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Rapid Review

Emergency care data to support learning health systems in Canada

Prepared for the BC Emergency Medicine Network

Morales-Vazquez M., Jamieson M., Roerig M., Abu-Laban R.B., Christenson J., Grafstein E., Stacy E., & Allin S.

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About

The North American Observatory on Health Systems and Policies (NAO) is a collaborative partnership of interested researchers, research organizations, governments, and health organizations promoting evidence-informed health system policy decision-making.

Contact Information

North American Observatory on Health Systems and Policies
155 College Street, Suite 425
Toronto, ON M5T 3M6

www.naohealthobservatory.ca

naobservatory@utoronto.ca

nao_health

Contents

List of Abbreviations

ADT	Admission Discharge Transfer
AHS	Alberta Health Services
APPROACH	Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease
BC	British Columbia
BDCU	Banque de Données Communes des Urgence (Common Emergency Room Data Bank), Quebec
CIHI	Canadian Institute for Health Information
DAD	Discharge Abstract Database
EC	emergency care
eCTAS	Electronic Canadian Triage and Acuity Scale
ED	emergency department
ED RVQP	Emergency Department Return Visit Quality Program
EDIS	Emergency Department Information System
EMR	Electronic medical record
EMS	Emergency Medical Services
ERNI	Emergency Room National Ambulatory Initiative
HA	health authority
HDNS	Health Data Nova Scotia
HDPBC	Health Data Platform BC
HQCA	Health Quality Council of Alberta
ICES	Institute for Clinical Evaluative Sciences
ISQ	Institut de la Statistique du Québec
LHS	Learning health system(s)
MSP	Medical Services Plan
NACRS	National Ambulatory Care Reporting System
OHIP	Ontario Health Insurance Plan
PHSA	Provincial Health Services Authority, BC
QI	quality improvement
SREMI	Schwartz/Reisman Emergency Medicine Institute
VCH	Vancouver Coastal Health
VUC	Virtual Urgent Care

Executive Summary

Emergency care (EC) is a critical component of advanced healthcare systems. By providing attention to acute and sometimes life-threatening conditions that require immediate attention, EC often serves as the entry point to the health system for people who need urgent care. Ensuring effective, equitable, and quality EC is essential to prevent death and disability. In Canada, Emergency Department (ED) overcrowding is increasingly prevalent, diminishing the quality of care and posing a significant challenge to the healthcare system. One important means to address this and other challenges, is for Canadian jurisdictions to harness the evidence generated in their EDs to continuously explore and inform practices that improve EC.

Learning health systems (LHS) offer an opportunity to capture data about ED usage, patient outcomes, and challenges in EDs that inform and optimize the healthcare system. In this rapid review, we sought to identify and compare the approaches taken in select Canadian provinces to enable the access and analysis of data relevant to EC, and to determine the extent to which these data are used to inform policy and clinical practice.

We conducted a rapid literature review and spoke with local experts to uncover the elements, access, analysis, and use of data relevant to EC in five Canadian provinces: British Columbia, Alberta, Ontario, Quebec, and Nova Scotia. We reviewed and summarized information from websites, reports, and other existing literature to populate standard data elements and guidelines for EC data in each province. We then consulted with 21 local experts to validate the information and fill gaps in our understanding.

This rapid review provides a high-level comparison and review of the accessibility and use of EC data across five provinces, and relies primarily on the experiences and perceptions of local experts. Findings are summarized to describe: 1) the availability of EC data sources, 2) the accessibility of EC data for different users, 3) how data are used to inform practices and system improvements, and 4) the integration of electronic medical record (EMR) data in EC.

Based on these methods, we identified four key findings that may provide insights for the future development of LHS for EC:

1. Administrative datasets, particularly the National Ambulatory Care Reporting System (NACRS) and health records, are the main sources of EC data.
2. Timely and affordable access to updated EC data from health records and ED information is primarily available to hospital administrators and other personnel working within EC facilities.
3. While there is routine use of EC data for research, health records data is generally used for EC quality improvement and performance reporting since timely access to this data is more challenging for users outside the hospital system.
4. The degree of integration of EMR systems into EC varies across provinces, and offers a promising means to generate and use standardized and up-to-date data to improve EC.

Introduction & Background

Emergency care (EC) is a critical component of Canada's healthcare system. It provides urgent interventions for acute and sometimes life-threatening conditions that require immediate attention and often serves as an entry point to the health system for people who need urgent care or face barriers accessing primary care. Ensuring effective, equitable, and quality EC is essential to prevent death and disability (1–3).

Over the last two decades, the demand for EC services has increased across OECD countries impacting the healthcare costs, optimal use of resources, and quality of EC services (1). In Canada, EC and ambulatory care are central components of provincial and territorial health services and are one of the services in the healthcare system with the largest volume of patients (4). Emergency Department (ED) overcrowding is worsening across the country and is, together with other pressures such as health worker shortages (5), one of the greatest current challenges facing our healthcare system (6). Some of the consequences of ED overcrowding include increased wait times, poorer care quality, and adverse patient outcomes (6). One important means to address this and other challenges, is for Canadian jurisdictions to harness the evidence generated in their EDs to explore and inform practices that improve EC.

Learning Health Systems (LHS) is a term used to describe an approach aimed at constantly improving health services by integrating, leveraging, and sharing multiple types of data to generate timely knowledge that then informs decisions at all levels across the continuum of care to improve outcomes. Overall, LHS reduce health systems costs and improve patients' experience and quality of care by analyzing and providing meaningful information to health staff and other decision makers in a way that is actionable to their day-to-day clinical care (7–9). Despite potential opportunities for LHS to inform and improve ED use within healthcare systems, outcomes and challenges to developing a learning approach are often impeded by stringent agreements and data protection regulations, insufficient clinical data, and onerous operational challenges (10).

Policy makers and practitioners are increasingly interested in reforming healthcare to support an LHS. A previous NAO rapid review with the British Columbia (BC) Emergency Medicine Network (BC EMN) identified a wide variety of EC clinical networks internationally. Some of these networks in Canada appear to have the building blocks in place to support LHS—including the collection and analysis of data to inform clinical practice and health system change (11). To achieve an LHS that will inform timely decisions at different levels (e.g., front-line staff and strategic managers), learning from variations across provinces in the rapid access, analysis, and use of relevant EC data will inform progress toward LHS in Canada.

This rapid review aims to identify and compare approaches taken in selected Canadian provinces to enable the access and analysis of data relevant to EC and explore whether and how these data are used to inform policy and clinical practice. The review addresses the following broad question: "What is the current status and use of data to improve EC in Canadian provinces?".

Methods

We conducted a rapid literature review and consulted with local experts to uncover the primary sources of data relevant to EC, including how they are accessed, and whether and how they are used for research and analysis, quality improvement (QI), and performance reporting in five Canadian provinces—British Columbia (BC), Alberta, Ontario, Quebec, and Nova Scotia. These provinces were selected based on the professional experience, network, and knowledge of the NAO and BC EMN regarding their use of EC data. For this review, we consider EC data to include any data that captures the leadup to receiving EC, the care provided within EC settings (e.g., in a hospital ED or community-based urgent care centre), and the linkage to data that captures outcomes after leaving emergency settings.

We first reviewed and summarized information from websites, reports, and other existing and pertinent literature to describe the standard data element lists and guidelines for EC data. We identified EC data sources from academic publications and grey literature using the Google search engine, the University of Toronto library database, and websites and EC reports of the Canadian Institute for Health Information (CIHI) and provincial Ministries of Health. Information about key data elements was co-developed with the BC EMN (**Box 1**). Sources were then extracted and summarized to form a case study summary for each jurisdiction. In this review, our interest was to capture sources of aggregate and individual de-identified and linkable EC data.

BOX 1. Key elements for case study data collection

- Entity responsible for collecting data
- Provincial data repository
- Data elements available
- Data visualization and analysis tools
- Who and at what level can individuals access the data
- Accessibility of data and ease/process of access
- Inclusivity of data across all EDs in the province
- Use, nature, and of role of electronic medical records in data capture
- Whether data is static or pushed to key individuals and decision makers
- Whether data is aggregated, at the individual level or both
- Quality of data
- Ability to query data in real or near real time
- Ability to link data
- Specific to NACRS, level of data captured and reporting done

Members of our team (MMV, MJ, and SA) then consulted with 24 local experts (BC: 7; Alberta: 6; Ontario: 5; Quebec: 4; Nova Scotia: 2) via Zoom between December 2022 and June 2023 to validate the information, fill gaps in our findings, and gain insight into whether and how data are being used in these provinces for policy or practice change. Local experts were identified by the BC EMN, the NAO, and suggested by the experts themselves. Experts included EC clinicians and researchers, health systems researchers involved in EC data analysis, and data custodians and analysts at the provincial level. Local experts were first contacted by the BC EMN via email to introduce the project and the NAO and invite participation. The NAO followed up by email and provided a draft of the case summary for the experts' review and a series of questions in advance of the consultations.

We complemented the province-specific summaries with information provided by local experts during the consultations and summarized the findings describing the availability of EC data sources, the accessibility of the EC data for different users, how data are used to inform practice and system improvements, and the integration of electronic medical record (EMR) data in EC. For additional feedback, refinement, and validation, we shared the final summaries for each province with the local experts, and incorporated their feedback in final revisions. Finally, we shared the relevant final province-specific summary with all local experts.

The structure of the case study summary template, general set of guiding questions, and draft versions of summaries and the report were reviewed by co-authors from the BC EMN, who also served as an additional part of the validation group for the BC case summary.

Limitations

This rapid review provides a high-level qualitative overview of the availability and use of EC data across provinces, and relied primarily on the experience shared by a relatively limited number of local experts. The local experts varied in their roles and experiences with EC data, limiting the comparability of our results across provinces, since all possible sources and emerging approaches to collect, access and use EC data in each province may not have been captured. Another limitation is that we restricted our analysis to a subset of Canadian provinces based on the BC EMN and NAO's professional experience, knowledge, and network. In addition, some reported considerations related to experts' EC data user experience such as wait times for data access and costs, could not be validated through the literature or other sources. The net result is that our analysis and scoring of levels-of-use and access is admittedly subjective, based on the information shared by the local experts, and aimed to broadly understand the different approaches to collecting and using EC data in Canada.

