were interviewed between May 13th, 2019 and August 1st, 2019 (Table 2). The average length of the interviews was 25 minutes (range 7-53 minutes). Multiple themes emerged from the qualitative analysis aligning with the domains of the CDHE Framework (Table 3).

**Table 2. Demographic characteristics of healthcare providers interviewed (n=33)**

Demographics		% Participants (n)
<b>Gender</b>		
	Female	60.6% (20)
	Male	39.4% (13)
<b>Age</b>		
	18-34	21.2% (7)
	35-49	36.4% (12)
	50-64	39.4% (13)
	NR	3.0% (1)
<b>Setting</b>		
	Urban	69.7% (23)
	Rural	18.2% (6)
	Both	12.1% (4)
<b>Healthcare setting</b>		
<b>Acute Care</b>		46.7% (15)
	General Medical Unit	20.0% (6)
	Specialist Medical Unit	13.3% (4)
	Emergency Department	6.7% (2)
	Other	10.0% (3)
<b>Primary Care</b>		16.7% (5)
<b>Long-Term Care</b>		3.3% (1)
<b>Community Care</b>		33.3% (10)
<b>Other</b>		6.7% (2)
<b>Healthcare profession</b>		
<b>Pharmacist</b>		45.5% (15)
<b>Physician</b>		39.4% (13)
<b>Other</b>		15.1% (5)
<b>Health record utilization</b>		
<b>Hospital information system</b>		20.0% (6)
<b>OntarioMD approved EMR</b>		23.3% (7)
<b>CHRIS</b>		3.3% (1)
<b>Paper records</b>		3.3% (1)
<b>Other*</b>		60.0% (18)
<b>Provincial Viewer</b>		
	Clinical Connect	39.4% (13)
	Connecting Ontario	39.4% (13)
	None	21.2% (7)
<b>DHDR utilization</b>		
<b>DHDR Access</b>		60.0% (18)
<b>Length of Access</b>		
	< 6 months	3.3% (1)
	6-12 months	6.7% (2)
	> 12 months	50.0% (15)
<b>Frequency of use</b>		
	< 4/month	40.0% (6)
	5-9/month	3.3% (1)
	10-14/month	10.0% (3)
	> 20/month	23.3% (7)
	NR	3.3% (1)

**Abbreviations:** CHRIS client health and related information system, EMR electronic medical record, NR not reported  
 \*Other resources used include Meditech, Soarin, Powerchart, EPIC, Accuro, Nexus, Nightingale on demand, pharmacy information systems such as Healthwatch, Kroll and Pharmaclick.

**Table 3. CDHE framework and key themes**

<b>CDHE Framework Domain</b>	<b>Key Themes</b>
<b>Technology</b>	<ul style="list-style-type: none"> <li>• Healthcare providers find DHDR satisfactory and intuitive.</li> <li>• Current data elements are valuable but overall repository is incomplete</li> <li>• Requested data elements include medication instructions, prescribed medications, and private insurance claims for dispensed medications</li> </ul>
<b>Feasibility</b>	<ul style="list-style-type: none"> <li>• Multiple resources used for BPMH</li> <li>• Onerous onboarding experience for community and long term healthcare providers (range: 77 days to 18 months)</li> </ul>
<b>Scale and Spread</b>	<ul style="list-style-type: none"> <li>• Awareness of DHDR and clinical value is a barrier to adoption</li> </ul>
<b>Impact</b>	<ul style="list-style-type: none"> <li>• Clinical use cases</li> <li>• Healthcare providers perceive DHDR reduces ADEs and related hospitalizations</li> </ul>

### 4.2.1 Technology

#### *User Experience*

For those with access to the DHDR, they utilized the repository a few times a month and were generally satisfied with the current data elements. Participants found the DHDR easy to use, and adaptable to their clinical needs, such as filtering between medication histories for the last 3 months or the last year. Some participants found the DHDR was slow to load. Participants were asked about consent blocks; however, only one participant had experience with this and knew the process well. Others felt confident they would know what to do in such a situation, or would utilize other resources.

#### *Usefulness of current data elements*

Healthcare providers valued the basic medication information in the repository, including drug name, strength, dosage form, number of pills dispensed, date, and contact information of the prescriber and dispensing pharmacy. Some participants noted the NMS

within DHDR is useful for specific situations when inappropriate drug use is suspected. Specifically, one participant would use DHDR exclusively for this purpose. The value in having basic dispensed medication information was similarly noted by healthcare providers who do not have access to the DHDR.

### *Requested data elements*

All healthcare providers with access, noted that a limitation of the DHDR is that it does not capture all residents (i.e., only ODB patients are captured) or private insurance claims for dispensed medications, which restricts the clinical value of the DHDR in providing a complete and comprehensive understanding of a patient's medications history. Other notable information missing was the medication instructions, alternative medication names, drug discontinuations, and prescribed medications (which was understood as encompassing all prescriptions, whether dispensed or not). One provider understood, however, that having access to prescribed medication information would be unknowable without universal e-prescribing.

## **4.2.2 Feasibility**

### *Onboarding and Training*

Obtaining access to the provincial viewers, and thereby DHDR, was an issue for participants working in community or long-term care settings. Those who were working in acute care settings did not have an issue obtaining access and delays were relatively small (i.e., a few days to weeks). For those not working in acute care settings, the process to obtain access was relatively onerous and long. A few physicians in the community were familiar with the process to obtain access and contacted eHealth Ontario directly. The delay to access would vary, but participants expressed waiting approximately 77 days to 18 months to gain access. Delays often included going through the security and privacy assessments or waiting for someone to respond to their inquiries. The process to obtain access for a large hospital was the same as a small community practice or a local pharmacy, and participants were often frustrated at the process.

For a select few, they decided not to pursue access further given the time delays. Others were not aware of the process to obtain access and some primary care physicians and pharmacists were unclear if they were eligible for access as they worked in solo or independent practices and therefore did not pursue access.

Participants with access expressed that DHDR was intuitive and did not require formal training. Many stated there were online modules available and were confident that additional help would be available if they requested it. However, one participant suggested that one-on-one individualized training might improve the adoption of the DHDR by healthcare providers ([Appendix 8](#)).

### *BPMH and resources utilized*

Participants expressed that BPMH was not conducted for everyone and there were certain use cases where it was appropriate. The consensus was that BPMH was mostly conducted for geriatric patients or those with comorbid conditions. Other use cases included were recently discharged patients, new patients, and those who are taking opioids or benzodiazepines in community settings.

Participants used multiple methods when conducting a BPMH such as reviewing the patient health record, patient/family member interview, and confirming with at least one reliable source such as calling the pharmacists or family physician and depending on the healthcare setting, utilizing the drug profile viewer (DPV). None of the participants utilized DHDR as the first reliable source of medication information for BPMH and only utilized DHDR when it was not possible to call the pharmacy or family physician (i.e., after hours).

Healthcare providers with access to the DHDR are able to integrate DHDR into their clinical workflow; however, this is not a seamless process and may involve modifying their traditional workflow. Some participants had to log out of their usual point of care system in order to log in to the provincial viewer to access DHDR, which takes time. Others noted that when accessing DHDR via a provincial viewer, they work around the long loading times by opening up new tabs and consulted other resources (i.e., patient health records) while DHDR is loading. Healthcare providers ideally would like the DHDR to be faster and integrated with point of care systems, such as EMRs or HIS, to avoid

having to log out and then log in to another portal. Healthcare providers who did not have access to the DHDR echoed the desire for these features ([Appendix 8](#)).

### 4.2.3 Scale and Spread

#### *Barriers to the adoption of DHDR*

The process to obtain access to the provincial viewers was identified as a barrier. Healthcare providers who were not part of a larger institution did not have the resources such as a dedicated IT department or privacy officer to address the security and privacy assessments. Overhead costs and resources associated with provincial viewer access were a concern to community providers ([Appendix 8](#)). Moreover, healthcare providers working in multiple healthcare settings (i.e., acute and community), who had access to a provincial viewer through their hospital, can only do so through the institutional server and were unable to access the DHDR in their community clinics due to privacy constraints. While the majority of participants understand the importance of these privacy components, it is clear that many community healthcare providers are thinking about what is best for patient care. Opportunities for community healthcare providers to gain access to the DHDR should be streamlined.

To note, there was some conflicting feedback on whether primary care physicians see value in having access to the DHDR. Although most participants expressed that communication around what other healthcare providers are prescribing is important, some felt that primary care physicians already have an accurate list of what medications their patients are on as they are most likely the prescriber and would not use DHDR often to have clinical value. Furthermore, participants found there to be little value for patients already in their care, and would only access the DHDR to conduct a BPMH for new patients or those who have been recently discharged from hospital settings. As such, they would not access the DHDR often and would prefer to call the pharmacist or other healthcare provider if they needed medication history information. Another primary care physician stated the DHDR did not hold much value unless the patient stated they were using a narcotic or controlled substance and requested a refill ([Appendix 8](#)). The primary care

physician would then review the information in the DHDR to inform potential narcotic prescribing.

### *Lack of awareness and access to DHDR*

Non-users of DHDR were unaware of how to gain access, while others, especially in community settings, highlighted the financial and administrative burden of gaining access to a provincial viewer. One participant mentioned that since they already had access to the DPV, pharmacy records, and information given by the patients themselves, they had no interest in adopting the DHDR. Many community pharmacists are unaware or lack knowledge of the benefits that access to DHDR enables and clinical information available in the provincial viewer ([Appendix 8](#)).

## **4.2.4 Impact**

### *Clinical Use Cases*

All providers agreed that having access to comprehensive patient medication information is valuable to clinical decision-making. Participant interviews highlighted several use cases where having access to DHDR was beneficial.

- Crucial in geriatric medicine as BPMH is conducted on all patients and access to DHDR has a significant impact on geriatric consultations.
- Valuable in ED at night, when calling a pharmacist or family physician is not feasible and the patient is unclear in what they are taking
- Valuable during surgical consultations in the hospital, as identifying anticoagulants may prevent drug interactions, ADE or narcotic prescribing
- Useful in primary care to inform antibiotic or narcotic prescribing for new patients or those requesting medications.
- Useful for community pharmacists when conducting medication reviews for high risk patients

### *Perceived benefits of a centralized drug repository*

Healthcare providers endorsed the need for a centralized drug repository. One participant expressed that the number of drug problems (i.e. issues with medications such as potential drug interactions, ADEs, or duplicate prescribing) increased significantly after gaining access to dispensed medications in the DHDR. Some participants expressed that not having access to this information generates unnecessary cost to the healthcare system due to duplicate prescribing and risk of ADE. Participants see the value of DHDR as a starting point when no other reliable sources of information are available, such as when the patient is unaware of what medications they are taking or it's after hours and calling a pharmacist or physician is not feasible.

#### **4.2.5 Summary of Interviews**

Overall, the interviews suggest that the DHDR is used as an adjunct resource for developing BPMH. DHDR users value the following data elements in the repository: strength, dosage form, contact information of the prescriber and dispensing pharmacy. Participants stated medication instructions (i.e., sig) were missing from the repository, which delayed the development of BPMH. Other pertinent data missing included prescribed medications, private insurance claims for dispensed medications, and medication histories for all residents in Ontario.

In addition, gaining access to the DHDR via a provincial viewer in the community is an onerous process and was identified as a barrier to adoption. Community providers lacked knowledge on the benefits of DHDR and were unclear how to gain access. Some community participants questioned whether they were eligible for access, as they were not affiliated with a hospital and had their own independent practice. Participant interviews suggest that knowledge and awareness are key barriers to adoption and uptake of DHDR in the community. Overall, participants identified high clinical use cases where DHDR was valuable. In acute care settings, DHDR was valuable for geriatricians as they conduct BPMH on all patients they see, moreover; value was observed in the ED when confirming medication history is conducted after hours and during surgical consults. In community care settings, primary care physicians found DHDR valuable for new patients, those who

were recently discharged from hospital, and those requesting antibiotics or narcotics. Target areas for adoption are community pharmacists and healthcare providers in long-term care settings. One pharmacist, who owned a dispensary, had access and found DHDR invaluable to completing medication reviews in a timely manner. Healthcare providers in long-term care settings did not have access and often relied on other resources. A recent inquiry on the safety and security of long-term care residents highlighted the need to track medications more effectively to ensure resident safety.<sup>25</sup> As such, DHDR can be clinically beneficial in long-term care settings and should be a target area for future deployment. Our findings are consistent with a previous benefit & evaluation report from connecting South West Ontario, in which DHDR was found to save time and improve decision making.<sup>26</sup>

There were several suggestions for how to enhance the data captured in the DHDR from healthcare providers, summarized below in Table 4.