Our depiction of the progress of EMR adoption across provinces is based on high-level description from the local experts, rather than reporting on the maturity level of the Electronic Medical Record Adoption Model (EMRAM) proposed by the Healthcare Information and Management Systems Society (HIMSS). The EMRAM scores hospitals' digital health systems progress on a scale from 0 to 7, where level 7 considers data security, support to clinicians, and patient satisfaction and safety (12).

Despite the broad definition of EC data that informed this review, we were unable to include pre- and post-ED care data in several provinces. Although multiple datasets capture pre-ED care in the selected provinces (notably Emergency Medical Services [EMS] data), these data are not integrated with the other EC datasets in any province, thus we did not include them in our report. In addition, while disease registries were noted as useful in the EC data landscape in some provinces, we did not comprehensively review all possible registries across the provinces. Finally, we excluded the Discharge Abstract Database (DAD) metadata, even though it captures post-ED care for admitted patients, since the data are standardized across provinces and were not raised by local experts as central to analyzing and improving EC quality and outcomes.

A strength of our approach is that we provide a high-level summary of the experiences with EC data in the select provinces, as well as challenges and opportunities for improving access and use. However, these findings should not be considered definitive, and are intended to be used and considered as a starting point for improvement and additional research.

Analytic Overview

Main Sources of EC Data

We categorized the main sources of EC provincial data in the provinces into three groups: 1) administrative, which captures non-health data such as wait times, triage score, and time to physician assessment; 2) health records, mainly oriented around capturing patient-level health data; and 3) patient survey data that pertains to province-wide administration of patient experience surveys. A detailed description of these categories is provided in **Appendix B**, alongside detailed province-specific case summaries in **Appendix C**. **Table 1** summarizes EC datasets available in the select Canadian province by source.

TABLE 1. Main sources of EC data in the select provinces

Category Name	Datasets; Province(s)
Administrative Data	• National Ambulatory Care Reporting System (NACRS); all provinces except Quebec • Action for Public Health Reporting; Nova Scotia • Admission Discharge Transfers (ADT); BC • Care Coordination Centre (C3); Nova Scotia • Common Emergency Room Data Bank; Quebec • EDIS; Nova Scotia • Electronic Canadian Triage and Acuity Scale (eCTAS); Ontario • Emergency Room National Ambulatory Initiative (ERNI); Ontario • ED Return Visit Quality Program (ED RVQP); Ontario Virtual Urgent Care; Ontario
Health Records	EMR data/paper records; all provinces
Patient Surveys	Patient Experience Surveys; all provinces except Quebec

Administrative datasets and health records are the main sources of EC data in the five provinces reviewed, with variations on the specific datasets used. In BC, Alberta, Ontario, and Nova Scotia, the administrative datasets mainly include different levels of the NACRS. The data available in NACRS depends on the level of submission at each facility as per CIHI guidelines (13), described in **Box 2**, including data on ED wait time indicators, presenting complaints, and ED discharge diagnoses. Administrative datasets are, for the most part, linkable with other EC and non-EC provincial datasets. Despite Quebec reporting data on NACRS, this dataset is not used for EC research, analyses, and reporting within the province. Instead, the Common Emergency Room Data Bank (BDCU) is the chief administrative dataset used, containing information on episodes of care given to people presenting to EDs (14). Among the provinces under review, BC is the only province that relies on physician billing (Medical Services Plan; MSP) data to populate its records of ED visits and service provision (15,16); data coverage in BC is limited, and only includes NACRS level 2—presenting challenges to the utility of the data. Moreover, BC billing data excludes a small subset of salaried physicians working in some ED settings.

Health records generally contain information on patient health, diagnoses, laboratory results, and associated time stamps with patient-physician interactions within an EC setting. These data are mainly used for EC analyses in BC, Ontario, Alberta, and Quebec and (with the exception of Quebec) can be linked

to other data sources. Nova Scotia uses its Emergency Department Information System (EDIS) and STAR databases that are linkable to patient records.

Surveys on patient experience can provide valuable insights into the quality of care provided in EC settings. Despite this, the usage of patient surveys is predominately limited to BC (17) and Nova Scotia (18), as described in the section "Use of EC data to inform practice/system improvements" below. Our research and consultations with experts did not identify any EC patient experience surveys conducted in Quebec. Since patient experience data are usually generated by case (patient) but reported in aggregate form, it generally cannot be linked to other datasets in the provinces reviewed; although, experts in BC mentioned that there is potential to link this data. We identified other sources of data in the five provinces that complement the core EC data, such as disease registries and billing data.

BOX 2. Levels of care submitted to NACRS and their data elements

NACRS is the national database for hospital- and community-based ambulatory care, including EDs. Data collection may vary across participating EDs and can be submitted to CIHI using three different options of levels of care at the individual (health record) level:

Level 1: Mandatory data elements required for ED Wait Time indicators.

Level 2: Level 1 data + mandatory completion of either the Presenting Complaint or ED Discharge Diagnosis data element.

Level 3: Level 2 data + mandatory capture of diagnoses and interventions using ICD-10-CA and Canadian Classification of Health Interventions (CCI).

Source: (13)

Accessibility of EC Data

Regarding the accessibility of EC data (**Table 2**), we describe the different ways to access the main EC datasets in selected provinces. We focus our description on the access platforms, type of staff or roles that can access the datasets, ease of access, frequency of updates, aggregation level, possibility to link to other datasets, and the availability of analytic and visual services. **Appendix C** provides more detailed province-specific summaries.

One way to access EC data in BC is through province-wide systems such as Population Data BC (19) and Health Data Platform BC (HDPBC) (20). Population Data BC is typically perceived to be slow (taking several months (21) or even years for data linkage across data sources) and expensive (fees depend on services requested (22) but offers data users linkage opportunities with health and social service data beyond ED care data. The HDPBC offers teams of data users and policy makers more expedited access to data holdings that are updated more frequently than Population Data BC. Neither platform provides analytical or visualization services for data analysis and comprehension, but both offer analytical tools for researchers (such as Excel, SAS, R, and SQL). The paucity of analytical resources and research support from data platforms are a concern for some local experts because even when EC data is available and accessible, researchers need appropriate analytic assistance to navigate the data. For example, people requesting data through these platforms might require support regarding the definition of variables and how to interpret measures that are not collected systematically across EDs or regions and might not be

comparable, leading to incorrect inferences. Data users and administrators working within hospitals and health authorities in BC can access health record data internal to their own and other hospitals using the same health record system within the same health authority. Additionally, some province-wide datasets are only accessible through the Provincial Health Services Authority (PHSA), such as the Trauma Registry. Public reporting on EC data is also generally limited, except for an ED wait time website active in the Vancouver Coastal Health regional health authority, the Provincial Health Services Authority, Providence Health Care, Fraser Health, and BC Children's Hospital (23).

Administrative datasets held by Alberta Health Services (AHS) can be accessed immediately by internal approved users, with dashboards available. External users can submit a request to AHS for data access, processed by either the AHS Provincial AMH Performance Measurement or the AHS Data & Analytics with criteria explained online (24,25). Experts noted that although the timeliness with which data access requests are handled has improved, there remained lags in data aggregation. Real-time EC data from health records can be accessed by approved users and by access requests from hospitals' internal clinical information systems. Patient experience data and other EC measures are publicly available on the AHS and the Health Quality Council of Alberta's FOCUS websites (26). The SPOR SUPPORT Unit provides faster access to administrative AHS datasets with the option for analytical services with a fee that can have financial support (24). Moreover, AHS reports ED wait times in six cities on a website, which are updated every two minutes and are determined by comparing the number of people in the ED and the available physicians (27).

In Ontario, provincial administrative datasets (i.e., NACRS and the Ontario Health Insurance Plan [OHIP] Claims Database) can be accessed by researchers through the data repository of the Institute for Clinical Evaluative Sciences (ICES). The application process for accessing the data is straightforward, but the data is outdated once received. One local expert indicated that sometimes the data can be a couple of years old when retrieved. Updated hospital-level administrative (including NACRS) and health record data are accessed more quickly through hospital data systems by approved staff within hospitals. External researchers and other users can request access to EC data through each hospital's internal processes; however, these applications are reported to take a long time to process.

The Institut de la Statistique du Québec (ISQ) is the chief point of access for provincial health and EC datasets in Quebec, including the Banque de Données Communes des Urgence (BDCU), which is costly and time-consuming to access for users without special endorsement. Accessing data through the hospitals is usually easiest for researchers and administrators working within the system and examining only a few hospitals. Public dashboards hosted on Microsoft Power BI describe the current, although not real-time, state of various healthcare system metrics to the public, including some information on ED wait times (28).

In Nova Scotia, researchers can pay to access administrative datasets that are aggregated for the entire province through the Nova Scotia Health Authority and the Health Data Nova Scotia (HDNS) repositories (29), which are usually delayed in aggregation and access for standardized measures such as NACRS. HDNS offers analytical services. Researchers and administrators working within hospitals can access continuously updated EDIS and STAR systems to inform ongoing clinical decision-making. Performance analytics professionals within hospitals develop and execute queries based on questions. The Action for Public Health Reporting dashboard is public and contains limited information on various healthcare metrics, including EC in the province (30).

TABLE 2. Access to EC data in select Canadian provinces

Province	Data category	Type of access	Ease of access	Frequency of updates	Aggregation level	Linkable to other datasets	Analytic or visual services
British Columbia	**Administrative data:** NACRS (level 2)	Upon request; restricted for hospitals and health authorities	Medium	3 months	Individual	Yes	No
	Other Administrative data - Admission Discharge Transfers	Upon request; restricted for hospitals and health authorities	Medium	ND	Individual	ND	ND
	Health Records	Restricted and upon request	Medium	Daily	Individual	Yes	Yes
	Patient Surveys	Limited – embargoed access	Low	Previously sporadic, most recent in 2023, now planned to be annual	Aggregated, Health Authority level	Potentially	No
Alberta	**Administrative data:** NACRS ACCS (level 3)	Upon request; restricted for hospitals	Medium	Monthly	Individual	Yes	Yes
	Health records	Upon request; restricted for approved staff	Medium	Real time	Individual	Yes	Yes
	Patient Surveys	Publicly available	High	Annually	Aggregated, hospital and provincial	No	Yes
Ontario	**Administrative data:** NACRS (level 3)	Upon request; restricted for hospitals	Medium	3 months; days for hospitals	Individual	Yes	Yes
	Other administrative data	Upon request; restricted for hospitals	Medium	Daily to every 3 months	Individual	Yes	Yes
	Health records	Restricted for hospitals	Low	Daily	Individual	Yes	No
	Patient surveys	Restricted for hospitals	Medium	Annually	Hospital	No	Yes
Quebec	**Administrative data:*** NACRS (level 1)	n/a	n/a	n/a	n/a	n/a	n/a
	Other administrative data (Common Emergency Room Data Bank)	Upon request and payment	High, if granted permission	Yearly	Individual	Yes	No
	Health records	Restricted	High	Real-time to monthly	Individual	No	Yes
	Patient surveys	n/a	n/a	n/a	n/a	n/a	n/a
Nova Scotia	**Administrative data** NACRS (level 1, 3)	Upon request	Medium	Yearly	Individual	Yes	Yes
	Other administrative data	Restricted; publicly available	Medium	Real-time	Individual; Aggregated, hospital	Yes	Yes
	Health records	n/a	n/a	n/a	n/a	n/a	n/a
	Patient surveys	ND	ND	Yearly	Individual	No	ND

Legend. **n/a (not applicable)**: Local experts indicated these are not used in EC in the province; **ND (Not Defined)**: Lack of any information on data usage, or conflicting information.

Definitions. **Data category**: Refers to the categories of the main sources of EC data; **Type of access**: Indicates whether data is restricted for approved staff, available upon request, or publicly available; **Ease of access**: Considers potential barriers to accessing EC data, including time, fees, length of request application, clarity in the process, among others; **Low**: Speed of access is low, data users may be waiting months for access and request processes are inconvenient. **Medium**: Speed of access for data users may be a couple of weeks or a month with request processes relatively simple. **High**: Access to datasets is either instantaneous or takes only a few days; **Frequency of updates**: Frequency on which data is updated. **Aggregation level**: Minimum level that data can be accessed; **Individual**: Data available at the patient level (record level) or at the physician level in the case of billing data. **Aggregated**: Data is available at levels other than individual (e.g., hospital); **Linkable to other datasets**: Whether data can be linked to variables in other data sources; **Analytic or visual services**: Interactive visuals and analytics, including predictive models and tableau visualizations.

***Notes on EC datasets:** According to the latest CIHI report, Quebec has facilities reporting on NACRS (13); however, two of our local experts and StatsCan (31) report that Quebec does not report hospitalization data to CIHI. Despite various databases capturing pre-ED care in the select provinces, we did not include pre-ED care datasets in this review since for the most part these data are not integrated with the other EC datasets in any province. Furthermore, we excluded the Discharge Abstract Database (DAD) even though it captures post-ED care for those patients who are admitted.

Use of EC Data to Inform Practice/System Improvements

In **Table 3** below, we describe the EC datasets available in the provinces and the extent to which data are used for four main purposes: research, QI, health system performance reporting, and physician performance reporting. We assigned different levels of use (i.e., low, medium, and high), based on the reported experiences of local experts, to comparatively illustrate the approaches taken by different provinces. While there may be pockets of data use in the provinces, the level of use provided is based on a global assessment of the province and thus might not reflect specific use of EC data in all settings. A detailed description of province-specific data use is provided in **Appendix C. Box 3** summarizes examples of different ways data have been used in the select provinces.

Overall, administrative data are consistently used for research across provinces and to inform areas of opportunity for health system improvement, particularly, datasets that are accessed through requests such as NACRS from Population Data BC (BC), Alberta Health Services (Alberta), ICES (Ontario), the Common Emergency Room Data Bank from ISQ (Quebec), and HDNS (Nova Scotia). These datasets are generally used only for QI and performance reporting by staff with leadership and analytical roles in hospitals as defined in the "Accessibility of EC data section" regarding staff with approval for immediate access to internal real-time data.

Health records data provide rich, timely, and relatively good-quality information at the hospital level that can inform decisions for issues that require immediate action. Because of confidentiality stipulations regarding patients' medical information, health record data is mainly available to approved staff in hospitals for QI and performance reporting in BC (and staff at health authorities), Alberta, Ontario, and Quebec, while in Nova Scotia EDIS records are used for this purpose instead. Using health record data for performance reporting was more frequently reported by local experts in Alberta, and to a lesser extent in Ontario and Quebec. Health record data is also used for research in select provinces but with longer waiting times for users submitting access requests. In Quebec, health record data for research is unavailable at the individual level.

Data from surveys on patient experience in the ED was reported to be used for research and health system performance only in BC and for QI only in Nova Scotia. Despite patient experience surveys being conducted in Ontario and Alberta, local experts indicated that these surveys were not routinely accessed or used to inform research, QI, or performance reporting. According to some experts, underuse of this data is partly due to the tendency of such data to represent a small volume of patients with little variation over time. We are not aware of any patient experience surveys conducted within Quebec, nor any research initiatives focusing on patient experience with the province's EC system.

TABLE 3. Use of EC data in select Canadian provinces

Province	Data Category	**Research** *Data used to answer specific research questions and generate knowledge*	**Quality Improvement** *Data used to improve the quality of EC*	**Performance Reporting: Health system** *Data used for public reporting on EC progress based on indicators*	**Performance Reporting: Physician** *Data used to report on the performance of individual physician practice in the ED*
British Columbia	**Administrative data:** NACRS (level 2)	High	Medium	Medium	Low
	Other administrative data	Low	Low	ND	Low
	Health records	Medium	High	Low	Low
	Patient surveys	Medium	Low	Medium	Low
Alberta	**Administrative data:** NACRS AACRS (level 3)	High	High	Low	Low
	Health records	Medium	High	High	Medium
	Patient surveys	Low	Low	Low	Low
Ontario	**Administrative data:** NACRS (level 3)	High	Medium	Medium	Low
	Other administrative data	Medium	High	High	Medium
	Health records	High	High	High	Low
	Patient surveys	Low	Low	Low	Low
Quebec	**Administrative data:** NACRS (level 1)	n/a	n/a	n/a	n/a
	Other administrative data	Medium	Medium	ND	Low
	Health records	Medium	Medium	Low	Medium
	Patient surveys	n/a	n/a	n/a	n/a
Nova Scotia	**Administrative data:** NACRS levels 1, 3	High	Medium	Medium	Low
	Other administrative data	Medium	High	High	Medium
	Health records	n/a	n/a	n/a	n/a
	Patient surveys	ND	Medium	Low	ND

Legend. **n/a (not applicable)**: Local experts indicated these are not used in EC in the province; **ND (Not Defined)**: Lack of any information on data usage, or conflicting information.

Abbreviations. NACRS (National Ambulatory Care Reporting System); AACRS (Ambulatory Care Classification System)

Definitions: **Low**: Information available suggesting either no use, or very limited use of data for those purposes (for example, evidence of use in one-off report); **Medium**: Information available suggesting moderate use of data for those

purposes (for example, data usage is possible, but infrequently used); **High**: Information available suggesting routine use of data for those purposes

BOX 3. Examples of different uses of EC data to inform improvement decisions in the selected provinces

Province	Examples
British Columbia	• Collection and analysis of health records and patient survey data using administrative sources to improve care for long-COVID patients (32,33). • Publication of real-time wait times within hospitals aiming to smooth differences in volume between ED facilities and improve system performance at the Vancouver Coastal Health, Provincial Health Services Authority, Providence Health Care, Fraser Health, and BC Children's Hospital (23). • Assessment of the Emergency iDoctors in-assistance 811 phone-line service that identifies callers requiring urgent and non-urgent care, and refers them to the ED or virtual assessment by off-site emergency and family physicians (34).
Alberta	• Research using administrative data to inform QI of EC for First Nations (35). • Research that explored predictors of ED return visits for pediatric mental health care aiming to improve system performance (36). • Analysis of health records data to assess physician performance in terms of the average number of patients seen per hour and patients' satisfaction in the ED (37).
Ontario	• Analysis of return inpatient visits during the first 3 years of the ED RVQ program for health system performance reporting and improvement (38). • Provincial evaluation of the implementation of eCTAS and its impact on hospital admission, rate of left-without-being-seen, and time from triage to physician initial assessment (39). • Use of virtual urgent care (VUC) data to inform provincial policy decisions on how to best structure and support VUC services for low-acuity complaints (40).
Quebec	• Pilot looking to predict risk levels of patients calling ambulances based upon historical hospitalizations and comorbidities. • Within government analyses with near-real-time administrative data, informing other government bodies on key indicators such as COVID-19 hospitalization rates (41).
Nova Scotia	• Development and planned expansion of the C3 platform at the QEII Health Sciences Centre in Halifax designed to optimize the flow of patients within a hospital by looking at the day-to-day logistics (42). • Performance metrics drawn from the EDIS/STAR systems, are routinely sent to physicians providing care in emergency settings.

Integration of Electronic Medical Records Data in EC

In this section we describe the progress in the provinces to integrate EC EMR data, focusing on the level of EMR adoption, the standardization of EMR systems, the level of EMR data access and linkage across facilities and for research, privacy considerations, and quality of the EMR data. **Table 4** summarizes and compares the adoption of EMR systems in EDs in the five provinces.

BC, Alberta, Ontario, Quebec, and Nova Scotia are at different stages in adopting EMR systems in their EDs. Alberta is moving towards integrating a single EMR system, replacing health information systems with Connect Care as part of a provincial initiative to create a single access point for health records (43). The adoption of Connect Care will allow standardized EMR systems across Alberta EDs for enhanced data use for clinical, research, and QI purposes. In zones that have not transitioned to Connect Care, approved staff can access health records data from other hospitals through Netcare, the provincial electronic health record system (44).

EMR adoption in EC varies in BC and Ontario, with some regions relying primarily on paper records, particularly in rural areas in Ontario. In BC the Regional Health Authorities are stewards of EMR system data, so it is possible to link EMR records to other sources; however, doing so requires data approval from custodians and therefore typically EMRs are not used by researchers external to BC hospitals and health authorities. In Ontario, each hospital is the custodian of its medical record system data and for those hospitals that use EMRs, the structure across hospitals is not standardized and accessing EMRs from other hospitals is usually not possible due to privacy concerns and differences among the vendors. Regardless, return visits to any EDs and their complaints can be tracked at an aggregate level in hospitals enrolled in a pay-for-results program (38). Moreover, the platform, Connecting Ontario, may allow for some clinical information to be accessed across hospitals, though it doesn't appear to be used for quality improvement or performance reporting (45).