**Table 4. Recommendations stemming from qualitative interviews**

	<b>Recommendation</b>
<b>1</b>	Improve the layout of the tool (i.e. be able to sort drugs based on therapeutic class and name, make the print-out look similar to a pharmacy record) and speed
<b>2</b>	Add additional data elements: privately paid prescription medications, dosing regimen, alternative medication names, drug discontinuations, prescribed medications
<b>3</b>	Streamlined onboarding process for healthcare providers in the community and long-term care settings.
<b>4</b>	Integrate with point of care systems
<b>6</b>	Explore the ability to access the provincial viewer outside of the provider's affiliated institution (i.e. a private practice)
<b>7</b>	Create more opportunities for community healthcare providers to become aware of the DHDR and the clinical value of the repository

## 4.3 Online Survey

### 4.3.1 Overall Demographics

Overall, 167 participants completed the survey, of which 82% (n=137) were female. Healthcare providers were diverse and ranged from care coordinators to specialized physicians, with the primary respondents being pharmacists (27%, n=45) and registered

nurses (26%, n=44) (Table 5). The majority of participants were authorized users of ClinicalConnect (53%, n=88). Approximately 32% of participants (n=53) did not use either provincial viewer. Of the 167 participants only 24% (n=40) stated they were using DHDR. (Table 5)

**Table 5. Demographics of online survey respondents (n=167)**

Demographics		% Participants (n)
Gender	Female	82.0% (137)
	Male	18.0% (30)
Age (years)	18-34	31.7% (53)
	35-49	27.0% (45)
	40-64	40.1% (67)
	>65	0.6% (1)
	NR	0.6% (1)
Urban		72.0% (120)
Healthcare Setting	Acute care	58.0% (97)
	Community care	21.0% (35)
	Primary care	14.4% (24)
	Long-term care	1.2% (2)
	Other*	5.4% (9)
Profession	RN, NP, or RPN	31.1% (52)
	Pharmacist	26.9% (45)
	Physician	15.0% (25)
	Pharmacy technician	5.4% (9)
	Clerk	3.6% (6)
	Midwife	3.0% (5)
	Care coordinator	3.0% (5)
	Registered dietician	1.2% (2)
	Social worker	0.6% (1)
	Case manager	0.6% (1)
	Physiotherapist	0.6% (1)
	Other**	9.0% (15)
Provincial Viewer	ClinicalConnect	52.7% (88)
	ConnectingOntario	15.0% (25)
	Neither	31.7% (53)
	NR	0.6% (1)

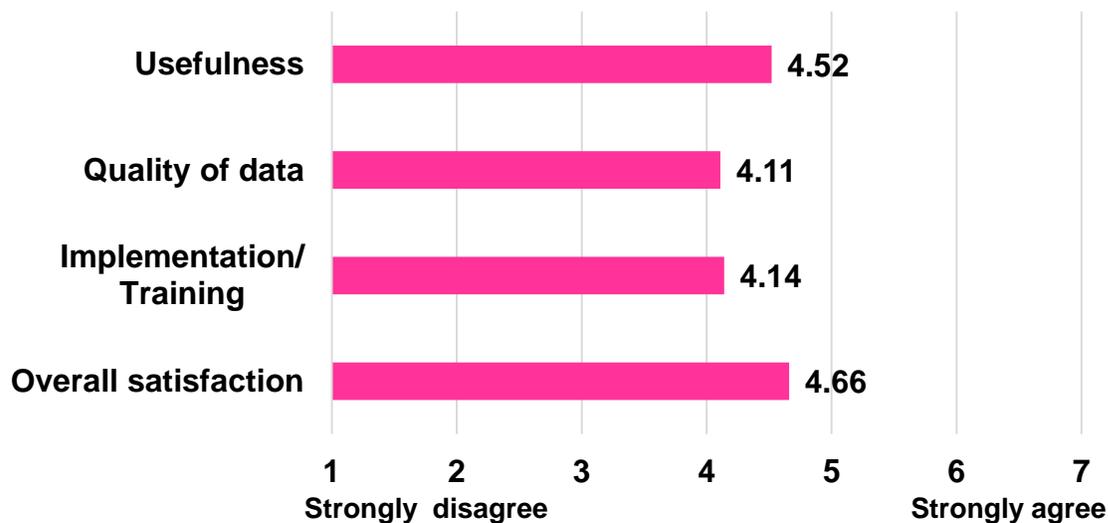
**Abbreviations:** NP nurse practitioner, NR not reported, RN registered nurse, RPN registered practical nurse. \*Other healthcare setting included: Mental health care, Laboratory services, and Midwifery. \*\*Other profession includes: laboratory technician, ultrasound technician, and clinical information specialist.

### 4.3.2 DHDR Users

Overall, 40 participants indicated they were using DHDR. Majority of users were female (73%, n=29), between the ages of 40-64 years (42%, n=17), and working in acute care (62%, n=25) in urban settings (68%, n=27). Users were often pharmacists in acute care settings or primary care physicians. Of the 40 participants who were using the DHDR, 70% (n=28) had been using DHDR for more than 12 months ([Appendix 9](#)).

Participants rated several key factors of the DHDR such as the usefulness of the data, the quality of the data contained in the DHDR, the implementation/training received regarding its use and their overall satisfaction with the DHDR. Across all categories, the average participant response trended towards neutral (neither agree nor disagree) with little variability (Figure 2). Specific response to each question per category are documented in [Appendix 10](#) and [11](#).

**Figure 2. Mean rating for DHDR key factors**



Participants rated their level of agreement on statements relating to the impact of DHDR. Overall responses were neutral with an average score of 4.4, standard deviation

(SD) 1.6. ([Appendix 12](#)) However, participants moderately agreed that having access to DHDR improved patient outcomes (4.76, SD 1.36).

### 4.3.3 Usefulness of Current Data Elements

Of the 14 data elements included in the survey ([Appendix 4](#)), nine had a rating greater than 4 suggesting that these data elements were important for development of BPMH. Specifically, the data elements that had the highest values were strength of dose (6.4, SD 0.82), generic name of the medication (6.07, SD 1.24), and the quantity of medication dispensed (5.97, SD 1.13). The data elements that held the least value among participants were therapeutic class (4.28, SD 1.92), therapeutic subclass (4.20, SD 1.92) and DIN (3.97, SD 1.83), suggesting that these are not useful data elements ([Appendix 13](#)). Information that participants would like to see include private insurance claims for dispensed medications, medications for all residents, medication instructions (i.e., sig), and discontinuations, to facilitate a comprehensive list of medications. Although not directly related to the usefulness of current data elements three participants commented on the print out from the DHDR and suggested the prescriber and pharmacy contact information should be added to the printed version along with the medication lists.

### 4.3.4 Value of the DHDR

Overall, all six questions relating to the value of the DHDR were rated moderately valuable with average scores ranging from (5.90 to 6.32) ([Appendix 14](#)).

### 4.3.5 Ranking Exercise

A ranking exercise was conducted to ascertain additions to the DHDR and which hold clinical value among participants. Including prescribed medications (which was understood as encompassing all prescriptions, whether dispensed or not) in the DHDR was ranked highest, followed by including privately paid medications, and addition of clinically relevant data. Increasing deployment of the DHDR to broader groups (in absence of any new enhancements) was ranked last (Table 7).

**Table 7. Ranked data elements for potential DHDR additions**

Rank	Prescribed medications (publicly paid)	Privately paid medications	Additional clinically relevant data elements	Increasing deployment of the DHDR to a broader user group
1 (most important)	19	10	2	7
2	12	16	10	2
3	6	5	18	8
4 (least important)	0	6	8	21

#### 4.3.6 Non-users of the DHDR

Overall, 127 participants indicated they were not using DHDR, 78% (n=99) had not heard of the DHDR and 87% (n=110) were not familiar with what DHDR was. Similar to DHDR user demographics, non-users were mainly female (85%, n=108), older aged (40-64 years, 39%, n=50), and worked in acute care in urban settings. ([Appendix 15](#))

Majority of non-users were nurses (31%, n=39) and pharmacists (23%, n=29), and frequently used hospital information systems (41%, n=52) or OntarioMD EMR (22%, n=28) as their primary source of patient information. Surprisingly, 61% (n=78) had access to a provincial viewer, of which 56% (n=71) were using *ClinicalConnect*.

For those with access to a provincial viewer, they were not using DHDR because there was limited information in the repository and not applicable to all residents. Some believed the records were incomplete and preferred to rely on pharmacy records, as they were deemed more accurate. Some participants prefer the resources they currently use, such as the DPV, *MediTech (or other EMR)*, *Telus Solutions*, *MedsTracker*, and patient reported medications to support BPMH. For those who did not have access to a provincial view, the reasons for not using DHDR included lack of availability or a cumbersome access process.

Of the 127 participants who were not using DHDR, 19% (n=24) participants stated they use DPV, and the reasons for this include: familiarity and ease of viewing;

availability in the workplace, loads quickly, and data is easily accessible. Of the 24 DPV users, 13% (n=16) participants stated they would like to see the medication instructions in the DPV and expand its repository to include non-ODB recipients.

Access to prescribed and dispensed medications, privately funded medications, and clinically relevant data were rated as moderately valuable ([Appendix 16](#) and [17](#)). Participants strongly agreed that having access to patient medication history would reduce ADE, or inappropriate prescribing, and improve patient outcomes (average scores 6.12 and 6.18 respectively, [Appendix 16](#) and [17](#)).

#### 4.4 Summary of Survey Data

Overall, 167 participants completed the online survey, with most being female and working in acute care settings. Only 24% of participants were using DHDR, which suggests participants prefer other resources to facilitate BPMH. Participants were not using DHDR, because they either did not have access or were in the process of gaining access. A large portion of non-users (61%, n=78) had access to DHDR via a provincial viewer. Reasons for not using DHDR included limited information (i.e., only ODP patients and not all residents), and preferring to use other resources such as DPV, EMRs, and other point of care systems. A few participants believed the DHDR to be incomplete and preferred to rely on pharmacy records as these were perceived as being more accurate.

Of the 24% (n=40) who used DHDR, overall they were satisfied with the repository. The key data elements they utilized were the strength of dose, quantity dispensed and the generic name of the medication. Similar to interview data, DHDR users expressed the need to include private insurance claims for dispensed medications, medication instructions and medication histories for all residents. Overall survey participants felt DHDR was valuable and contributed to improved patient outcomes.

## 5. IMPLICATIONS AND BEST PRACTICE RECOMMENDATIONS

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Overall, the evaluation study identified several areas to enhance the DHDR's adoption and clinical use.

### **1. Integration with point of care systems for improved provider workflow efficiency**

Integration of the DHDR into point of care systems, such as EMRs, HIS or PMS, will enhance healthcare provider decision-making ability, as they will have access to prescribe medications (whether dispensed or not) alongside other important clinical data (i.e., allergies, tolerances) in one place. This will facilitate the determination of a BPMH with fewer resources and minimal disruption to provider workflow while supporting appropriate prescribing decisions.

### **2. Inclusion of private and public insurance claims for dispensed medications**

The current DHDR contains public insurance claims for dispensed medications. Inclusion of private insurance claims for dispensed medications will provide a better understanding of medication histories to accurately inform BPMH. This will enhance the DHDR, not only for ODB recipients but also for all residents in Ontario, making it clinically valuable for healthcare providers.

### **3. Inclusion of medication instructions in the DHDR to reduce time spent facilitating BPMH**

Healthcare providers often spend time determining the medication instructions or regimen based on the quantity of medication dispensed and dosage form (i.e., current data elements in the DHDR). If medication instructions were provided as a data element, it would reduce the time to determine this information and efficiently facilitate BPMH.

### **4. Streamline the onboarding process for access to the DHDR via a provincial viewer**

Onboarding processes for access to DHDR via the provincial viewers is often a lengthy process ranging from 77 days to 18 months and is a key barrier to adoption and use among community providers. Communication with deployment partners and privacy and security assessments could be improved to reduce the long onboarding process.

Additional supports should also be made available to assist community providers meet security and privacy requirements.

#### **5. Promote broad adoption of DHDR through multiple channels to improve knowledge, awareness and adoption.**

A key barrier identified is the lack of knowledge and awareness among community providers. Community providers were not aware they were eligible for access to DHDR, and were not familiar with the process to obtain access. In addition, many were not clear on the benefits of DHDR. To increase knowledge and awareness of DHDR, information regarding the repository should be widely circulated among healthcare provider organizations such as the Ontario Medical Association, Ontario Pharmacists Association or the Registered Nursing Association of Ontario. Access to DHDR via a provincial viewer could be provided to all providers (i.e., clinicians, pharmacists, as an outcome of licensure to improve awareness and streamline access. Wide dissemination of DHDR benefits will improve adoption among community provider.

#### **6. Evaluate the validity of the DHDR to increase healthcare provider confidence in the repository**

The environmental scan indicated that most drug repositories are incomplete; as such, they often contain medication errors, or omissions. To increase confidence in the DHDR and assure quality, MOH should evaluate the completeness of records by comparing multiple sources of BPMH (i.e., patient interview vs pharmacy record vs DHDR record) and document the number of medication omissions, inappropriate prescribing, and documenting discrepancies to validate DHDR. The impact of DHDR on patient care can be assessed by examining relevant healthcare system outcomes such as ADE-related hospitalizations and ED visits. Knowledge that DHDR is accurate will increase uptake.

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[https://www.nhi.gov.tw/english/Content\\_List.aspx?n=02BA04454AED80E0&topn=BCB2B0D2433F6491](https://www.nhi.gov.tw/english/Content_List.aspx?n=02BA04454AED80E0&topn=BCB2B0D2433F6491). (Accessed: 8th August 2019)

## 7. Appendices

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### Appendix 1. Detailed Methodology

A mixed methods approach was utilized to gain insight into our research questions. Specifically, we aimed to conduct a cross-sectional survey to gain insights into the user groups for which the DHDR has clinical value. This information was supplemented with semi-structured interviews with users and non-users of DHDR to identify enablers and barriers to meaningful use. An environmental scan was conducted to identify optimal indicators or benchmarks to evaluate the impact of DHDR.

The CDHE framework was applied to interpret and synthesize the data, when possible. The CDHE framework considers the existing problem(s) the solution is attempting to solve from the perspective of all relevant stakeholders (i.e., providers, patients, institutions, and/or health system) with a focus on workflows and pain points. Survey data along with interviews and quantitative user data supplied by eHealth Ontario were triangulated to gain a deeper understanding of the impact of DHDR.

#### **Environmental Scan Methods**

An environmental scan was conducted to identify indicators used in the monitoring and evaluation of other drug repositories. Preliminary findings for Canadian drug repositories were reported in the CDHE's interim report to the MOHLTC. To further inform the evaluation, the scan was expanded to international drug repositories to understand their attributes and impact on patient or health care system-level outcomes.