In Quebec, local experts noted strict privacy regulations limiting access to EMR records in the province. With few exceptions, clinicians, and hospital managers cannot access patient information across Quebec facilities, so information is not sharable within the health system. EMR data are available for research purposes within facilities, such as chart reviews, but generally research cannot be conducted on cohorts across facilities.

None of the hospitals in Nova Scotia have electronic record keeping that would qualify as EMRs since existing systems are generally scanned records that cannot be integrated within hospitals' existing digital record systems. However, there is a plan to implement a system of having one record for each patient (46). The lack of EMR integration in Nova Scotia has ramifications beyond the purposes of research and QI, as it makes it difficult for physicians to track their patients throughout the healthcare system, denying them potentially important knowledge on care pathways.

TABLE 4. Adoption of EMR systems in emergency departments in select Canadian provinces

Province	Owner of EMR	Level of EMR adoption	Standardization of EMR systems	EMR data access (+ linkage) across EDs	EMR data access for research	Privacy considerations	Quality of EMR data
British Columbia	Regional Health Authorities	Some hospitals with EMR	Variable definitions and collection procedures with a need for standardization across EDs and regions	EMR connected within each health authority, and EDs with same EMR system. It is possible to link EMR to other datasets but approval from different custodians is required	EMR data can be accessed by request to the specific health authority	Each HA requires its own ethics and privacy approval process with variable requirements	ND
Alberta	Alberta Health Services	In progress of connecting all EMR across province	Standardized through Connect Care	Connected across EDs adopting Connect Care	Upon request	Access by authorized staff and under request	Some input errors
Ontario	Hospitals	EMR in some urban hospitals	Different companies providing EMR software to hospitals, with variation across vendors' systems	EMR not connected between EDs but return visits to different EDs can be tracked in hospitals enrolled in the pay-for-results program	Upon request	Each hospital requires its own ethics and privacy approval process with variable requirements	Some input errors
Quebec	ND	ND	Three companies providing ED software to Quebec, not used in the rest of Canada	Data at individual level across EDs is not shareable by law.	Not available for research, except at a hospital level	Does not allow clinicians/hospital managers to access patient information across EDs	ND
Nova Scotia	Nova Scotia Health Government	No EMR but they are implementing a "one patient, one record" system	n/a	n/a	n/a	n/a	n/a

Legend. **n/a (not applicable)**: Local experts indicated these are not used in EC in the province; **ND (Not Defined)**: Lack of any information on data usage, or conflicting information.

Abbreviations. ED (emergency department); EMR (electronic medical record); HA (health authority).

Conclusions

Through our consultations with experts in the field, we have identified the key EC data sources and their uses in BC, Alberta, Ontario, Quebec, and Nova Scotia. Data sources in each province fell into one of five categories (administrative, health records, disease registries, billing data, and patient surveys) and were generally used for one or more of four purposes (academic research, system-level quality improvement, public performance reporting, and physician reporting). Most provinces have multiple access points for data analysis, depending on whether data users are hospital administrators, academic researchers, or government employees. Varied perspectives from data users in each province were encountered, and our findings for each province are briefly summarized below.

Provincial Findings

Overall, the availability and scope of EC data in BC vary substantially by data access platform, with data users facing long wait times, high fees, limited provision of analytical services, and generally limited access to some critical datasets. There are strengths within the data landscape, and new opportunities for QI research in the form of the HDPBC holdings, rich pre- and post-hospital datasets, and limited public ED wait times data. Furthermore, there is an opportunity for the province to integrate more analytical support to data requests to enhance EC data access and use. Although data sharing between health authorities could be limited, EMR systems and levels of EMR adoption vary substantially, and NACRS reporting is limited to level 2, some local experts believe existing technologies can help address these challenges. Additionally, experts noted the issue that hospitals' data systems are on different platforms, which restricts the opportunity to share data across health authorities or ED settings in a timely fashion. Beyond these challenges, a general feeling exists among users that there is not a strong culture of data fluency, transparency, or usage in the BC health system.

The available EC data in Alberta are considered to be rich and accessible in particular to people in the system, and relative to other provinces we reviewed. There is a sense among several local experts that there has been more progress toward generating the EC data to inform a LHS. However, some local experts noted some challenges, such as accessing timely and systematic data for users outside the hospital system. Patients' journeys in the care system can be tracked across hospitals, however, challenges exist in identifying whether or not return visits are due to the same cause. Moreover, while EC data holds great potential for informing practice and system improvements in Alberta, some local experts believe that EC data is underleveraged, particularly concerning opportunities that exist to highlight geographic variation. Additionally, Alberta experts noted that while there are frequent data requests for knowledge generation, including the creation of dashboards, the data are not always used for action and improvement of the EC and healthcare system.

In Ontario, a high capacity for accessing, linking, and using EC data exists, particularly through ICES for research, and for select data as part of the hospital payment system. There are various EC datasets across Ontario with relatively good quality that allow assessing and improving EC services from triage to EC and identifying patients returning to emergency services across EDs and the reason for their return. Nevertheless, updated data to inform timely decisions is primarily available only to individuals with hospital leadership roles, and access for other users is more challenging.

In Quebec, it seems that although there may be alternative methods to accessing data, most research and analysis leverages in-house data holdings at hospitals. Hospital-level initiatives facilitate system-level improvement, except for some groups that provide data across the province, such as the Institut de la Statistique du Québec. Data access for these users is typically fast and responsive to researcher needs, but questions remain about the use and accessibility of data for users operating externally to hospitals (university-based researchers, for example).

The lack of definitive collection of EMR data in Nova Scotia is cited as a major drawback of the data landscape in this province, as is the inability to link datasets. The strength of the EDIS and STAR databases used in some hospitals is their ability to provide real-time access to hospitals, and the availability of C3 to operationalize those datasets into real-time facility optimization. However, data users suggest that the true issue facing the province is not a lack of rich data, but rather in policy making and system-level improvement, where there is insufficient will to act upon data-driven conclusions.

Challenges and Opportunities

Through our research and consultations with local experts, we identified variability and several challenges and opportunities for data use and access in the five studied provinces. Challenges concern the collection and use of NACRS data, timeliness and costs associated with data access, privacy concerns, and political concerns. There were additionally many promising practices within the provinces, such as BC and Alberta's ED wait time website, the forthcoming expansion of Connect Care in Alberta, Ontario's pay-for-results program, and others. Although pre-ED care was beyond the scope of our review, there were many examples of how pre-ED care has improved using available data sources. Several provinces described programs designed to improve triage using EC data, some of which related to 911 and 811 (non-urgent triage health services (47) calls and ambulance services.

A key method for comparing EC data within Canada is to use CIHI's NACRS holdings. Although all the studied provinces report to NACRS, the collection of NACRS data is not uniform within or between provinces, and reporting ranges from levels 1 to 3 further limiting the ability of researchers to conduct comparative analyses between provinces using these data. An additional issue is the hurdles researchers must overcome to access timely and updated data. Timely, affordable access is not common in many provinces; while hospital administrators and other personnel working within EC facilities may be able to access data relatively easily, substantial barriers remain for academic researchers. The net result is a limited ability to compare EDs within and across provinces borders.

Privacy concerns and restrictions are another issue prohibiting effective use of available EC data holdings. In Quebec, for example, protections around the use and access of personal data are particularly stringent compared to other provinces. Although tight restrictions regarding access to personal data connote potentially greater protections for patients against invasions of privacy, this must be balanced against impediments to accessing timely and updated data to improve EC. In all the studied provinces, hospitals can access their own data; however, this is usually unavailable between hospitals (e.g., Ontario), or across health authorities (e.g., BC), due to privacy agreements. The current privacy protection approach comes at a significant cost: additional and sometimes insurmountable barriers for data users seeking to make informed and timely policy recommendations. A final concern among experts in some provinces was the belief that governments themselves are concerned about making access to EC data wider—particularly to the public. The perception exists that greater public viewership of data could present a risk for

governments in power, in that data showing poor performance metrics could be co-opted for political purposes by rival parties.

A general cautionary note about these findings is that these concerns are not exclusive to the field of EC data; challenges related to politics, privacy, and access are all relevant topics in the broader discussion about Canada's healthcare system. Although innovative advancements exist in the Canadian EC data field, the challenges that provinces face to achieve LHS in EC are relevant to improvements in other health areas.

Finally, this report highlights variations in the approaches that the Canadian provinces under review have taken to generate, access, and use EC data. In all the studied provinces, EC data exist and are used for different purposes (inform clinical practices, research, QI, and health system performance reporting) depending on the level of access. Furthermore, in all the studied provinces we identified several challenges in accessing timely, updated, and affordable data, that help understand gaps in performance and inform best practices, including the inability to compare data between hospitals or regions. This is particularly the case for users outside the hospital systems. Efforts to enhance EC data access are warranted, but should be advanced with consideration to the local limitations of the data to ensure its proper use. Nevertheless, we also identified examples of actions that offer new opportunities for EC data collection, integration, and usage, which can help improve EC data systems and advance toward LHS in Canada. Provincial and territorial governments can learn from the approaches and lessons of other Canadian jurisdictions to enhance their own EC systems, and we hope this report will be helpful in this regard. We believe there is an urgent need to shift in the conceptualization of EC data: from being mostly a clinical tool to being a tool for greater and continuous research, QI, system change, and ultimately patient care improvement.

Advancing LHS in Canada

LHS can improve EC and related outcomes by leveraging data to inform clinical and system-level decision-making across the continuum of care. This rapid review revealed numerous challenges in the current health data systems, though it also notes that there is progress in Canada with generating, accessing, integrating, analyzing, and updating various types of EC data. For example, BC has agreements in place to make data sharing between health authorities less onerous; Alberta has advanced toward the integration of their EMR system, which will allow systematizing clinical data; Ontario's pay-for-results program incentivizes EC data generation and use for QI; in Quebec, EC data is accessible to approved staff within hospitals; and Nova Scotia is expanding C3 centres that use real-time data for QI. All studied provinces generate various types of EC data, mostly linkable across sources, and with the capacity to integrate and use data in a meaningful and timely way especially within individual hospital systems. Nevertheless, there is a need to expand this potential outside the hospital settings to inform policy decisions across the health system. We believe there is an urgent need to shift in the conceptualization of EC data: from being mostly a clinical tool to being a tool for greater and continuous research, QI, system change, and ultimately patient care improvement.

References

1. Berchet C. Emergency Care Services: Trends, Drivers and Interventions to Manage the Demand [Internet]. Paris: OECD; 2015 Aug [cited 2023 May 4]. Available from: https://www.oecd-ilibrary.org/social-issues-migration-health/emergency-care-services_5jrts344crns-en
2. Reynolds TA, Sawe H, Rubiano AM, Shin SD, Wallis L, Mock CN. Strengthening Health Systems to Provide Emergency Care. In: Jamison DT, Gelband H, Horton S, Jha P, Laxminarayan R, Mock CN, et al., editors. Disease Control Priorities: Improving Health and Reducing Poverty [Internet]. 3rd ed. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2017 [cited 2023 May 4]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK525279/
3. Hirshon JM, Risko N, Calvello EJ, Stewart de Ramirez S, Narayan M, Theodosis C, et al. Health systems and services: the role of acute care. Bull World Health Organ [Internet]. 2013 May 1 [cited 2023 May 4];91(5):386–8. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3646345/
4. Canadian Institute for Health Information (CIHI). Emergency and ambulatory care [Internet]. [cited 2023 May 4]. Available from: https://www.cihi.ca/en/topics/emergency-and-ambulatory-care
5. Boniol M, Kunjumen T, Nair TS, Siyam A, Campbell J, Diallo K. The global health workforce stock and distribution in 2020 and 2030: a threat to equity and 'universal' health coverage? BMJ Glob Health [Internet]. 2022 Jun [cited 2023 May 17];7(6):e009316. Available from: https://gh.bmj.com/lookup/doi/10.1136/bmjgh-2022-009316
6. Affleck A, Parks P, Drummond A, Rowe BH, Ovens HJ. Emergency department overcrowding and access block. CJEM [Internet]. 2013 Nov [cited 2023 May 4];15(06):359–70. Available from: https://www.cambridge.org/core/product/identifier/S1481803500002451/type/journal_article
7. Friedman C, Rubin J, Brown J, Buntin M, Corn M, Etheredge L, et al. Toward a science of learning systems: a research agenda for the high-functioning Learning Health System. J Am Med Inform Assoc [Internet]. 2015 Jan 1 [cited 2023 May 4];22(1):43–50. Available from: https://academic.oup.com/jamia/article/22/1/43/834511
8. Lavis JN, Gauvin FP, Mattison CA, Moat KA, Waddell K, Wilson MG, et al. Rapid synthesis: Creating Rapid-learning Health Systems in Canada [Internet]. McMaster Health Forum; 2018. Available from: https://www.mcmasterforum.org/docs/default-source/product-documents/rapid-responses/creating-rapid-learning-health-systems-in-canada.pdf?sfvrsn=4
9. Alliance for Healthier Communities. The EPIC Learning Health System [Internet]. [cited 2023 May 4]. Available from: https://www.allianceon.org/EPIC-Learning-Health-System
10. Lowes LP, Noritz GH, Newmeyer A, Embi PJ, Yin H, Smoyer WE, et al. 'Learn From Every Patient': implementation and early results of a learning health system. Dev Med Child Neurol [Internet]. 2017 Feb [cited 2023 May 4];59(2):183–91. Available from: https://onlinelibrary.wiley.com/doi/10.1111/dmcn.13227
11. Roerig M, Carbone S, Lynch M, Abu-Laban R, Duncan R, Marchildon G, et al. An International Review of Emergency Care Clinical Networks [Internet]. Toronto: North American Observatory on Health Systems and Policies.; Report No.: 31. Available from: https://naohealthobservatory.ca/wp-content/uploads/2021/03/NAO-Rapid-Review-31_EN.pdf

12. Healthcare Information and Management Systems Society (HIMSS). HIMSS Maturity Models: Models for Digital Health Transformation [Internet]. 2020 [cited 2023 May 23]. Available from: https://www.himss.org/what-we-do-solutions/digital-health-transformation/maturity-models

13. Canadian Institute for Health Information (CIHI). Data Quality Documentation. National Ambulatory Care Reporting System. Current-Year Information 2021–2022 [Internet]. 2022. Available from: https://www.cihi.ca/sites/default/files/document/nacrs-data-quality-current-year-information-2021-2022-report-en.pdf

14. Sante et Service Sociaux Quebec. FICHIER DE RENSEIGNEMENTS PERSONNELS, Banque de données communes des urgences (BDCU) [Internet]. 2016. Available from: https://www.msss.gouv.qc.ca/inc/documents/ministere/acces_info/renseignements-personnels/formulaire_bdcu.pdf

15. Peterson S, Wickham M, Lavergne R, Beaumier J, Ahuja M, Mooney D, et al. Methods to comprehensively identify emergency department visits using administrative data in British Columbia [Internet]. Vancouver, BC: UBC Centre for Health Services and Policy Research; 2021 Jan p. 33. Available from: https://chspr.sites.olt.ubc.ca/files/2021/02/CHSPR-ED-Report-2021.pdf

16. Abu-Laban R, Duncan R. NACRS in British Columbia: History, Current Status and it's Impact, and Proposal for Improvement. BC Emergency Medicine Network Scientific Program; 2021 Nov.

17. BC Patient-Centred Measurement. Survey tools, results and success stories [Internet]. [cited 2023 May 4]. Available from: https://www.bcpcm.ca/node/172

18. Nova Scotia Health Authority. Patient Experience Survey [Internet]. Available from: https://www.cdha.nshealth.ca/about-us/measuring-success-progress/patient-experience-survey

19. Population Data BC [Internet]. [cited 2023 May 5]. Available from: https://www.popdata.bc.ca/

20. Health Data Platform BC [Internet]. Available from: https://www2.gov.bc.ca/gov/content/health/conducting-health-research-evaluation/data-access-health-data-central/health-sector-partner-access-to-data/health-data-platform

21. Population Data BC. Application processing times [Internet]. [cited 2023 May 5]. Available from: https://www.popdata.bc.ca/data_access/application_processing_times

22. Population Data BC. PopData fees and charges [Internet]. [cited 2023 May 5]. Available from: https://www.popdata.bc.ca/data_access/popdata_fees

23. Vancouver Coastal Health, Pronvincial Health Services Authority, Providence Health Care, BC Childrens Hospital. Emergency Department Wait Times [Internet]. [cited 2023 May 4]. Available from: http://www.edwaittimes.ca/WaitTimes.aspx

24. Alberta Health Services. Requesting AHS Data Resources [Internet]. Alberta Health Services. [cited 2023 Apr 27]. Available from: https://www.albertahealthservices.ca/research/Page16074.aspx

25. Alberta Health Services. Accessing AMH Data at AHS: A Guide for AMH Researchers. [Internet]. 2022. Available from: https://www.albertahealthservices.ca/assets/info/amh/if-amh-rh-accessing-amh-data-ahs.pdf

26. FOCUS: Emergency Departments [Internet]. HQCA Focus. [cited 2023 Apr 27]. Available from: https://focus.hqca.ca/emergencydepartments/

27. Alberta Health Services. Estimated Emergency Department Wait Times [Internet]. Alberta Health Services. [cited 2023 May 19]. Available from: https://www.albertahealthservices.ca/waittimes/waittimes.aspx

28. Gouvernement du Québec. Performance du réseau de la santé et des services sociaux [Internet]. 2023. Available from: https://www.quebec.ca/sante/systeme-et-services-de-sante/organisation-des-services/donnees-systeme-sante-quebecois-services/performance-reseau-sante-services-sociaux

29. Dalhousie University. Health Data Nova Scotia Data Access [Internet]. Health Data Nova Scotia. [cited 2023 May 5]. Available from: https://medicine.dal.ca/departments/department-sites/community-health/research/hdns/data-access-guidelines.html

30. Nova Scotia Health. Nova Scotia Action for Health – Public Reporting [Internet]. [cited 2023 May 5]. Available from: https://public.tableau.com/app/profile/nova.scotia.health/viz/ActionforHealth-PublicReporting/Overview

31. Statistics Canada. Discharge Abstract Database, National Ambulatory Care Reporting System and Ontario Mental Health Reporting System linked to the Canadian Vital Statistics Deaths Database [Internet]. 2022 [cited 2023 May 4]. Available from: https://www.statcan.gc.ca/en/microdata/data-centres/data/dad-nacrs-omhrs-cvsdd

32. Provincial Health Services Authority. Post-COVID Research [Internet]. Provincial Health Services Authority. 2023. Available from: http://www.phsa.ca/our-services/programs-services/post-covid-19-care-network/post-covid-research

33. Levin A, Malbeuf M, Hoens AM, Carlsten C, Ryerson CJ, Cau A, et al. Creating a provincial post COVID - 19 interdisciplinary clinical care network as a learning health system during the pandemic: Integrating clinical care and research. Learn Health Syst [Internet]. 2023 Jan [cited 2023 Apr 5];7(1). Available from: https://onlinelibrary.wiley.com/doi/10.1002/lrh2.10316

34. Ho K, Abu-Laban RB, Stewart K, Duncan R, Scheuermeyer FX, Hedden L, et al. Health system use and outcomes of urgently triaged callers to a nurse-managed telephone service for provincial health information after initiation of supplemental virtual physician assessment: a descriptive study. CMAJ Open [Internet]. 2023 May [cited 2023 May 25];11(3):E459–65. Available from: http://cmajopen.ca/lookup/doi/10.9778/cmajo.20220196

35. McLane P, Barnabe C, Mackey L, Bill L, Rittenbach K, Holroyd BR, et al. First Nations status and emergency department triage scores in Alberta: a retrospective cohort study. Can Med Assoc J [Internet]. 2022 Jan 17 [cited 2023 Apr 3];194(2):E37–45. Available from: http://www.cmaj.ca/lookup/doi/10.1503/cmaj.210779