A broad and rapid scoping review of the academic and grey was performed for drug repositories in Sweden, Finland, Denmark, the United States, Taiwan, and Australia, as these countries either had similarities in healthcare structures to Canada or had well-established centralized patient drug data systems. Targeted internet searches from Google scholar, and MEDLINE were included. Search terms consisted of keywords related to drug information systems (e.g., “drug information system”, “drug repository”, “centralized prescription network”, “electronic health record”) and evaluation studies (e.g., “benefits evaluation”, “evaluation report”, “outcomes evaluation”). Reference lists were also scanned for any additional articles not previously identified. Full- text articles were then assessed based on the following inclusion criteria:

- English-language full-text publications; and
- Focus on use cases, attributes or impact of drug repositories

## **Interviews**

Semi-structured interviews were conducted with authorized and non-authorized users of the DHDR to explore barriers and enablers to adoption and meaningful use.

## **Participants**

Participants across multiple healthcare settings, such as acute care, community care, and primary care were interviewed. A purposive sampling strategy was used in an effort to achieve a balance between urban and rural health care settings as well as healthcare provider type.

## **Recruitment**

Potential participants were identified by LRAs from eHealth Ontario or captured from the cross-sectional survey. We utilized a snowball sampling technique, whereby participants were asked to provide suggestions for colleagues whose experience would provide valuable insights for this work. As a secondary strategy, we reached out to participants in our network asking those who meet the general participant criteria if they self-identify as users or non-users of the DHDR. Twitter and LinkedIn posts were also made on the Women's College Hospital accounts to recruit participants for the interviews. Prior to the interviews, we asked demographic questions. The interview explored the following areas:

- Current methods for accessing the DHDR
- Features and functions of the technology that are critical for adoption
- Interest, need, and likelihood of use of data elements
- Barriers and enablers to adoption
- Potential impact on processes and health outcomes
- Potential use cases and fit into clinical practice or workflow

Questions were tailored by user type (authorized and non-authorized users). The interviews were audio recorded and transcribed.

## **Analysis**

Two coders independently coded the first three transcribed interviews, after which the two coders met to discuss coding and establish a codebook. One coder then applied the codebook to the remaining interviews. The second coder reviewed a random subsample of three additional interviews to ensure accuracy. These interviews were analyzed using qualitative description, a paradigm that seeks which create an understanding of a phenomenon through accessing the meanings participants ascribe to them. The research team identified key themes related to the implementation and evaluation of the DHDR in the context of health care delivery in Ontario. Qualitative description was used to identify themes and construct high value cases.

### **Cross-sectional Survey**

An online cross-sectional survey was conducted to understand how users and non-users across multiple healthcare settings utilize data within the DHDR and their understanding of its features and access requirements. The survey targeted authorized and non-authorized users of the DHDR. Non-authorized users are individuals who are eligible for DHDR access but have not yet been issued secure credentials for access to the DHDR. Non-eligible users and non-English speakers were excluded.

### **Participant recruitment**

A wide range of participants such as physician specialists, family physicians, pharmacists, nurses and admitting clerks/administrative personnel were targeted. Multiple strategies were employed to distribute the survey and increase participant recruitment:

- **Local Registration Authorities (LRAs):** LRAs are individuals nominated by their organization or sites to train authorized users on the clinical viewers (i.e., *ConnectingOntario*, *ClinicalConnect*). LRAs were approached from 24 targeted sites, representing a cross-section of authorized users across three healthcare settings (i.e., primary care, acute care and community care) in South West Ontario and North Eastern Region of Ontario. Using aggregate data obtained from eHealth Ontario we stratified the data based on type of healthcare setting and region and then randomly selected sites with  $\geq 20$  active users to ensure we were capturing high users of DHDR

- **DHDR Clinical Working Group:** This group comprises of healthcare providers who are actively engaged in digital health solutions at their respective organizations and helped identify authorized and non-authorized DHDR users in the Great Toronto Area.
- **Internal network:** We reached out to participants in our internal network at Women's College Hospital, asking those who meet the general participant criteria if they self-identify as users or non-users of the DHDR.
- **Social media:** Twitter and LinkedIn posts were made on the Women's College Hospital accounts to recruit potential participants

### Survey Distribution

The cross-sectional survey was created in REDCap, a secure web application for building and managing online surveys. Information regarding age, gender, provider type, and work setting were collected. The remainder of the survey focused on the following:

- Usefulness of the DHDR data in making clinical decisions
- The quality of data contained in the DHDR
- Implementation and training for the DHDR
- Overall satisfaction
- Perceptions of efficiency
- Usefulness of current data elements

### Analysis

Demographic questions were summarized using frequencies and descriptive statistics and were used to identify subgroups of interest for further analysis. Participant responses were aggregated and descriptively analyzed using means, and standard deviations (SD). Items rated on the 7-pt Likert scale using the anchors 'strongly disagree' to 'strongly agree' were collapsed into disagreement, neutral and agreement. We considered ratings from '1-3' as disagreement, '4' as neutral and ratings from '5-7' as agreement. Survey items rated on a 7-pt scale using anchors 'not at all important/valuable' to 'extremely important/valuable' were collapsed into similar categories such important (ratings  $\geq 5$ ) and not important ( $\leq 3$ ).

## Appendix 2. Demographic Questionnaire

1. I am:

- Male  Non-binary  
 Female

2. Please select your age category:

- 18-34 years old  50-64 years old  
 35-49 years old  ≥ 65 years old

3. Which area of health care setting do you primarily work in?

- Acute care  Long term care  
 Primary care  Other (please specify): \_\_\_\_\_  
 Community care \_\_\_\_\_

<<If **acute care** is selected>>

3.a. Please select the specific area in which you primarily work:

- Emergency department
- Intensive care unit  Surgical unit  
 General medical unit  Other (please specify): \_\_\_\_\_  
 Specialist medical unit \_\_\_\_\_  
(i.e. oncology, orthopedic, cardiology, geriatrics)

<<If **primary care** is selected>>

3.b. Please select the specific area in which you primarily work:

- Family Health Group  Other (please specify): \_\_\_\_\_  
 Solo practice \_\_\_\_\_  
 Family Health Network

<<If **community care** is selected>>

3.c. Please select the specific area in which you primarily work:

- Pharmacy  Other (please specify): \_\_\_\_\_  
 Mental health facility  
 Community health centre

<<If **long term care** is selected>>

*Allied Health Professional*

- Pharmacist  Physiotherapist  
 Midwife  Nutritionist/Dietician  
 Psychologist  Respiratory therapist  
 Social worker

*Support Personnel*

- Case Manager  Care Coordinator

*Administrative*

- Clerk

*Other Personnel*

- Other (please specify): \_\_\_\_\_

6. What patient record system do you use as your primary source of clinical information?

- Hospital information system  Paper records  
 Other (please specify): \_\_\_\_\_
- Ontario MD approved Primary Care Electronic Medical Records (EMR)  
 Client Health and Related Information System (CHRIS)

7. Which provincial viewer do you primarily use to access the DHDR (also referred to as the medications portlet, home meds or the pharmacy module in your clinical viewer)?

- ClinicalConnect  ConnectingOntario

8. How long have you had access to the DHDR?

- ≤ 3 months  
 3-6 months

3.d. Please select the specific area in which you primarily work:

- Nursing home
- Retirement home
- Assisted living facility
- Other (please specify): \_\_\_\_\_

4. How would you characterize the health care setting in which you work?

- Urban
- Rural
- Other (please specify): \_\_\_\_\_

5. Which of the following best represents your primary occupation (Please select one)

*Medicine*

- Specialist physician
- Emergency physician
- Primary care physician

*Nursing*

- Nurse practitioner
- Registered Nurse
- Registered Practical Nurse

6-12 months

$\geq 12$  months

9. On average, how many times do you access the DHDR in a month?

0-4 times

5-9 times

10-14 times

15-19 times

$\geq 20$  times

## Appendix 3. Interview Guide

1. Who are the patients that you would conduct a best possible medication history for?
  - a. Are there particular types of patients or particular health care settings?
2. How well are you able to determine a best possible medication history for your patients?
  - a. Can you give me an example of how this information factors into your clinical decision making?
3. What resources do you use when determining a best possible medication history for a patient?
  - a. Why do you prefer those resources?
  - b. Is there information you would like to have but can't access?
4. How valuable is having access to a patient's medication history versus other clinical information (probe for examples)?

### **IF THEY USE DHDR**

5. Are you aware of the DHDR? << questions 5-13 if they state YES to this question>>
  - a. Which viewer do you use?
  - b. How did you gain access to the DHDR? Can you describe your onboarding experience/training?
  - c. Can you describe the consent process in DHDR?
    - i. What do you do when a participant has placed a block on their medication history?
  - d. How satisfied are you with this process? Can you describe any delays/challenges/frustrations you experience when it comes to accessing the DHDR?
6. What information do you value in the DHDR?
7. What information do you use in DHDR to make a best possible medication history?
  - a. What additional information would you like to see in DHDR to help inform best possible medication history?
  - b. Are there any features you would like to see in the repository that don't currently exist?
8. Can you walk me through an example of how the DHDR fits (or doesn't fit) into your clinical workflow?
  - a. What settings would you use the DHDR (e.g., emerg, ambulatory clinic, OR ICU)?
  - b. Are there any differences between the different health care settings?
9. What are your perceived benefits of having access to dispensed drug information? OR can you describe a situation in which the DHDR had value for you?
  - a. Which settings do you think the DHDR would be most appropriate for? Who else could benefit from access to DHDR?
10. What are the current barriers to adoption of the DHDR?
  - a. What should we do to get more people to use/be aware of the DHDR
11. To what extent does your ability to access the DHDR impact on the timeliness with which you can provide care? How?
12. How easy is it to construct your patient's medication history using the information provided in the DHDR?
  - a. Are there any data that are hard to interpret?
13. Are you aware of what medications are NOT listed in the DHDR?
  - a. How do you access that missing data specifically?

### **IF THEY DO NO USE DHDR**

14. Why do you choose not to use the DHDR?
  - a. Are there specific factors that make it difficult to use? (probe – navigating the platform, accessing the platform (login issues), slow to load, inaccurate information)
  - b. Are there intuitional barriers that may prevent you from using DHDR?
  - c. What resources do you use to develop a BPMH
15. Have you ever used the drug profile viewer?
  - a. How does the process differ for accessing DPV?

## Appendix 4. Online Survey

### Survey Questions

Please select the choice that reflects how you feel regarding your use of the DHDR. If any of the questions are not applicable, please leave blank.

#### <<Usefulness of DHDR>>

1. Constructing my patient's medication history using the information provided in the DHDR is difficult

Strongly disagree  Strongly agree  
1 2 3 4 5 6 7

2. Using the DHDR saves time when developing a best possible medication history

Strongly disagree  Strongly agree  
1 2 3 4 5 6 7

3. The DHDR contains the features/information that I need to conduct a best possible medication history

Strongly disagree  Strongly agree  
1 2 3 4 5 6 7

4. The DHDR fits well within my clinical routine/workflow

Strongly disagree  Strongly agree  
1 2 3 4 5 6 7

#### <<Quality of data in DHDR>>

5. The DHDR does not contains the right data to establish a patient's medication history

Strongly disagree  Strongly agree  
1 2 3 4 5 6 7

6. The DHDR helps identify potentially harmful drug interactions/reactions

Strongly disagree  Strongly agree  
1 2 3 4 5 6 7

7. The DHDR provides timely information on a patient's dispensed medication history

Strongly disagree  Strongly agree  
1 2 3 4 5 6 7

8. The DHDR shortens the medical and/or nursing assessment time

Strongly disagree  Strongly agree  
1 2 3 4 5 6 7

#### <<Implementation/Training>>

9. The process to obtain access to the DHDR was simple and straightforward

Strongly disagree  Strongly agree

1                      2                      3                      4                      5                      6                      7

10. I obtained access to the DHDR in a timely manner

Strongly disagree  Strongly agree  
1                      2                      3                      4                      5                      6                      7

11. The training and materials I received on the DHDR was sufficient and easy to understand

Strongly disagree  Strongly agree  
1                      2                      3                      4                      5                      6                      7

12. I often encounter technical issues when accessing the DHDR

Strongly disagree  Strongly agree  
1                      2                      3                      4                      5                      6                      7

<<Overall satisfaction>>

13. Access to the DHDR allows me to improve the quality of care I provide

Strongly disagree  Strongly agree  
1                      2                      3                      4                      5                      6                      7

14. The DHDR has enhanced my ability to coordinate continued care

Strongly disagree  Strongly agree  
1                      2                      3                      4                      5                      6                      7

15. The DHDR is confusing to use and navigate

Strongly disagree  Strongly agree  
1                      2                      3                      4                      5                      6                      7

16. Overall, I am satisfied with the DHDR

Strongly disagree  Strongly agree  
1                      2                      3                      4                      5                      6                      7

<<Perceptions>>

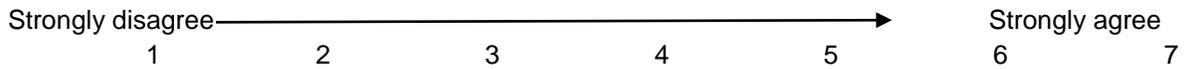
17. Do you feel that having access to DHDR reduced the need to reach out to other healthcare providers when making a clinical decision/ developing a best possible medication history?