36. Newton AS, Ali S, Johnson DW, Haines C, Rosychuk RJ, Keaschuk RA, et al. Who Comes Back? Characteristics and Predictors of Return to Emergency Department Services for Pediatric Mental Health Care. Acad Emerg Med [Internet]. 2010 Feb [cited 2023 May 4];17(2):177–86. Available from: https://onlinelibrary.wiley.com/doi/10.1111/j.1553-2712.2009.00633.x

37. Lenz K, McRae A, Wang D, Higgins B, Innes G, Cook T, et al. Slow or swift, your patients' experience won't drift: absence of correlation between physician productivity and the patient experience. CJEM

[Internet]. 2017 Sep [cited 2023 Apr 4];19(5):372–80. Available from: https://www.cambridge.org/core/product/identifier/S1481803516003857/type/journal_article

38. Chartier LB, Ovens H, Hayes E, Davis B, Calder L, Schull M, et al. Improving Quality of Care Through a Mandatory Provincial Audit Program: Ontario's Emergency Department Return Visit Quality Program. Ann Emerg Med [Internet]. 2021 Feb [cited 2023 Apr 10];77(2):193–202. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0196064420312221
39. McLeod SL, Grewal K, Thompson C, Thabane L, Borgundvaag B, Ovens H, et al. Influence of electronic triage decision-support on hospital admission, left without being seen and time to physician initial assessment in the emergency department. Can J Emerg Med [Internet]. 2021 Mar [cited 2023 Mar 31];23(2):214–8. Available from: http://link.springer.com/10.1007/s43678-020-00043-1
40. McLeod SL, Mondoux S, Hall JN, Dainty K, McCarron J, Tarride JE, et al. Demographic characteristics, outcomes and experience of patients using virtual urgent care services from 14 emergency department led sites in Ontario. Can J Emerg Med [Internet]. 2023 Jan [cited 2023 May 4];25(1):65–73. Available from: https://link.springer.com/10.1007/s43678-022-00407-9
41. Données COVID-19 au Québec [Internet]. INSPQ. [cited 2023 May 4]. Available from: https://www.inspq.qc.ca/covid-19/donnees
42. Nova Scotia Health Authority. C3: Care Coordination Centre [Internet]. Nova Scotia Health Innovation Hub. 2022. Available from: https://innovationhub.nshealth.ca/projects/c3-care-coordination-centre#:~:text=Nova%20Scotia%20Health%E2%80%99s%20Care%20Coordination%20Centre%20%28C3%29%20will,flow%2C%20and%20health%20system%20resources%20to%20support%20decision-making.
43. Alberta Health Services. Connect Care: Implementation Timeline [Internet]. 2022. Available from: https://www.albertahealthservices.ca/assets/info/cis/if-cis-cc-infographic-site-implementation-timeline.pdf
44. Government of Alberta. Alberta Netcare [Internet]. [cited 2023 Apr 27]. Available from: https://www.albertanetcare.ca/
45. eHealth Ontario. ConnectingOntario ClinicalViewer [Internet]. eHealth Ontario. [cited 2023 May 5]. Available from: https://ehealthontario.on.ca/en/health-care-professionals/connectingontario
46. Communications Nova Scotia. New Technology to Improve Patient Care [Internet]. News Releases. 2018 [cited 2023 May 17]. Available from: https://novascotia.ca/news/release/?id=20230201001
47. BC Emergency Medicine Network. HEiDi [Internet]. Emergency Care BC. [cited 2023 May 19]. Available from: https://www.bcemergencynetwork.ca/rtvs/heidi/
48. CIHI. National Ambulatory Care Reporting System metadata (NACRS) [Internet]. [cited 2023 Mar 31]. Available from: https://www.cihi.ca/en/national-ambulatory-care-reporting-system-metadata-nacrs
49. Population Data BC. Patient Centered Measurement: Emergency Department Survey 2018 [Internet]. [cited 2023 Jun 6]. Available from: https://www.popdata.bc.ca/data/health/pcm/EDS_2018
50. HDPBC Data. Data holdings. Health Data Platform BC [Internet]. [cited 2023 Jun 6]. Available from: https://healthdataplatformbc.ca/index.php/hdpbc-data

51. Population Data BC. National Ambulatory Care Reporting System data set [Internet]. [cited 2023 Jun 6]. Available from: https://www.popdata.bc.ca/data/health/nacrs

52. Provincial Health Services Authority. Approvals & Agreements [Internet]. [cited 2023 Jun 6]. Available from: http://www.phsa.ca/researcher/data-access-privacy/research-privacy/approvals-agreements

53. BC Ministry of Health. Healthideas [Internet]. [cited 2023 Jun 6]. Available from: https://public.healthideas.gov.bc.ca/

54. Health Data Platform BC. The HDPBC and the HEiDi Program [Internet]. Available from: https://www2.gov.bc.ca/assets/gov/health/conducting-health-research/health-data-platform/heidi-testimonial.pdf

55. Government of Alberta. Pharmaceutical Information Network (PIN), Netcare Learning Centre [Internet]. [cited 2023 Apr 27]. Available from: https://www.albertanetcare.ca/learningcentre/pharmaceutical-information-network.htm

56. Clinical Research Unit, University of Calgary, Cumming. APPROACH [Internet]. [cited 2023 May 5]. Available from: https://approach.org/

57. Alberta Health Services. EMS Patient Experience Survey [Internet]. Alberta Health Services. [cited 2023 Jun 1]. Available from: https://www.albertahealthservices.ca/ems/Page8048.aspx

58. Cancer Care Ontario. ECTAS: Safer, consistent triage across Ontario [Internet]. CCO Health. [cited 2023 Apr 10]. Available from: https://www.ccohealth.ca/en/blog/Safer%2C%20consistent%20triage%20across%20Ontario

59. Ontario Health. Emergency Room National Ambulatory Reporting System Initiative (ERNI) - Dataset [Internet]. Ontario Data Catalogue. [cited 2023 Apr 10]. Available from: https://data.ontario.ca/dataset/emergency-room-national-ambulatory-reporting-system-initiative-erni

60. Health Quality Ontario (HQO). Emergency Department Return Visit Quality Program [Internet]. [cited 2023 Apr 10]. Available from: https://www.hqontario.ca/Quality-Improvement/Quality-Improvement-in-Action/Emergency-Department-Return-Visit-Quality-Program

61. Urgences Santé Québec. Recherche [Internet]. 2023. Available from: https://www.urgences-sante.qc.ca/ce-que-nous-faisons/recherche/

62. Government of Nova Scotia. Action For Health: A Strategic Plan for Nova Scotia [Internet]. Government of Nova Scotia. Available from: https://novascotia.ca/actionforhealth/

Appendix A. List of Local Experts

British Columbia

Alexandra Flatt	Provincial Health Services Authority
Alireza Saremi	British Columbia Provincial Health Services Authority
Eric Grafstein	Vancouver Coastal Health
Heather Hair	British Columbia Interior Health Emergency Services Network
Kendall Ho	University of British Columbia
Lindsay Hedden	Health Research BC
Ross Duncan	BC Emergency Medicine Network and Health Research BC

Alberta

Andrew McRae	University of Calgary
Brian Holroyd	Alberta Emergency Strategic Clinical Network; Alberta Health Services; University of Alberta
Eddy Lang	University of Calgary; Alberta Emergency Strategic Clinical Network
Jeffrey A. Bakal	Alberta Health Services; University of Alberta
Patrick McLane	Alberta Emergency Strategic Clinical Network
Rhonda Rosychuk	University of Alberta

Ontario

Howard Ovens	Ontario Emergency Department Advisory Committee
Ian Drennan	University of Toronto
Michael Schull	ICES
Shelley McLeod	Schwartz Reisman Emergency Medicine Research Institute

Quebec

Bernard Unger	McGill University
Brice Kuimi	University of Toronto
Erin Strumpf	McGill University
Luc de Montigny	Urgences-santé

Nova Scotia

David Petrie	Halifax Infirmary
Kirk Magee	Dalhousie University; Nova Scotia Health Authority

Appendix B. Main Sources and Types of EC Data in Canada

Category name	Description and notes	Sample datasets
Administrative data	Category captures non-health data, such as wait times, triage score, time to physician assessment, etc. Some admin sources do include health data (i.e., diagnostic codes for NACRS), but they are still mostly admin-focused datasets.	• National Ambulatory Care Reporting System (NACRS); all provinces except Quebec • Action for Public Health Reporting; Nova Scotia • Admission Discharge Transfers (ADT); BC • Care Coordination Centre (C3); Nova Scotia • Common Emergency Room Data Bank; Quebec • EDIS; Nova Scotia • Electronic Canadian Triage and Acuity Scale (eCTAS); Ontario • Emergency Room National Ambulatory Initiative (ERNI); Ontario • Emergency Department Return Visit Quality Program (ED RVQP); Ontario • Virtual urgent care; Ontario
Health records	Data sources that are mostly oriented around capturing patient-level health data. Access is mostly restricted to physicians and approved employees at EDs.	• EMR data / paper records (all provinces)
Patient surveys	Pertains to province-wide administration of patient experience surveys. Present in most provinces.	• Patient Experience Surveys (all provinces except Quebec)
Additional sources identified as used in EC in some provinces:		
Name	**Description and notes**	**Datasets**
Disease registries	Concerns mostly the trauma registries in each province. ***Note.*** Disease registries were described by some participants as not being useful or relevant sources of information, so this category is very sparsely populated in our summary tables.	• Trauma registry • Alberta APPROACH registry
Billing data	A unique category mainly populated by BC MSP files; to the best of our knowledge, BC is the only province that relies upon billing data to populate its records of ED visits and service provision whereas other provinces rely on NACRS and their ED information systems.	• BC MSP files

Appendix C. Case Summaries of the EC Data Landscape

British Columbia

Main sources of EC data

We categorized the main sources of emergency care (EC) data in each province into three groups: 1) administrative, 2) electronic medical records (EMRs), and 3) patient survey data. In BC, administrative data comes largely from level 2 data from NACRS,[1] collection of which is partially mandated in the province. Currently, 30 BC facilities submit NACRS level 2 data to CIHI, capturing approximately 73% of all ED visits in the province but only approximately 39% of the acute care facilities with an ED (as of June 2023) (13). Level 2 NACRS collects data on ED wait time indicators, presenting complaints, and ED discharge diagnoses[2] (48), and it can be linked to other datasets, although it does not contain the depth of coded diagnostic information available in NACRS level 3. Moreover, the lack of complete NACRS reporting necessitates work-arounds to capture the totality of ED visits (15,16). Another administrative source of data in use in BC is the Admission Discharge Transfer (ADT) files, which comprise information on patient movement within a facility, as well as tests ordered. In BC, EMRs contain information on patient health, diagnoses, laboratory results, and associated time stamps with patient-physician interactions within an EC setting. Depending on the health body (including the five regional health authorities, Provincial Health Services Authority [PHSA], and First Nations Health Authority [FNHA]) and their capabilities, EMR results can sometimes be linked to other sources through one of the available data platforms in BC. Patient surveys are conducted using the Patient-Centered Measurement ED Survey (17). Conducted as a random-sample of ED facilities in all health authorities, this annual survey asks patients about experiences with quality of care and services received in hospitals and is designed to be used specifically for patient-centered research.