Strongly disagree  Strongly agree  
1                      2                      3                      4                      5                      6                      7

18. Do you feel that having access to DHDR reduces adverse drug events or inappropriate prescribing?

Strongly disagree  Strongly agree  
1                      2                      3                      4                      5                      6                      7

19. Do you feel that having access to DHDR improves patient outcomes?

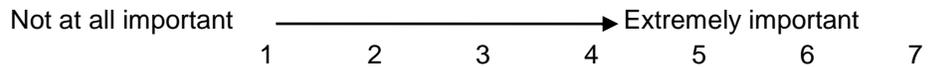


*Usefulness of current data elements*

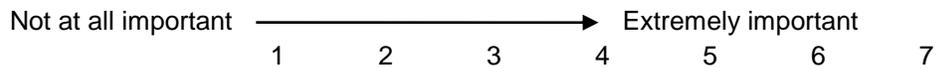
20. Please indicate how important the following items are when making a clinical decision/developing a best possible medication history.

Dispensing Information

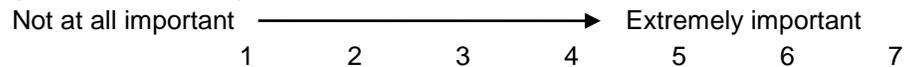
- Dispensed date (When the prescription was dispensed or the pharmacy service was rendered)



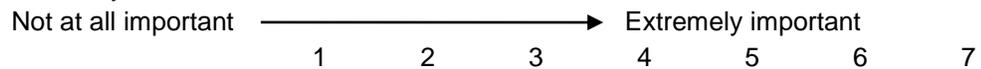
- Prescription count (The numerical count of the dispensed drug or pharmacy service events in each grouping)



- Quantity of medication dispensed

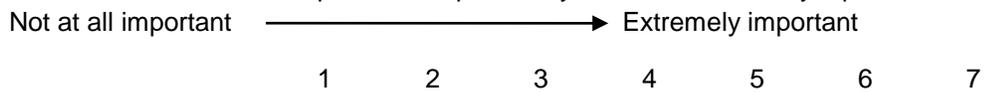


- Pharmacy contact information

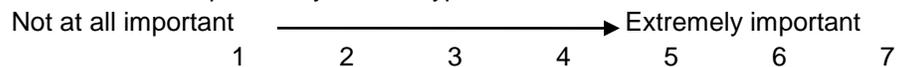


Drug Information

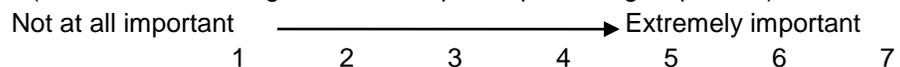
- Generic name (Non-proprietary name of the drug dispensed). For Pharmacy Services, this field will contain the description of the pharmacy service rendered by a pharmacist.



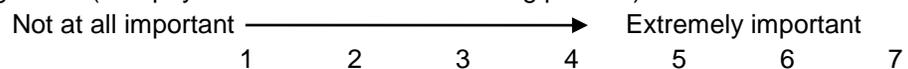
- Brand name (Trade name of the prescription drug dispensed). For Pharmacy Services, this field will contain the pharmacy service type.



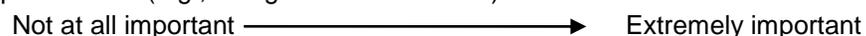
- Strength (Amount of active ingredient in the prescription drug dispensed)



- Dosage form (The physical form of a dose of a drug product)



- Therapeutic class (e.g., analgesics nonsteroidal)



1 2 3 4 5 6 7

- Therapeutic subclass (e.g. anti-inflammatory agent)

Not at all important —————> Extremely important  
1 2 3 4 5 6 7

Other Information

- Prescriber contact information

Not at all important —————> Extremely important  
1 2 3 4 5 6 7

- Estimated supply (Estimated number of days of treatment based on the directions for use on the prescription and/or the pharmacist's judgment on usage)

Not at all important —————> Extremely important  
1 2 3 4 5 6 7

- Drug Utilization Review (Historical Information on drug alerts that were generated and communicated to the dispenser when a drug claim was submitted for adjudication ("approval") or when a monitored drug dispense event record is submitted to the Narcotics Monitoring System, and include drug to drug interactions).

Not at all important —————> Extremely important

1 2 3 4 5 6 7

- DIN (drug information number assigned by Health Canada to a drug product marketed in Canada)

Not at all important —————> Extremely important

1 2 3 4 5 6 7

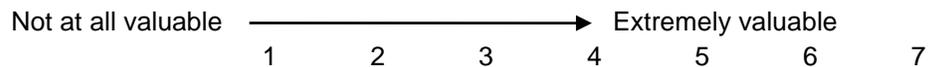
21. Are there other features or data elements that you think should be included in the repository? Please comment below.

<<value added>>

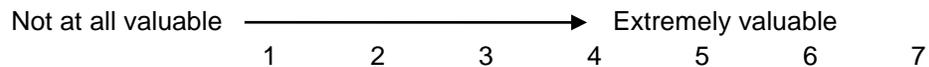
22. How valuable is it to have access to prescribed medications when making a clinical decision/developing a best possible medication history?

Not at all valuable —————> Extremely valuable  
1 2 3 4 5 6 7

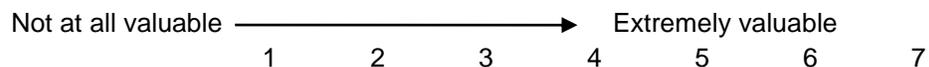
23. How valuable is it to have access to dispensed medications when making a clinical decision/ developing a best possible medication history?



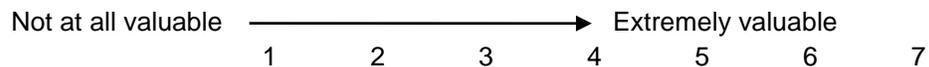
24. How valuable is it to have access to additional clinically relevant data elements (e.g. Route, Frequency, Dose Instructions, etc.) when making a clinical decision/ developing a best possible medication history?



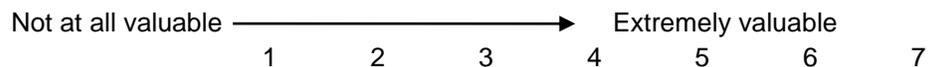
25. How valuable is it to access privately funded medications when making a clinical decision/developing a best possible medication history?



26. How valuable is it to have DHDR integration into your hospital information system or electronic medical record when making a clinical decision/developing a best possible medication history?



27. How valuable is it to have DHDR used more broadly to facilitate communication with healthcare providers?



28. For the greatest impact on patient care, please prioritize the following with (1) being the most important to (4) being the least important.

- a. Including prescribed medications (publicly paid medications) in the DHDR
- b. Including additional clinically relevant data elements in the DHDR
- c. Including privately paid medications in the DHDR
- d. Increasing deployment of the existing DHDR (in the absence of enhancements a, b, or c) to a broader user group

<<if NO to question 8>>

29. Have you heard of the Digital health drug repository (DHDR)?

- YES
- NO

30. Are you familiar with what the DHDR does?

- YES
- NO

<< if yes>>

31. What are the reasons for not using DHDR?

32. What resources do you use to make a best possible medication history?

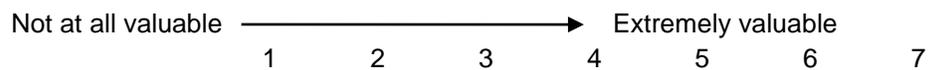
- YES
- NO

<<if YES, 3-4>>

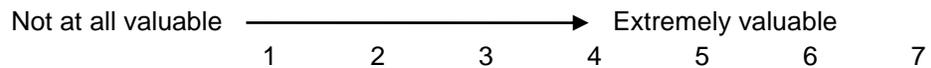
34. Why do you prefer the drug profile viewer

35. Is there information that you would like access to but currently do not have in DPV?

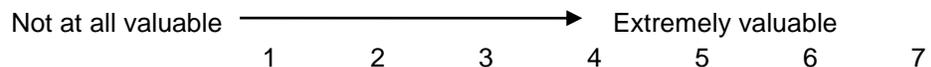
36. How valuable is it to have access to prescribed medications when making a clinical decision/ developing a best possible medication history?



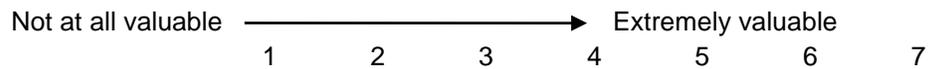
37. How valuable is it to have access to dispensed medications when making a clinical decision/ developing a best possible medication history?



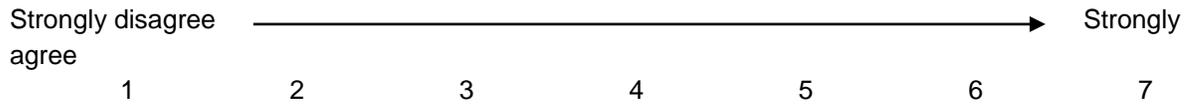
38. How valuable is it to have access to clinically relevant data elements around medications (e.g. Route, Frequency, Dose Instructions, etc.) when making a clinical decision/ developing a best possible medication history?



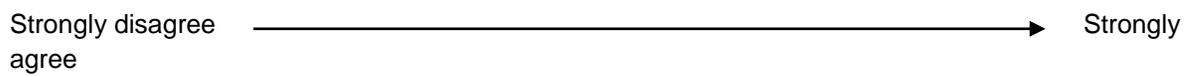
39. How valuable is it to access privately funded medications when making a clinical decision/developing a best possible medication history?



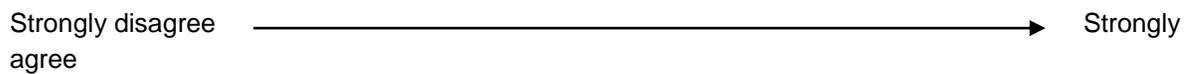
40. Do you feel that having access to a patient's medication history would reduced the need to reach out to other healthcare providers when making a clinical decision/ developing a best possible medication history?



41. Do you feel that having access to a patient's medication history would reduce adverse drug events or inappropriate prescribing?



42. Do you feel that having access to a patient's medication history would improve patient outcomes?



## Appendix 5. Characteristics of Canadian Drug Repositories by Province/Territory

Province (YR)	Name of Drug Repository	Information included	Information excluded
BC (1995) <sup>27</sup>	PharmaNet	<ul style="list-style-type: none"> <li>• Dispensed medications (drug name, quantity, dose, route)</li> <li>• Allergy and intolerance information</li> </ul>	<ul style="list-style-type: none"> <li>• Prescription drugs received in a hospital or mental health facility</li> <li>• Oncology/chemo drugs (BC cancer agency)</li> <li>• BC Centre for Excellence in HIV/AIDS</li> <li>• BC Transplant Society</li> <li>• BC Renal Agency (dialysis)</li> <li>• Drug samples</li> </ul>
AB (1999) <sup>28,29</sup>	Pharmaceutical Information Network	<ul style="list-style-type: none"> <li>• Prescribed and dispensed medications (drug name, quantity, dose, route)</li> <li>• Allergy and intolerance information</li> <li>• Historic senior's drug information from <i>Alberta Blue Cross Group 66</i></li> <li>• Pharmacy &amp; provider information from Alberta Health databases (Delivery Site Registry, Provincial Provider Registries, Alberta Health, Central Stakeholder Registry)</li> </ul>	<ul style="list-style-type: none"> <li>• Medication components of hospital discharge summaries</li> <li>• Institutional pharmacy information system data</li> <li>• Long-term care medication dispensing</li> </ul>
SK (2005) <sup>30,31</sup>	Pharmaceutical Information Program	<ul style="list-style-type: none"> <li>• Prescribed and dispensed medications (drug name, quantity, dose, route)</li> <li>• Allergy and intolerance information</li> </ul>	<ul style="list-style-type: none"> <li>• Oncology medications</li> <li>• Prescription drugs received while in a hospital</li> </ul>
MB (1994) <sup>32</sup>	Drug Program Information Network	<ul style="list-style-type: none"> <li>• Dispensed medications (drug name, quantity, dose)</li> <li>• Allergy and intolerance information</li> </ul>	<ul style="list-style-type: none"> <li>• Prescription indication</li> <li>• Hospital pharmacy services, nursing stations, ward stock, outpatient visits at CancerCare Manitoba</li> </ul>
ON (2016) <sup>33</sup>	Digital Health Drug Repository	<ul style="list-style-type: none"> <li>• Publicly funded drugs dispensed for ODB recipients (drug name, quantity, dose, form, days supply)</li> <li>• Pharmacy services paid for by the ministry</li> <li>• Monitored drugs dispensed</li> </ul>	<ul style="list-style-type: none"> <li>• Non-publicly funded drugs and professional pharmacy services</li> <li>• Over-the-counter drugs</li> <li>• Drug samples</li> <li>• Drugs dispensed to hospital in-patients</li> </ul>
QC (2013) <sup>34,35</sup>	Health Information Exchange	<ul style="list-style-type: none"> <li>• Prescribed and dispensed medications</li> <li>• Allergy and intolerance information</li> </ul>	<ul style="list-style-type: none"> <li>• Patients who are not registered with the Régie de l'assurance maladie du Québec</li> </ul>

NB (2016) <sup>36</sup>	New Brunswick Drug Information System	<ul style="list-style-type: none"> <li>• Dispensed medications (drug name, quantity, dose)</li> <li>• Allergy and intolerance information</li> </ul>	<ul style="list-style-type: none"> <li>• Over-the-counter drugs consumer</li> <li>• Drug samples</li> <li>• Drugs dispensed to hospital in-patients</li> </ul>
PEI (2008) <sup>37</sup>	Prince Edward Island Drug Information System	<ul style="list-style-type: none"> <li>• Dispensed medications (drug name, quantity, dose)</li> <li>• Allergy and intolerance information</li> </ul>	<ul style="list-style-type: none"> <li>• Over-the-counter drugs</li> <li>• Drug samples</li> <li>• Drugs dispensed to hospital in-patients</li> </ul>
NS (2013) <sup>38</sup>	Nova Scotia Drug Information System	<ul style="list-style-type: none"> <li>• Dispensed medications (drug name, quantity, dose)</li> <li>• Allergy and intolerance information</li> <li>• Immunizations</li> </ul>	<ul style="list-style-type: none"> <li>• Over-the-counter drugs</li> <li>• Prescription drugs received while in a hospital or in-patient setting</li> <li>• Medical supplies or devices</li> <li>• Prescriptions dispensed by Canadian Forces or correctional penitentiaries</li> </ul>
NL (2009) <sup>39</sup>	Newfoundland and Labrador Pharmacy Network	<ul style="list-style-type: none"> <li>• Dispensed medications (drug name, quantity, dose, route)</li> <li>• Allergy and intolerance information</li> </ul>	<ul style="list-style-type: none"> <li>• Over-the-counter drugs</li> <li>• Drug samples</li> <li>• Drugs dispensed to hospital in-patients</li> </ul>
YK (2016) <sup>40</sup>	Yukon Drug Information System	<ul style="list-style-type: none"> <li>• Dispensed medications (drug name, quantity, dose, route)</li> <li>• Allergy and intolerance information</li> </ul>	<ul style="list-style-type: none"> <li>• Over-the-counter drugs</li> <li>• Drug samples</li> <li>• Drugs dispensed to hospital in-patients</li> </ul>
NWT* (2016) <sup>41</sup>	Territorial Electronic Medical Record	<ul style="list-style-type: none"> <li>• Prescribed medications</li> <li>• Allergy and intolerance information</li> </ul>	<ul style="list-style-type: none"> <li>• Dispensed medications</li> </ul>
NU <sup>§42</sup>	NA	<ul style="list-style-type: none"> <li>• Dispensed medications from the pharmacy where the information is being accessed</li> </ul>	<ul style="list-style-type: none"> <li>• Dispensed medications from other Nunavut pharmacies</li> </ul>

**Abbreviations:** BC: British Columbia; AB: Alberta; SK: Saskatchewan; MB: Manitoba; ODB Ontario Drug Benefit; ON: Ontario; QC: Quebec; NB: New Brunswick; PEI: Prince Edward Island; NS: Nova Scotia; NL: Newfoundland and Labrador; YK: Yukon; NWT: Northwest Territories

\* NWT does not have a centralized DIS, but rather a territorial EMR. Medication profile is of prescribed drugs only.

§ NU does not yet have a centralized DIS. Drug information is available at individual pharmacies.

## Appendix 6. Evaluation Studies of Canadian Drug Repositories

Author (YR)	Study Design	Drug repository	Key Findings
Connecting South West Ontario Analysis and Research team <sup>43</sup>	Mixed-methods evaluation	Digital Health Drug Repository (DHDR)	<p><b>Study objective:</b> To document health care provider experiences within the first year of gaining access to the DHDR</p> <p><b>Study sample:</b> 263 responses for a training survey</p> <p><b>Outcomes:</b></p> <ul style="list-style-type: none"> <li>• Feedback on user satisfaction of the functionality and training offered for DHDR</li> <li>• Case study examples of how information accessed through DHDR impacted patient, provider, and health system</li> <li>• Perceived benefits and barriers of adoption</li> </ul> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>• Realized benefit of the DHDR when conducting pre-anesthesia evaluations for elderly patients</li> <li>• Importance of the DHDR for patient safety in an ED setting when community pharmacies are closed</li> <li>• Patients with complex medical needs (older age, multiple comorbidities, polypharmacy) have discrepancies between medications in the EMR and what they are actually taking</li> <li>• The DHDR improved the timeliness of care</li> </ul>
Fernandes et al. (2010) <sup>44</sup>	Prospective, dual-centre, randomized controlled trial with blinded in dependent observer assessments	Drug Profile Viewer (DPV)	<p><b>Study objective:</b> To determine whether the DPV system adds unique value to a structured BPMH and medication reconciliation process in a surgical pre-admission clinic</p> <p><b>Study sample:</b> 410 patients in a surgical pre-admission clinic</p> <p><b>Outcomes:</b></p> <ul style="list-style-type: none"> <li>• Number of surgical patients with at least one unintentional BPMH medication discrepancy at the time of pre-admission assessment</li> <li>• Mean overall time required to obtain a complete BPMH</li> <li>• Types of unintentional BPMG discrepancies</li> <li>• Number of surgical patients with at least one potential ADE</li> <li>• Number of patients with at least one unique discrepancy prevented upon obtaining a BPMH linked to the DPV system</li> </ul> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>• 28.3% of patients had at least one discrepancy in BPMH without using DPV, and 5.2% of patients who did have the DPV used</li> <li>• 0.43 BPMH discrepancies per patient with no DPV use, and 0.06 discrepancies with DPV use</li> <li>• 26.8% of patients had at least one unique discrepancy prevented with DPV</li> <li>• BPMH took less time for those who used the DPV</li> </ul>
Motuksly et al. (2015) <sup>10</sup>	Retrospective study	Quebec Health Information	<p><b>Study objective:</b> To determine usage and assess accuracy of medication lists obtained from the Quebec HIE.</p> <p><b>Study sample:</b> 31,022 HIE users and 111 emergency department patients</p>

		Exchange (HIE)	<p><b>Outcomes:</b></p> <ul style="list-style-type: none"> <li>Usage pattern by role</li> <li>Accuracy of HIE medication list compared to list obtained by medication reconciliation</li> </ul> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>31,022 users accessed HIE in 2015, mainly by pharmacists (83%) and GPs (74%), only 25% specialists</li> <li>44% of access by users in acute care, 32% primary care, 22% community pharmacy</li> <li>Very small number of users used it routinely, and vast majority are prospecting customers, therefore the system is usable/useful for some and diffusion is likely still ongoing</li> <li>38% of patients had medication discrepancies</li> <li>46% false positive, 43% false negative, some medication duplicates on HIE 32% of discrepancies for essential systemic medications</li> <li>Patient characteristics associated with discrepancies: mean age 76, 54% male, mean of 11 medications upon arrival, 4.2 discrepancies per patient</li> <li>Accuracy of medication lists using HIE is still a concern especially for high risk patients</li> </ul>
Price et al. (2012) <sup>22</sup>	Prospective, multi-center study	BC PharmaNet	<p><b>Study objective:</b> To determine the accuracy of BC PharmaNet compared to actual medication usage (BPMH)</p> <p><b>Study sample:</b> 1215 patient medication profiles</p> <p><b>Outcomes:</b></p> <ul style="list-style-type: none"> <li>Most common medication discrepancies found</li> <li>Which medications are most accurate and discrepant</li> <li>Rate of potentially significant discrepancies</li> </ul> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>84.3% of profiles contained at least one discrepancy, missing medications being most common</li> <li>Some of the most discrepant medications included warfarin and codeine, insulin, and salbutamol</li> <li>Cardiac medications tended to be more accurate</li> <li>Potentially significant adverse drug events in 48.2% of reviewed cases</li> <li>Discrepancies are expected for over-the-counter, hospital, and HIV medications</li> <li>PharmaNet should therefore be used in conjunction with other clinical information, judgment, and follow-up to prevent ADEs</li> </ul>
Dormuth et al. (2012) <sup>20</sup>	Retrospective study of prescription	BC PharmaNet	<p><b>Study objective:</b> Determine whether implementation of BC PharmaNet reduced the number of potentially inappropriate prescriptions for opioids and benzodiazepines in patients on social assistance and senior residents</p> <p><b>Study sample:</b> 86,704 patients on social assistance, 199,497 senior residents</p> <p><b>Outcomes:</b></p> <ul style="list-style-type: none"> <li>The proportion of filled prescriptions before and after the implementation of BC PharmaNet</li> </ul> <p><b>Results:</b> PATIENTS ON SOCIAL ASSISTANCE</p>

			<ul style="list-style-type: none"> <li>32.8% reduction in inappropriate fills for opioids and 48.6% reduction in inappropriate fills for benzodiazepines after 30 months of PharmaNet implementation</li> </ul> <p>SENIOR RESIDENTS</p> <ul style="list-style-type: none"> <li>40.1% reduction in inappropriate fills for opioids and 42.4% reduction for benzodiazepines 30 months after PharmaNet implementation</li> <li>The implementation of a centralized prescription network was associated with a dramatic reduction in inappropriate filled prescriptions for opioids and benzodiazepine</li> </ul>
Au et al. (2016) <sup>45</sup>	Single-center retrospective study	BC PharmaNet	<p><b>Study objective:</b> Compare rates of complete warfarin BPMH documentation before and after the implementation of medication reconciliation processes aided by BC PharmaNet</p> <p><b>Study sample:</b> 100 patients pre- and 100 patients post-implementation of medication reconciliation processes aided by BC PharmaNet</p> <p><b>Outcomes:</b> The rate of complete warfarin BPMH documentation during each period</p> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>Statistically significant increase in the rate of complete warfarin BPHM documentation after the medication reconciliation process was implemented (65% vs. 84%)</li> </ul>
Dahri et al. (2008) <sup>21</sup>	Prospective, longitudinal study	BC PharmaNet	<p><b>Study Objective:</b> Assess the accuracy of BC PharmaNet for adherence assessment in heart failure patients taking B-blockers</p> <p><b>Study sample:</b> 43 heart failure patients</p> <p><b>Outcomes:</b> The extent of agreement between BC PharmaNet dispensing records and a Medication Event Monitoring System (MEMS; gold standard) technology that monitors vial openings</p> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>Mean adherence to medications was 97.8% when assessed by PharmaNet and 97.1% when assessed by MEMS</li> <li>PharmaNet data accurately reflects medication adherence for most patients</li> </ul>
Gartner Consulting (2013)	BC eHealth Benefits Estimation using CHI Benefits Evaluation Framework	BC PharmaNet	<p><b>Study Objective:</b> To evaluate BC PharmaNet using the CHI Benefits Evaluation Framework</p> <p><b>Study sample:</b> N/A</p> <p><b>Outcomes:</b></p> <ul style="list-style-type: none"> <li>Number of drug interaction alerts</li> <li>Dollars saved in benefits to drug management, reduced adverse drug events (ADEs), and medication abuse</li> </ul> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>PharmaNet improves quality of care by alerting &gt;40M drug interactions that could lead to ADEs</li> <li>Estimated 200.3M in benefits through: improved drug cost management, reduced ADEs, reduced call-backs, reduced medication abuse, increased provider efficiency, and increased medication compliance</li> </ul>
Kent (2000) <sup>46</sup>	Commentary on evaluation results	BC PharmaNet	<p><b>Study Objective:</b> N/A</p> <p><b>Study sample:</b> N/A</p> <p><b>Outcomes:</b> N/A</p> <p><b>Results:</b></p>

			<ul style="list-style-type: none"> <li>• Most BC Physicians think the system us a useful treatment tool – 45% of respondents rated the program from 8-10/10</li> <li>• 20% of all drug profiles obtained through the service affected treatment decisions</li> <li>• Value propositions: Accurate compared to a patient’s memory, elimination of language barriers, time saved in retrieving drug information</li> </ul>
Kalb et al. (2009)	Prospective study	BC PharmaNet	<p><b>Study Objective:</b> To determine the accuracy of patient BPMHs using PharmaNet with physician admission orders</p> <p><b>Study sample:</b> 20 patients</p> <p><b>Outcomes:</b></p> <ul style="list-style-type: none"> <li>• Proportion of patients who had information in PharmaNet consistent with BPMH upon admission</li> <li>• Proportion of unintended medication discrepancies and ones that have the potential for moderate to severe harm</li> </ul> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>• 40% of patients had information in PharmaNet consistent with prescription medication list obtained during BPMH at admission</li> <li>• For remaining 60%, 30 unintended discrepancies identified, 43% of which were identified as having potential for moderate or severe harm</li> <li>• Unintended discrepancies are frequent despite use of PharmaNet’s database at the time of admission</li> <li>• Must educate practitioners about limitations in order to encourage more appropriate use of PharmaNet</li> <li>• Practitioners should also be educated about the importance of routinely collecting information for non-prescription products, as 25% of patients in this study had an admission order discrepancy associated with nonprescription med, 23% of which were potentially causing severe adverse outcome</li> </ul>
Dersch-Mills et al. (2011) <sup>47</sup>	Prospective study	Alberta Pharmaceutical Information Network (PIN)	<p><b>Study Objective:</b> To identify the most time-efficient sources of information about medication history for use by clinicians in a pediatric care setting</p> <p><b>Study sample:</b> 99 pediatric patients</p> <p><b>Outcomes:</b> The completeness score based on name, dose, and frequency for various sources of medication information: admission history, Alberta PIN, community pharmacy record, and interview</p> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>• Informed interview was the most comprehensive (100%), admission history 33%, community pharmacies 67%, prescription database 0%</li> <li>• The provincial prescription database was the least complete source for all subgroups of patients, limited by system downtimes and pharmacies that do not upload all prescription data</li> <li>• Prescription database cannot reflect verbally-discussed dose adjustments</li> <li>• Prescription databases will have limited benefit and carry the potential for harm if their use is not implemented on a widespread and consistent basis by all involved</li> </ul>