We identified additional sources of data that can also inform EC practice and system improvement; these complement core EC data, and include disease registries, such as the BC Trauma Registry, and practitioner claims, such as Medical Services Plan (MSP) records. **Table B1** summarizes the EC datasets available in the province and the characteristics related to their access.

Accessibility of EC data

There are several ways to access EC data in BC—through province-wide systems such as Population Data BC and Health Data Platform BC, and through health authorities or individual hospitals. The province-wide systems typically offer detailed information on the provincial health system, acting as data stewards for NACRS, MSP files, and patient experience survey data (49,50). Specific datasets vary in terms of how frequently they are updated on the platform. For instance, NACRS is updated every three months (51) and the patient experience ED survey was last updated in 2018 according to the websites (49,50), although additional surveys are known to have been completed since then. Data access through Population Data BC is typically slow and expensive for researchers who are not affiliated with a health authority but comes with the benefit of offering researchers linkage opportunities with health and social service data beyond

[1] See ***BOX 2.*** *Levels of care submitted to NACRS and their data elements* in the main report (p.6).

[2] May not be available in some health authorities.

ED care data. The Health Data Platform BC (HDPBC) offers teams of data users and policy makers significantly expedited access to data holdings that are updated more frequently than Population Data BC. Moreover, since HDPBC is a relatively new entity with potential to further develop its data access capabilities. Neither platform provides analytical or visualization services for data analysis and comprehension, but both offer analytical tools for researchers (such as excel, SAS, R, and SQL), with Population Data BC having a slight advantage in terms of available software for researchers. The paucity of analytical resources and research support from data platforms are a concern for some local experts because even when EC data is available and accessible, researchers need appropriate analytic assistance to navigate the data. For example, people requesting data through these platforms might require support regarding the definition of variables and how to interpret measures that are not collected systematically across EDs or regions and might not be comparable, leading to incorrect inferences. Popdata BC serves projects, such as retrospective analyses and similar academic studies, that do not require data for iterative and constantly evolving projects.

Researchers and administrators working within hospitals and health authorities also usually access data internal to their organization, including data submitted to NACRS and other datasets such as ADT. Although limited data sharing between health authorities makes system-level surveillance and improvement difficult for many key metrics. EMR data are collected primarily for the purpose of patient care, and so access is typically restricted within organizations. Separation of legal status and stewardship of data among health organizations also affect accessibility, as regional health authorities and the PHSA have separate data governance processes and different EMR systems (e.g., Meditech and Cerner). These legal separations make health record data sharing between PHSA facilities (such as BC Children's Hospital) and neighbouring facilities in Vancouver Coastal Health (VCH) (such as UBC Hospital), where patients might seek care at multiple hospital EDs in close succession, more challenging since cumbersome information sharing agreements are required. Nevertheless, there are systems in place such as the General Health Information Sharing Agreement (GHISA) that allows data sharing between GHISA members more easily through brief information sharing plans instead of cumbersome information sharing agreements (52). Local experts shared that GHISA is an example of the potential to expand data sharing in the future as PHSA and VCH are actively working to establish parameters and criteria for data sharing between sites. Additionally, some province-wide datasets are only accessible through PHSA, such as the Trauma Registry. Public reporting on EC data is also generally limited, with the exception of an ED wait time website active in the VCH Authority, PHSA, Providence Health Care, Fraser Health, and at BC Children's Hospital (23). As a way of reporting for internal users, the Healthideas system performance portal provides province-wide EC dashboards with aggregated non-real-time data to support decision making and is accessible for the Ministry of Health and approved health authorities' staff. This portal includes data such as wait times, volumes overtime, and left-without-being-seen, and is updated at different frequencies, including some data updated annually (53).

TABLE C1. Access to EC data in BC

Data Category	Dataset	Access platform	Type of access	Ease of access	Frequency of updates	Aggregation level	Linkable to other datasets	Analytic or Visual Services
Administrative data	NACRS (level 2)	PopData; HDPBC; Hospitals	Upon request; restricted for Hospitals and health authorities	Medium	3 months	Individual	Yes	No
	Admission Discharge Transfers	ND	Upon request; restricted for Hospitals and health authorities	Medium	ND	Individual	ND	ND
Health records	ED EMR Data	Regional Health Authorities	Restricted, and upon request	Medium	Daily	Individual	Yes	Yes
Disease registries	BC Trauma Registry	PHSA	Upon request	Low	ND	Individual	ND	ND
	BC Cardiac Arrest Registry	BC RESURECT Research Committee	Upon request	Low	ND	ND	ND	ND
Billing data	MSP Supplement	PopData; Hospitals	Upon request	Low	3 months	Individual (physician-level)	Yes	No
Patient surveys	Patient-Centered Measurement ED Survey	PopData; HDPBC	Limited – embargoed access	Low	Annually, with the most recent occurring in 2018	Aggregated, Health Authority level	Potentially	No

Legend. **ND (Not Defined):** Lack of any information on data usage, or conflicting information.

Abbreviations: **NACRS**: National Ambulatory Care Reporting System; **MSP**: Medical Services Plan

Definitions: **Data category**: Refers to the categories of the main sources of EC data; **Access platform**: Platform that provides access to the EC data; **Type of access**: Indicates whether data is restricted for approved staff, available upon request, or publicly available; **Ease of access:** Considers potential barriers to access the EC data, including time, fees, length of request application, clarity in the process, among others. For datasets that are internally held by a hospital or organizations, access may be very easy for internal data users, such as senior leadership or analysts. Other data platforms may have long waits for access; **Low:** Speed of access is low, data users may be waiting months for access and request processes are inconvenient; **Medium**: Speed of access for data users may be a couple of weeks or a month with request processes relatively simple; **High**: Access to datasets is either instantaneous or takes only a few days; **Fees**: Fees associated with accessing the data; **Frequency of updates**: Frequency on which data is updated; **Aggregation level**: Minimum level that data can be accessed: Individual: Data available at the patient level (record level) or at the physician level in the case of billing data; **Aggregated**: Data is available at levels other than individual (e.g., hospital); **Linkable to other datasets**: Whether data can be linked to variables in other data sources; **Analytic or visual services:** Interactive visuals and analytics, including predictive models and tableau visualizations.

Use of EC data to inform practice/system improvements

EC data serves many purposes in BC—Population Data BC is intended to be used primarily by academic researchers, while the HDPBC is focused on improving the ability of researchers and policy makers to collaborate to perform QI and adjust existing programs with greater ease. One example of how HDPBC data is used is the HealthLink BC Emergency iDoctor in Assistance Program (HEiDi), which uses HDPBC to access recent data to provide constant updates and improvements for practice to virtual physicians in 811-call settings (54). Within hospitals, EMR data is more often used, along with several other sources of data such as imaging, ADT, MSP data, among others, to inform practice improvements compared to other data sources. Health records data provide rich, timely, and relatively good quality information at the hospital level to inform decisions pertaining to issues that require immediate action. For example, within hospitals and health authorities, an administrator or manager can examine the relationship between triage score and outcomes for patients presenting with cardiovascular distress, and EMR data would be summarized into reports by analysts to answer such questions. A specific example is work being done by the BC Post-COVID-19 Interdisciplinary Clinical Care Network to support patients with long COVID (32,33). Physicians working at different hospital sites collect their EMR data and patient survey data with administrative sources, with an aim of improving care for long-COVID patients. While it is possible to report on physician performance using the ADT dataset, this depends on each hospital for which we identified a low current use of the data for this purpose. The publication of wait times within VCH hospitals also represents an effort to improve system performance, as patients can choose hospitals with shorter wait times—effectively smoothing differences in volume between facilities. This wait time information is real-time and is based on administrative sources within VCH. **Table C2** summarizes the different uses of EC data use in the province.

TABLE C2. Use of EC data in BC

Data Category	Dataset	**Research** *Data used to answer specific research questions and generate knowledge*	**Quality Improvement** *Data used to improve the quality of EC*	**Performance reporting: Health system** *Data used for public reporting on EC progress based on indicators*	**Performance reporting: Physician** *Data used to report on the performance of individual physician practice in the ED*
Administrative data	NACRS (level 2)	High	Medium	Medium	Low
	Admission Discharge Transfers	Low	Low	ND	Low
Health records	ED EMR Data	Medium	High	Low	Low
Disease registries	BC Trauma Registry	ND	ND	ND	ND
	BC Cardiac Arrest Registry	ND	ND	ND	ND
Billing data	MSP Supplement	High	ND	Low	Low
Patient surveys	Patient-Centered Measurement ED Survey	Medium	Low	Medium	Low

Legend. **ND (Not defined):** Lack of any information on data usage, or conflicting information.

Abbreviations. **MSP:** Medical Services Plan; **NACRS**: National Ambulatory Care Reporting System

Definitions. **Low**: Information available suggesting either no use, or very limited use of data for those purposes (for example, evidence of use in one-off report); **Medium**: Information available suggesting moderate use of data for those purposes (for example, data usage is possible, but infrequently used); **High**: Information available suggesting routine use of data for those purposes.

Integration of EMR data in EC

EMR adoption in EC varies across the province, with some regions relying mostly on paper records. In regions where electronic records are standard practice, there is still a limited ability to fully capture the patient journey across facilities. A specific example of a particular challenge is the use of two different EMR systems in the adjacent locations of Fraser Health and VCH—two health authorities that frequently manage ED patients from either authority. While it is possible to link EMR records to other sources, doing so requires data approval from stewards, making it difficult to achieve for researchers external to hospitals and health authorities. **Table B3** summarizes the adoption of EMR systems in EDs in BC.