Tulloch & Evans (2009) <sup>24</sup>	Prospective study	Saskatchewan Pharmaceutical Information Program (PIP)	<p><b>Study Objective:</b> To determine the accuracy of a patient PIP compared to a BPMH</p> <p><b>Study sample:</b> 50 general medicine patients</p> <p><b>Outcomes:</b></p> <ul style="list-style-type: none"> <li>• Number of medication discrepancies</li> <li>• Type of medication discrepancies</li> </ul> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>• 78% of patients had one or more prescription discrepancies between the PIP profile and BPMH</li> <li>• Top 3 discrepancies were: medication incorrectly appeared as active, dosing discrepancy, or the medication did not appear at all</li> <li>• Common reasons for discrepancies were recent change in dose/medication</li> <li>• PIP should never be used as a substitute for communicating directly with the patient</li> </ul>
Kozyrsky and Mustard (1998) <sup>48</sup>	Retrospective study	Manitoba Drug Profile Information Network (DPIN)	<p><b>Study Objective:</b> To assess the completeness of the Manitoba DPIN to determine whether treaty status Indians and social assistance recipients are underrepresented</p> <p><b>Study sample:</b> 2196 Indian Affairs prescriptions and 1879 Social Services prescriptions</p> <p><b>Outcomes:</b> The proportion of accurate prescriptions compared to pharmacy records</p> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>• 79.7% and 90.1% DPIN accuracy for Indian Affairs and Social Services prescriptions, respectively, compared to original pharmacy records</li> <li>• DPIN may underrepresent prescriptions for aboriginals</li> </ul>
PEI Department of Health and Wellness (2010) <sup>37</sup>	Review of administrative data and online survey for current Drug Information System (DIS) users	PEI DIS	<p><b>Study Objective:</b> To evaluate the PEI DIS 24 months after implementation</p> <p><b>Study sample:</b> 44 survey respondents</p> <p><b>Outcomes:</b> Whether the PEI DIS is achieving stated objectives in relation to patient and stakeholder benefits</p> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>• Mixed satisfaction – 32% somewhat satisfied, 27% somewhat dissatisfied, 25% very dissatisfied, 14% neither, 2% don't know</li> <li>• Most did not think it improved productivity, but improves quality of care</li> <li>• Mixed feelings on whether it makes job easier, but does enhance ability to coordinate care and improve sharing of patient info among providers</li> <li>• Mixed feelings about acceptability and quality of information</li> <li>• Most are always using it, for 75-100% of their patients</li> </ul>
Newfoundland and Labrador Centre for Health Information (2014) <sup>49</sup>	Focus groups and interviews	Newfoundland Pharmacy Network	<p><b>Study Objective:</b> Examine the impact of the Newfoundland Pharmacy Network on prescription drug misuse</p> <p><b>Study sample:</b> 13 informants, including stakeholders such as pharmacists, addiction staff, emergency room staff, family physicians, and law enforcement</p> <p><b>Outcomes:</b> In-depth understanding of the impact of the Pharmacy Network on prescription drug misuse</p> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>• No change in amount of prescription drug misuse</li> </ul>

			<ul style="list-style-type: none"> <li>• Common sources of diversion (double doctoring, theft) have not decreased since implementation</li> <li>• Not all hospitals are connected to the network and the viewer is time consuming in emergency situations, so emergency room staff end up calling pharmacies anyway</li> <li>• Prescription Network cuts out time consuming step of pharmacists calling other pharmacists to see if a client has already filled a prescription at their pharmacy</li> <li>• Crime has not increased in the area</li> </ul>
Newfoundland and Labrador Centre for Health Information (2014) <sup>50</sup>	Focus groups and interviews	Newfoundland Pharmacy Network	<p><b>Study Objective:</b> Identify contributing success factors to implementation, perceived benefits, challenges, and lessons learned for the Newfoundland Pharmacy Network</p> <p><b>Study sample:</b> 51 informants, including internal stakeholders (executives, project management, operations, consultants) and external stakeholders (frontline users, government, vendors)</p> <p><b>Outcomes:</b> Benefits, facilitators, disadvantages, and barriers to implementation in community pharmacies</p> <p><b>Results:</b></p> <ul style="list-style-type: none"> <li>• As of 2014 not many pharmacists were connected to the network, so benefits not fully realized</li> <li>• Users are experiencing and believe in benefits of DIS, but uptake causes disappointment</li> <li>• Access has enabled better decision support</li> <li>• Challenges/barriers: system complexity issues, workflow, system support, training</li> <li>• Lack of a mandate to connect within a defined timeframe – largest obstacle</li> </ul>

**Appendix 7. Summary of International Drug Repositories**

<b>Country</b>	<b>Drug system</b>	<b>Evaluation studies</b>
<p><i>Australia</i></p>	<p><b>Medicines Information View</b> (within My Health Record EHR)</p> <ul style="list-style-type: none"> <li>• Contains prescription and dispensing records and patient-entered information<sup>51</sup></li> <li>• Data elements include: drug name, dose, formulation, directions, date dispensed, patient allergies, and adverse reactions<sup>52</sup></li> </ul>	<ul style="list-style-type: none"> <li>• No comprehensive evaluations have been performed for these repositories</li> </ul>
	<p><b>MedView</b></p> <ul style="list-style-type: none"> <li>• Cloud-based platform that contains prescription drug and dispensing information such as: drug name, prescription source and date, dose instructions, and hospital discharge reports</li> <li>• Patients can access their medication information via a mobile application and can scan QR codes on their prescriptions for filling<sup>53</sup></li> </ul>	
	<p><b>SafeScript</b></p> <ul style="list-style-type: none"> <li>• Prescription monitoring computer software system that transmits prescribing and dispensing records for controlled substances in real-time to a centralized database</li> <li>• Providers are notified when a patient has previously been prescribed a medicine, is</li> </ul>	

	taking excessive doses or risky combinations of medicines, or is visiting multiple providers <sup>51</sup>	
<i>Denmark</i>	<b>Personal Electronic Medication (PEM) database</b> <ul style="list-style-type: none"> <li>Established in 2004 by the Danish Medicines Agency</li> <li>Captures prescription medication information from the past 2 years<sup>54,55</sup></li> <li>Captures: drug name, dose, days' supply, expected refill date, prescriber information, pharmacy information, reimbursement method</li> <li>Providers can prescribe directly through this system</li> </ul>	<ul style="list-style-type: none"> <li>Karkov et al. (2010) demonstrated that the PEM is not completely accurate, with 46.14% of discrepancies being clinically significant and potentially fatal<sup>13</sup></li> <li>Showed limited value in measuring patient compliance in comparison to pill counts<sup>11</sup></li> </ul>
	<b>Shared Medication Record (SMR) database</b> <ul style="list-style-type: none"> <li>Established in 2010, accessible by all healthcare providers</li> <li>Embedded into the patient's EHR, which is also accessible by patients via a portal</li> <li>Fully implemented in 2 Danish regions<sup>56</sup></li> </ul>	<ul style="list-style-type: none"> <li>Integrates well into ER provider workflow, and is perceived by providers to be a useful resource for medication reconciliation<sup>12</sup></li> </ul>
<i>Sweden</i>	<b>National Prescription Drug Record (NPDR)</b> <ul style="list-style-type: none"> <li>Established in 2005 by the National Corporation of Swedish Pharmacies</li> <li>Repository of dispensed drug information accessible to pharmacists and physicians</li> <li>Pharmacists may modify information</li> <li>Patients can access their medication list through the portal, Journalen<sup>57</sup></li> <li>Captures: prescriber information, dispensing date and prescriber profession</li> </ul>	<ul style="list-style-type: none"> <li>A study by Ekedahl et al found that it contained discrepancies such as inactive, duplicate, or missing prescriptions compared to physician EMR records and patient-reported medication use<sup>14</sup></li> <li>Other studies suggested it is of limited value as an accurate source of medication information<sup>15</sup></li> </ul>

<i>Netherlands</i>	<b>The National Medication Record System (NMRS)</b> <ul style="list-style-type: none"> <li>Established in 2011</li> <li>Captures dispensed medications from all pharmacies nationwide</li> <li>Accessible by pharmacists and physicians who have received patient consent.</li> </ul>	<ul style="list-style-type: none"> <li>A prospective study revealed only 17% of patients captured in the NMRS had a complete BPMH, with most discrepancies being OTC medicines, discontinued therapies, or incorrect dosing schemes<sup>16</sup></li> <li>This study concluded that the NMRS should not function as a standalone information source for managing a patient's medications</li> </ul>
<i>United States</i>	<b>Veterans Affairs (VA)</b> <ul style="list-style-type: none"> <li>All VA patients are part of a centralized medical record, but adoption is dependent on the institution</li> <li>Contains a patient portal where patients can enter their own medications and supplements along with prescription and dispensing drug information</li> <li>Medication history captures: prescription name, dose, last refill, next refill, status (active, discontinued, expired), and prescriber facility</li> <li>Additionally, there are a number of de-centralized medication record systems and EHRs that are institution-specific</li> </ul>	<ul style="list-style-type: none"> <li>A cross-sectional observational study found that very few medication histories were accurate (5.3%) among 493 VA patients over the age of 65<sup>58</sup></li> <li>23.2% of allergy information and 63.9% of adverse drug reactions were not included in the record<sup>58</sup></li> </ul>
	<b>Medicare</b> <ul style="list-style-type: none"> <li>There is an incentive program in place for where providers will get compensated for adopting a certified EHR</li> <li>As of 2017, over 237,000 providers successfully registered for this program</li> <li>These EHRs can include: computerized prescription order entry, drug-drug and drug-</li> </ul>	<ul style="list-style-type: none"> <li>To the best of our knowledge, no comprehensive post-implementation evaluations have been performed for the medication viewer in EHRs to date.</li> </ul>

	allergy interaction checking software, a list of active medications <sup>59</sup>	
<i>Taiwan</i>	<p><b>PharmaCloud</b></p> <ul style="list-style-type: none"> <li>Established in 2013 by The National Health Insurance Administration<sup>60</sup></li> <li>Patient medication records are accessible to physicians, pharmacists, nurses, and other authorized staff members in all medical institutions contracted with the NHIA</li> <li>Captures: drug name, prescriber and date, diagnosis, drug ingredients, treatment dates, dosing instructions, quantity dispensed, and estimated remaining day supply</li> <li>Includes drug interaction software to further inform clinical decision-making</li> <li>The purpose of the system is to monitor for repeated prescriptions or reconstituted drugs, and to delete payments associated with these claims<sup>19</sup></li> </ul>	<ul style="list-style-type: none"> <li>Current estimates suggest health system savings of \$100-250M USD due to fewer medication duplications<sup>19</sup></li> <li>Liu and Lee (2018) explored factors affecting pharmacists' adoption of PharmaCloud, and found that self-efficacy and perceived usefulness were among the top factors<sup>18</sup></li> <li>Tseng et al. (2017) reported low-to-moderate satisfaction towards PharmaCloud due to incomplete and incorrect information and slow loading time<sup>17</sup></li> </ul>

## Appendix 8. Quotes from Qualitative Interviews

CDHE Domain	Quote
<b>TECHNOLOGY</b>	
Value of NMS Data	“Someone came and asking for opioids for dental pain and didn’t really mention that she had been on opioids before. And so I looked in the medication list and she’d actually been prescribed opioids from numerous different Emergency Departments, and so I called the pharmacy just to verify that she had all these medications and I didn’t prescribe any more...” – P16
The need for the sig/dosing regimen	“It’s particularly relevant for things like diuretics where like you may be dispensing a Lasix 20 milligram tablet, but the standard thing you’re telling the patient is ‘I want you to take 2 of these twice a day.’ So me as an Emergency Physician, I just see that they’re on Lasix 20 and if I’m going to renew their prescription or they’re saying what should I do tomorrow, I don’t know. If I don’t have what their active bottle is, actually I don’t if they’re taking 20 or 40 and I make the wrong assumptions and I refill their prescription for 20 once a day and really they’re taking 40 twice a day and that leads to real harm. We make big mistakes both ways about that so that’s very frustrating.” - P12
Other valuable components of the provincial viewer	“In the drug repository in and of itself there is not a significant amount of value... value for pharmacy is going in through, let’s use a Clinical Connect example, and having it access to the hospital that discharged that data for example... that kind of information that pharmacies don’t usually get is extremely helpful to us” – P21
Views on the lack of completeness of drug data	<p>“Some of the newer medications that are on the market are not covered by the ministry, and so... it gets missed. I’ve seen BPMHs created by nurses, that have missed those drugs, and then after, where digging through ... speaking to the community pharmacy, they come up, something that was dispensed. That has led to a delay in therapy being continued” – P27</p> <p>“Obviously it’s a gap but hopefully this could be like a piece and a step towards getting a more complete record at some point. Even knowing that it has a gap it’s still useful. It’s still less of a gap than I have without it.” – P24</p>
<b>FEASIBILITY</b>	
Impact of non-centralized data on provider workflow	“I think it adds to the workflow, it stops and you may have to go back to the patient or you have to go to these other resources, a community pharmacist or you have to go to the family doctor to get that information. Whereas if I had access directly I’m saving everybody else time too.” – P23

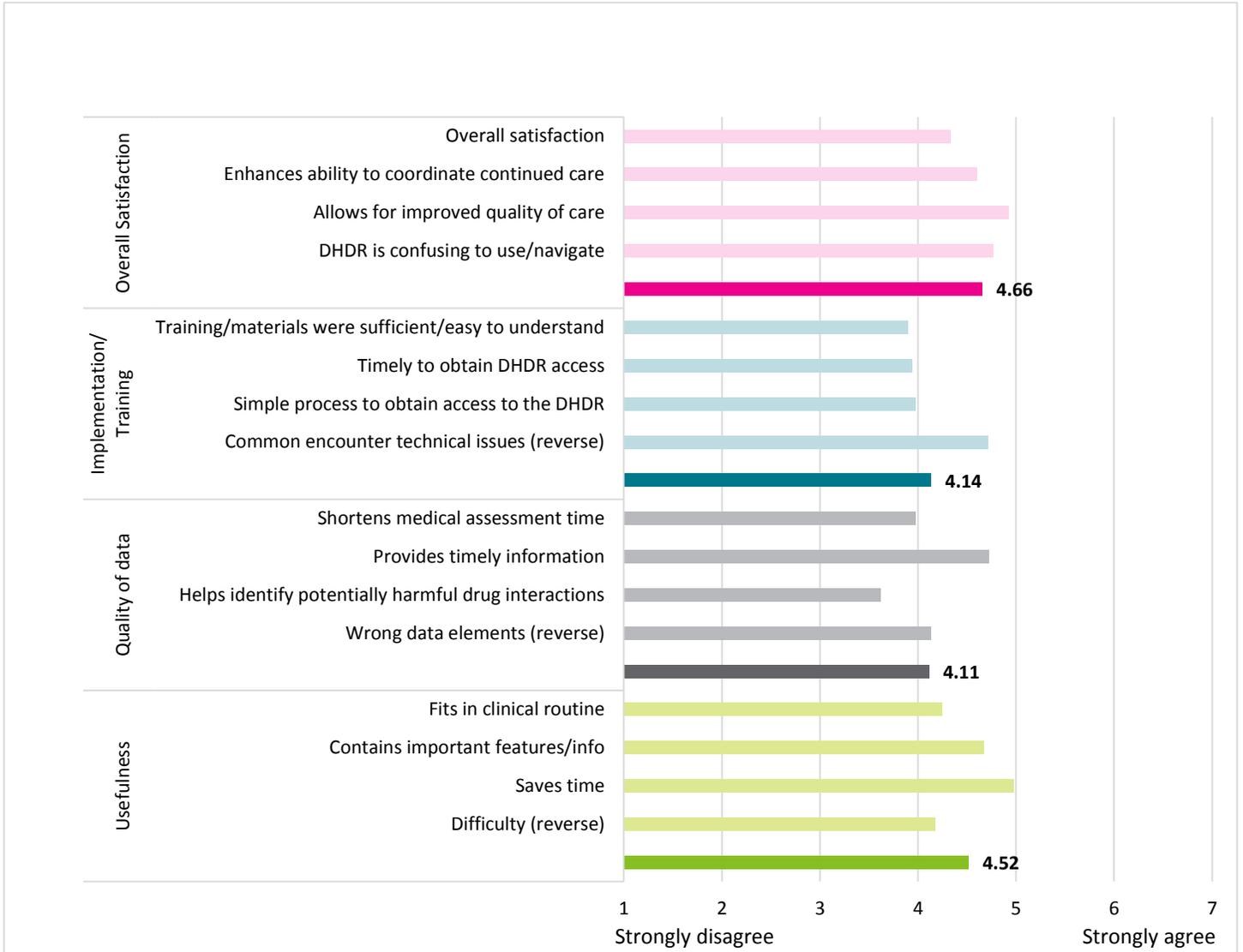
	“It would be nice if everything was included in there. That would be great if it could be added. But we are so used to asking that it doesn't become a really big problem.” – P23
Views on lack of EMR integration	“As you can imagine, somebody...is doing a consult, they're opening up their computer, they're looking through [their EMR]...But then, in order to get to ConnectingOntario you have to actually open up a different window...you actually have to come out of [the EMR] to load up another window, which takes you away from what you were doing before...That takes time. It takes time to load. So, I think you should...actually integrate it into an EMR system, so that the information can be accessed easily instead of through the ConnectingOntario interface.” – P5
Educating providers about the DHDR to increase adoption	“Training all the outpatient prescribers to do medication reconciliation and BPMHs, I have to go one on one to them, to give them training in person, and that's been the only way that they will engage in training. They don't want to do another module, they don't want to do all this...I think maybe sometimes even giving them access before they know exactly how to use it may be valuable, so that they could see the value, and then they'd do the training.” – P11
A suggestion for one-on-one training	“Just in my experience for training all the outpatient prescribers to do medication reconciliation and BPMHs, I have to go one on one to them, to give them training in person, and that's been the only way that they will engage in training. They don't want to do another module, they don't want to do all this. If they're asked to do a module, they just say they did it, and then start using it. I think it's time limiting and workload potentially, and I don't know, I think maybe sometimes even giving them access before they know exactly how to use it may be valuable, so that they could see the value, and then they'd do the training.” – P11
<b>SCALE &amp; SPREAD</b>	
Organizational barriers to adoption for some community pharmacists	“...the barrier to pharmacists accessing more information and doing more good things for people, means they do more stuff, more work. Which means that...it doesn't fit the business models people who want pharmacists doing less stuff and less work, and just churning products...that's the business that they're in, and that's the challenge of having the business part conflicting with what pharmacists can do and should do...But if you give somebody more tools to use, they're going to do a better job...it's going to take more time, and effort, and energy, and all this stuff, which is resources, which is money, which is creating a conflict.” – P8
Suggestion of having different onboarding procedures	“I think a standard protocol connection should be written. There is one for hospitals that works. There isn't one for pharmacy that would address the different ownership models. I think it would be, based on our experience, we could assist very quickly in writing that protocol to enable any pharmacy to connect. As it is today I think that protocol, whoever is at cSWO at the time interprets privacy differently and has different requirements. It's a very fluid discussion that we've been having so I think nailing down that process for

depending on the organization	<p>example with cSWO and then transporting it to the other two viewers, you could very quickly get community pharmacy connected across the board.” – P21</p> <p>“It’s very simple and then you have kind of a toolkit that says if you’re independent or an associate owner this is the path you follow, and if you’re a corporate owner this is the path you follow then it’s simple but it’s just been nailing that process that has been frustrating” – P21</p>
Improved communication is required between providers looking to gain access and eHealth Ontario	<p>“You basically go on the eHealth Ontario website and then you look at the link that talks about getting access for your clinic. Then you contact somebody and they usually will take their time to get back to you, but within maybe a month they’ll get back to you and they’ll put you on the waiting list and you’ll wait another month and then they’ll call you back to arrange a time. Kind of works like that. Then, they’ll come to your clinic to give you a little bit of orientation and then they’ll set it up.”- P5</p> <p>“Yeah, I mean, just don’t make it something I have to adopt, just put it in my workflow. And then, if I’m knocking on your door trying to adopt it, like answer me and don’t make it so difficult.” – P24</p>
The case for community pharmacy access	<p>“If the Ontario College of Pharmacists wants pharmacists to practice to their full scope in community then it needs to be available in community.” – P25</p>
<b>IMPACT</b>	
Clinical use case: Overdose	<p>“People will come in and say that they took a whole bunch of medications, like they overdosed. And it’s really helpful if you know, at the very least, the dose of what they take...It really makes a difference as far as toxicity levels and that can change your plan of care.” – P30</p>
Clinical use case: Out of town patients	<p>“I had a scenario where a woman came to town, she was visiting family, she forgot, she couldn’t remember the name of her atrial fib medication, she forgot it at home. She was only going to be there for a couple of days, her pharmacy was closed. Just no ability to help this poor woman who was experiencing an a-fib pretty much at the time she was in the store. Being able to look up on the DHDR what she was taking, and provide an emergency supply of that medication was ... that, to me, was one of the most valuable ... we literally prevented a stay in the hospital, doing that.” – P29</p>
Clinical use case: Emergency	<p>“It eliminates some of those patients who aren’t able to tell me what they’re on, aren’t able to tell me what pharmacy they go to, haven’t brought in any medications. It’s by far, for those situations, it’s unbelievably monumental. I honestly, working in Emerg on Sundays, I don’t know how I would get this information any other way. They would go without therapies for multiple days, more than likely. I think in those specific situations, I wouldn’t be able to do a BPMH without it.” – P11</p>

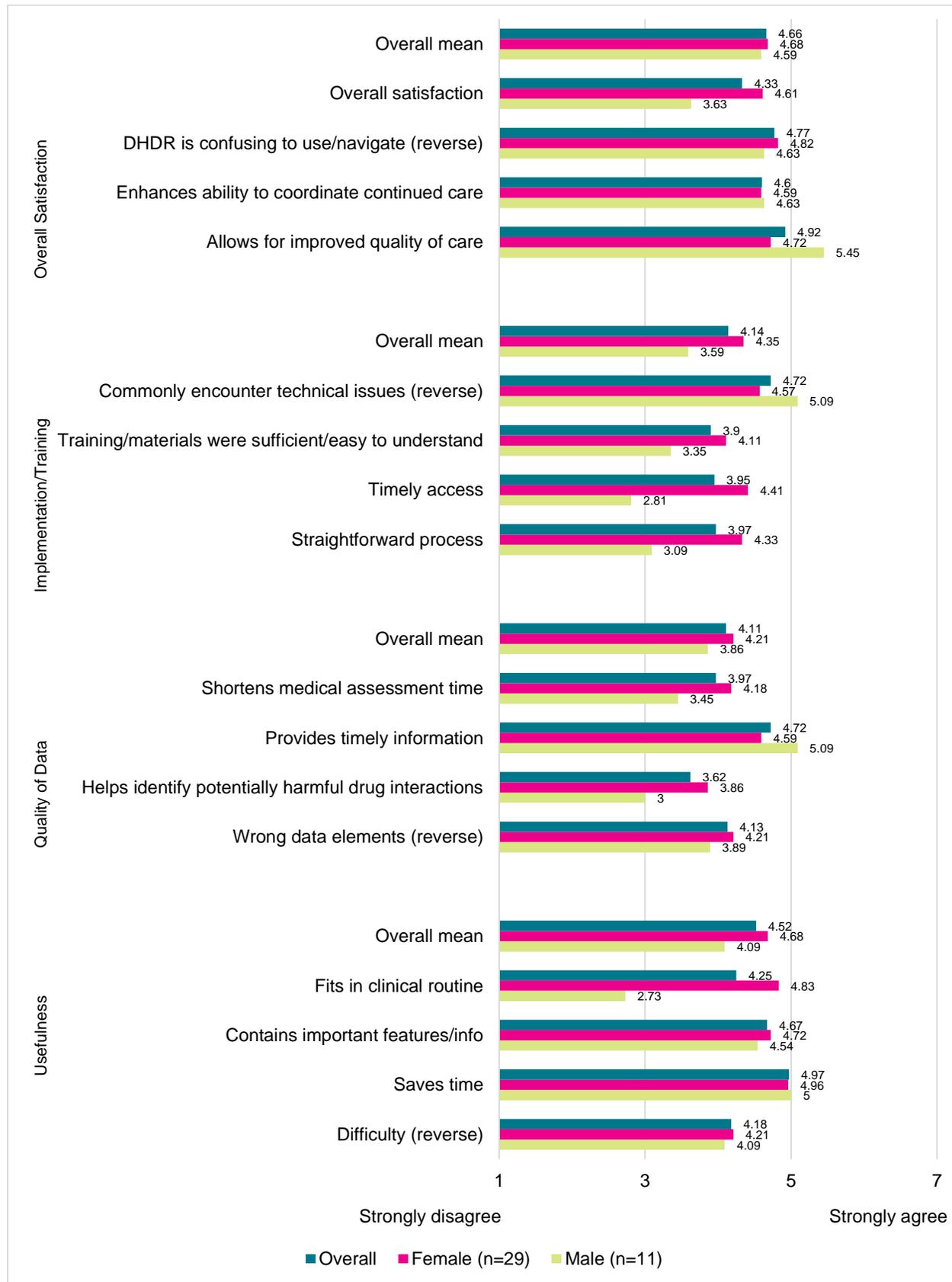
## Appendix 9. DHDR user demographics (N=40)

		% Participants (n)
		100% (40)
<b>Demographics</b>		
Female		72.5% (29)
Male		27.5% (11)
Age (years)		
	18-34	25.0% (10)
	35-49	30.0% (12)
	40-64	42.5% (17)
	NR	2.5% (1)
Urban		67.5% (27)
<b>Professional Characteristics</b>		
<b>Setting</b>		
	Acute Care	62.5% (25)
	Community Care	15.0% (6)
	Primary Care	20.0% (8)
	Other	2.5% (1)
<b>Profession</b>		
	Pharmacist	40.0% (16)
	Pharmacy Technician	5.0% (2)
	Primary Care Physician	15.0% (6)
	Specialist Physician	10.0% (4)
	Emergency Physician	5.0% (2)
	Nurse Practitioner	2.5% (1)
	Registered Nurse	12.5% (4)
	Care Coordinator	2.5% (1)
	Clerk	5.0% (2)
<b>Clinical Viewer</b>		
	ConnectingOntario	45.0% (18)
	ClinicalConnect	42.5% (17)
	Neither	12.5% (5)
<b>DHDR Characteristics</b>		
<b>Length of time with access</b>		
	<3 months	5.0% (2)
	3-6 months	17.5% (7)
	6-12 months	7.5% (3)
	>12 months	70.0% (28)
<b>Frequency of use</b>		
	0-4 times	97.5% (39)
	5-9 times	35.0% (14)
	10-14 times	22.5% (9)
	15-19 times	10.0% (4)
	>20 times	5.0% (2)
		25.0% (10)

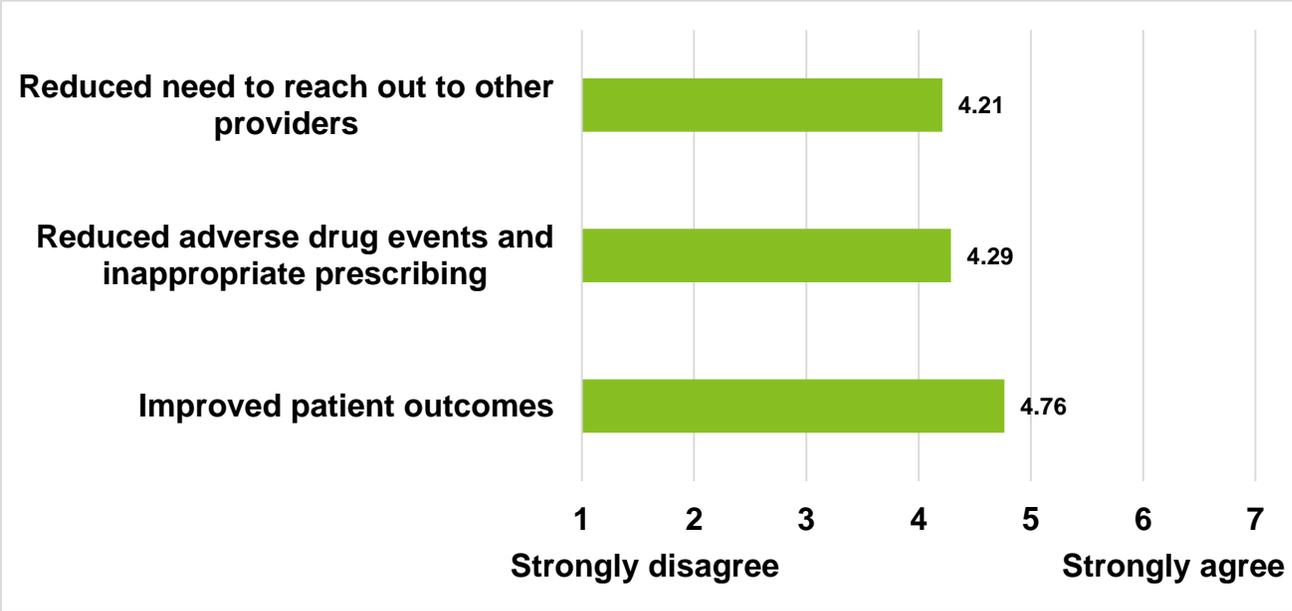
## Appendix 10. Mean rating scores for all DHDR users per section



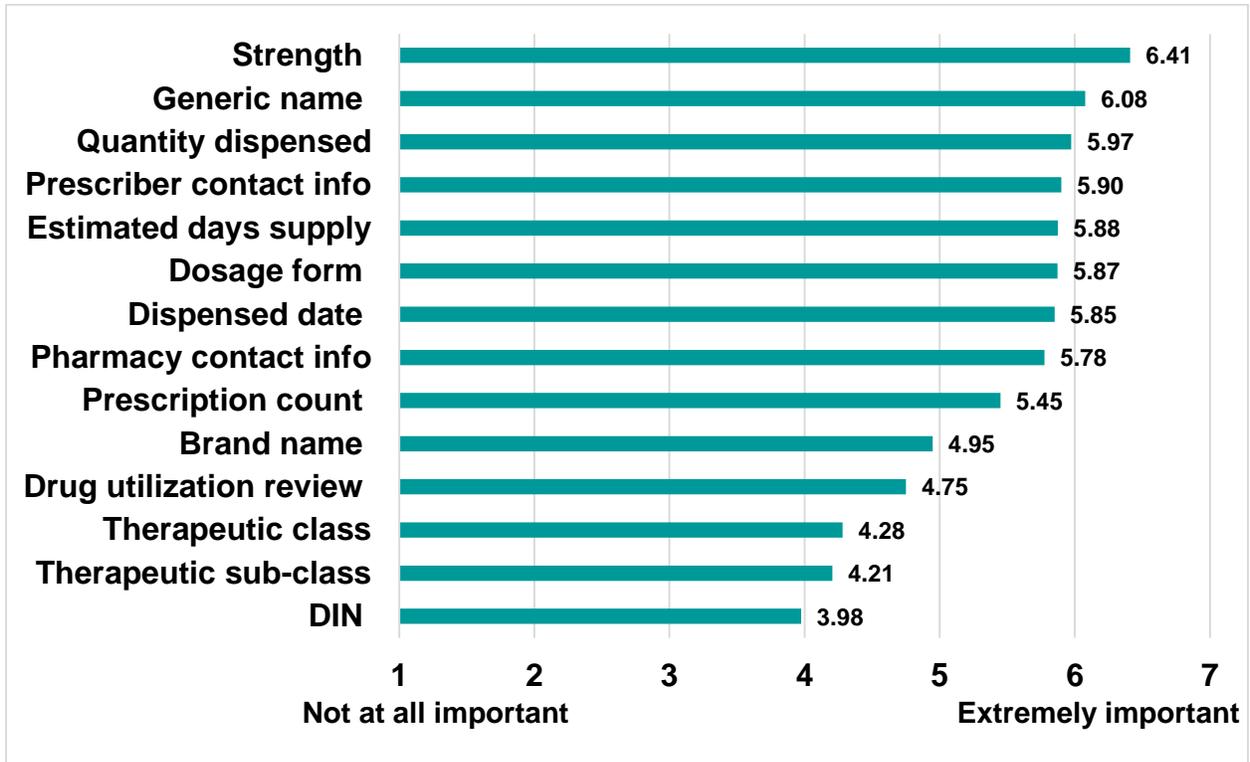
## Appendix 11. Mean rating scores for DHDR users by gender per section



**Appendix 12. Mean rating scores for perceptions of the DHDR**

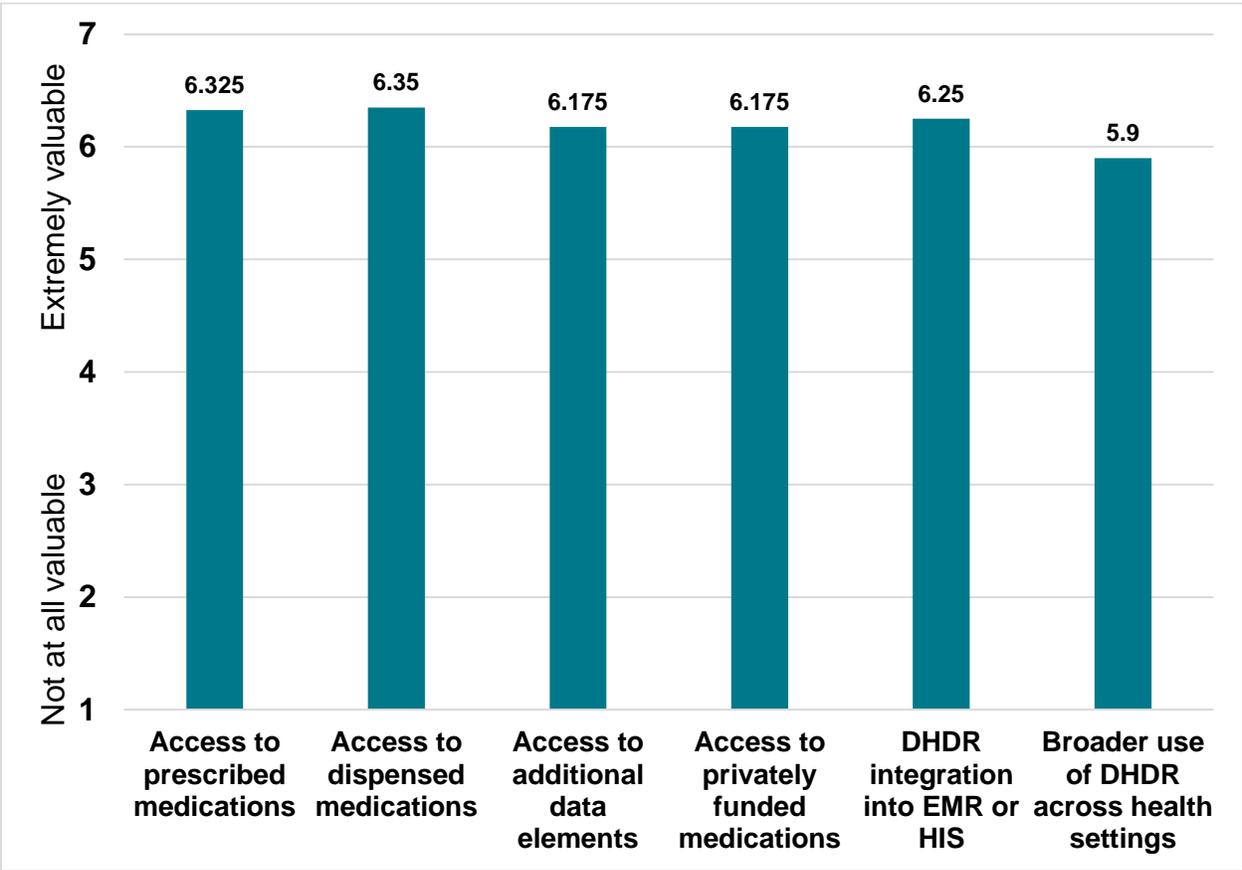


### Appendix 13. Mean rating scores for usefulness of DHDR data elements



Abbreviations: DIN drug information number

**Appendix 14. Mean rating scores for value of access to the DHDR**

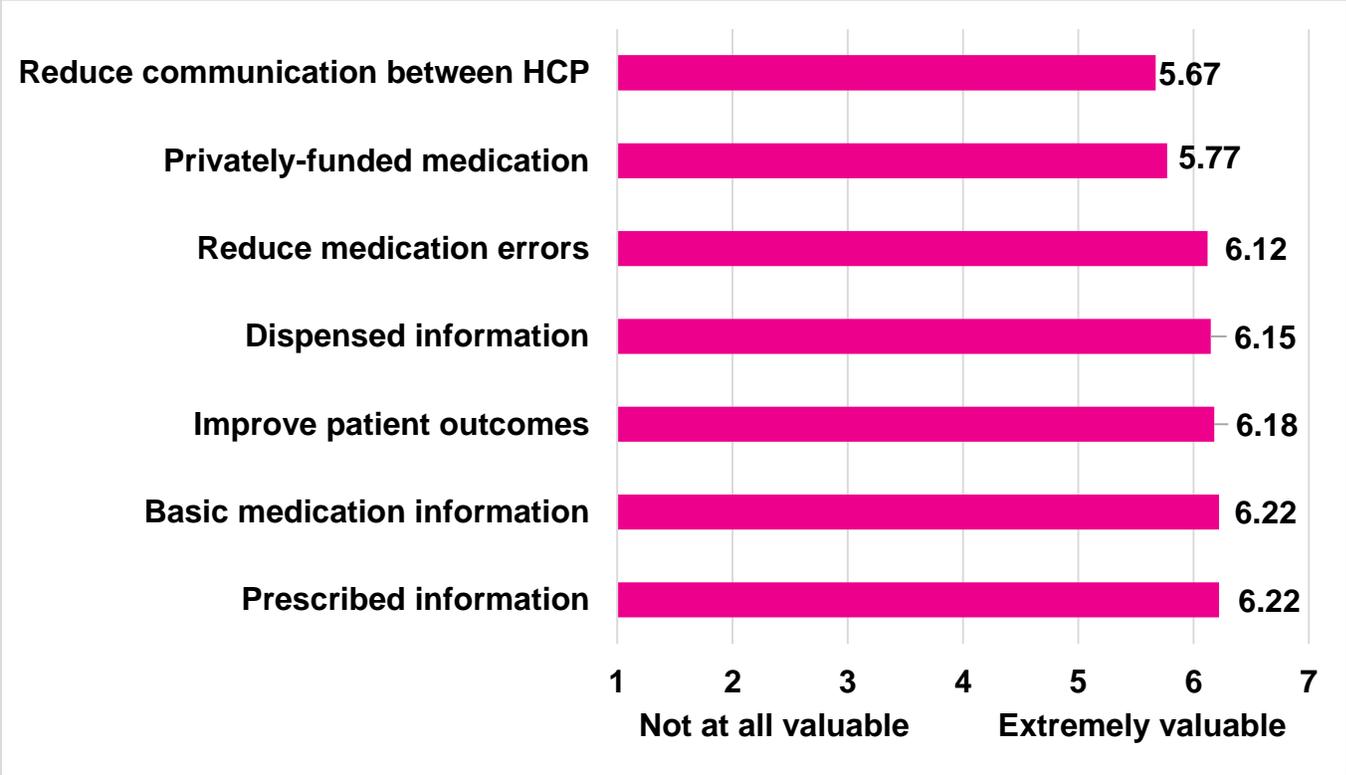


## Appendix 15. Demographic information for DHDR non-users

		% Participants (n)
		100% (127)
<b>Demographics</b>		
Female		85.0% (108)
Male		15.0% (19)
Age (years)		
	18-34	33.9% (43)
	35-49	26.0% (33)
	40-64	39.4% (50)
	>65	0.1% (1)
Urban		73.2% (93)
<b>Professional Characteristics</b>		
<b>Setting</b>		
	Acute Care	56.7% (72)
	Community Care	24.4% (31)
	Primary Care	12.5% (16)
	Other	6.3% (8)
<b>Profession</b>		
	Pharmacist	22.8% (29)
	Nurse and Nurse Practitioner	36.2% (46)
	Physician	11.0% (14)
	Pharmacy technician	5.5% (7)
	Midwife	3.9% (5)
	Clerk	3.1% (4)
	Care Coordinator	3.1% (4)
	Case Manager	0.1% (1)
	Social Worker	0.1% (1)
	Other	11.0% (14)
<b>Provincial viewer</b>		
	ConnectingOntario	5.5% (7)
	ClinicalConnect	55.9% (71)
	Neither	37.8% (48)
	Missing	0.1% (1)
<b>DHDR Characteristics</b>		
Has not heard of DHDR		78.0% (99)
Not aware of what the DHDR does		85.0% (108)
Primary source of clinical information		
	Hospital information system	40.9% (52)
	Ontario MD approved electronic medical record (EMR)	22.0% (28)
	Paper records	17.3% (22)
	Client health related information system (CHRIS)	6.3% (127)
	Other*	13.4% (17)

\*Other sources of clinical information included: Meditech and pharmacy information systems

**Appendix 16. Mean rating scores for non-user perceptions on data elements needed for BPMH**



**Appendix 17. Mean rating scores for perceptions by gender for non-users of DHDR**