TABLE C3. Adoption of EMR systems in emergency departments in BC

Owner of EMR	Level of EMR adoption	Standardization of EMR systems	EMR data access (+ linkage) across EDs	EMR data access for research	Privacy considerations	Quality of EMR data
Regional Health Authorities	Some hospitals with EMR	Variable definitions and collection procedures with a need for standardization across EDs and regions	EMR connected within each health authority, and EDs with same EMR system; It is possible to link EMR to other datasets but approval from different custodians is required	EMR data can be accessed by request to the specific health authority	Each health authority requires its own ethics and privacy approval process with variable requirements	ND

Legend. **ND (Not Defined):** Lack of any information on data usage, or conflicting information

Summary

Overall, the availability and scope of EC data in BC vary substantially by access platform, with researchers facing long wait times, high fees, limited provision of analytical services, and generally limited access to some critical datasets. There are strengths within the data landscape and new opportunities for quality improvement research in the form of the HDPBC holdings, rich pre- and post-hospital datasets, and public ED wait times data. Furthermore, there is an opportunity for the province to integrate more analytical support for data requests to enhance EC data access and use. Limited data sharing between health authorities, variable EMR systems and levels of EMR adoption, and incomplete NACRS reporting at only level 2 remain significant problems, although some local experts believe existing technologies can help address these challenges. Additionally, experts noted that other issues include hospitals' data systems being on different platforms and the challenge of sharing data across health authorities. Beyond these challenges, a general feeling exists among users that a culture of data fluency, transparency, or usage in the health system could be improved.

Alberta

Main sources of EC data

We categorized the main sources of emergency care (EC) data in each province into five groups: 1) administrative, 2) health records, 3) disease registries, 4) billing, and 5) patient survey data. In this review, our interest is to capture sources of individual, de-identified, and linkable data. In Alberta, administrative data comprises the individual, de-identified, and linkable level 3 data from the National Ambulatory Care Reporting System (NACRS;[3] the province's Ambulatory Care Classification System [ACCS]), which emergency departments (ED) across the province are mandated to submit. Level 3 NACRS collects data on ED wait time indicators, presenting complaints, ED discharge diagnoses, and ICD-10-CA[4] diagnoses and interventions (48). Despite Alberta's mandate to report NACRS to CIHI, the impression among some local experts was that not all variables are captured systematically across hospitals. Health records in Alberta contain timestamps, diagnoses, laboratory values, allergy and intolerance information, and pharmacy care plans (44,55), and are used as the source of data to report to NACRS and other administrative datasets, including disease registries and information on presenting complaint. ED patient experience surveys include: the 1) Alberta Health Services (AHS) Emergency Medical Services Patient Experience Survey across all provincial health regions; and 2) Emergency Department Patient Experience of Care Survey, which collects information from 16 EDs with higher demand regarding patients' experience in the ED, including staff introductions, help for pain, communications, and overall experience.

We identified additional data that can also inform EC practice and system improvement; these complement core EC data, including disease registries pulled from the electronic health record systems such as the APPROACH dataset (56), and practitioner claims (physician and other providers' fee-for-service and shadow-billed claims). All the identified EC datasets can be linked to other data sources. **Table C4** summarizes the EC datasets available in the province and the characteristics related to their access.

Accessibility of EC data

Researchers and other users external to AHS can access provincial administrative datasets, including NACRS, by submitting a request to AHS with variable fees (24,25). Some local experts noted that despite researchers accessing data through AHS requests has improved over time in timeliness, particularly if the data does not need to be linked between diverse datasets, there are delays in data aggregation making it unsuitable to inform timely decision making in hospital settings. For operational data and quality improvement activities internal to AHS, EC data can be accessed by approved internal staff immediately and using Tableau dashboards for data visualization as a self-serve tool. Another way to access EC data in the province is through the provincial internal clinical information systems where approved staff can access health record data with daily updates and available visualization tools (Connect Care EPIC's visualization and analysis tools). Because of privacy and data sharing agreements this data is openly available only to some staff with leadership and analytical roles in the hospital or to members of the Emergency Strategic Clinical Network, while other users such as external researchers can only access the data by submitting a request. One concern mentioned about accessing individual de-identified data

[3] See ***BOX 2.*** *Levels of care submitted to NACRS and their data elements* in the main report (p.6).

[4] International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada

through AHS is a potential risk of sharing identifiable data when external users request high volumes of data. To address this potential issue, AHS is adopting an approach in which they release minimum information for the project and are looking to implement an analytical service that allows researchers to obtain the outputs of their models without seeing the data.

The AHS Emergency Medical Services Patient Experience Survey reports are publicly available on the AHS website (57). The Emergency Department Patient Experience of Care Survey data, along with other non-real time measures on wait times and delivery of care, are also publicly available on the Health Quality Council of Alberta's FOCUS website (26). Local experts considered that patient experience data has not been widely used to inform research, quality improvement or performance reporting. Other ways to access data include the Alberta SPOR SUPPORT Unit that provides faster access to administrative AB HS datasets with the possibility for analytical services; and access requests to datasets held by the Alberta Ministry of Health. These services are available with a fee and might also get financial support (24).

Use of EC data to inform practice/system improvements

There is routine use of EC data in Alberta for research, though only clinical/health records data are consistently used for EC quality improvement and performance reporting. Because of the hurdles to access timely and updated EC data through AHS requests, these datasets in the province are generally used for research and to inform areas of opportunity for health system improvement. One example of EC data used in Alberta for research and quality improvement is the work by McLane et al. (2022) which found that First Nations had a higher probability of being assigned lower acuity triage scores, often related to inequities in EC and health outcomes (35). Another example is the work of Newton et al. (2010) that explored predictors of ED return visits for pediatric mental health care, finding higher probability of return linked to how patient presentations were triaged and whether visits were made to a pediatric or general ED (36). Health records data provide rich, timely, and relatively good quality information at the hospital level, mainly used for operational, quality improvement, and health system performance reporting. Health records are also used at the hospital level to develop individual physician performance reports. These reports include, among others, readmission rates, and are shared with ED physicians to anonymously compare with their peers for performance improvement in areas where Connect Care has expanded, including Calgary and Edmonton. The work by Lenz et al. (2017) illustrates the use of health records data to assess physician performance in terms of the average number of patients seen per hour and patients' satisfaction in the ED. One limitation of the data at the hospital level is that readmission rates are not traceable across hospitals, and it is complicated to know if visits are for the same complaint. Nevertheless, the roll-out of a single emergency health record (Connect Care) is addressing this traceability challenge using data on unscheduled return visits within 72 hours of index visits that resulted in admission. As of June 2023, the return measure is only available at large Connect Care EDs' emergency physician dashboards. **Table C5** summarizes the EC datasets available in the province and describes the extent to which data is used for four main purposes: research, quality improvement, health system performance reporting, and physician performance reporting.

TABLE C4. Access to EC data in Alberta

Data Category	Dataset	Access platform	Type of access	Ease of access	Frequency of updates	Aggregation level	Linkable to other datasets	Analytic or Visual Services
Administrative data	NACRS ACCS (Level 3)	Alberta Health Services	Upon request	Medium	3 months	Individual	Yes	Yes
Health records	Hospital EMRs	Hospitals	Upon request; Open for approved staff	Medium	Real time	Individual	Yes	Yes
	Netcare	ANP	Upon request; Open for approved staff	Medium	Real time	Individual	Yes	No
	PIN	Alberta Netcare Electronic Health Record	Upon request; Open for approved staff	Medium	Real time	Individual	Yes	No
Disease registries	Various derived from electronic health record systems, e.g., APPROACH	APPROACH platform	Upon request	Medium	Real-time and every 3 months	Individual	Yes	No
Billing data	Practitioner claims	Alberta Health	Upon request	Low	Six months	Individual	Yes	Yes
Patient surveys	Emergency Medical Services Patient Experience Survey	Alberta Health Services	Publicly available	High	Six months	Aggregated, AHS Zone	No	Yes
	Emergency Department Patient Experience of Care Survey	HQCA	Publicly available	High	Annually	Aggregated, hospital and provincial	No	Yes

Abbreviations. ANP (Alberta Netcare Portal); APPROACH (Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease); HQCA (Health Quality Council of Alberta); NACRS (National Ambulatory Care Reporting System); PIN (Pharmaceutical Information Network)

Definitions. **Data category:** Refers to the categories of the main sources of EC data; **Access platform:** Platform that provides access to the EC data; **Type of access:** Indicates whether data is restricted for approved staff, available upon request, or publicly available; **Ease of access:** Considers potential barriers to access the EC data, including time, fees, length of request application, clarity in the process, among others. For datasets that are internally held by a hospital or organizations, access may be very easy for internal data users, such as senior leadership or analysts. Other data platforms may have long waits for access.; **Low:** Speed of access is low, data users may be waiting months for access and request processes are inconvenient. **Medium:** Speed of access for data users may be a couple of weeks or a month with request processes relatively simple. **High:** Access to datasets is either instantaneous or takes only a few days. **Fees**: Fees associated with accessing the data; **Frequency of updates**: Frequency on which data is updated. **Aggregation level:** Minimum level that data can be accessed: Individual: Data available at the patient level (record level) or at the physician level in the case of billing data. **Aggregated**: Data is available at levels other than individual (e.g., hospital); **Linkable to other datasets**: Whether data can be linked to variables in other data sources; **Analytic or visual services:** Interactive visuals and analytics, including predictive models and tableau visualizations.

TABLE C5. Use of EC data in Alberta

Data Category	Dataset	**Research** *Data used to answer specific research questions and generate knowledge*	**Quality Improvement** *Data used to improve the quality of EC*	**Performance reporting: Health system** *Data used for public reporting on EC progress based on indicators*	**Performance reporting: Physician** *Data used to report on the performance of individual physician practice in the ED*
Administrative data	NACRS AACRS (Level 3)	High	High	Low	Low
Health records	Hospital EMRs	Medium	High	High	Medium
	Netcare	Low	Medium	Medium	Medium
	PIN	Medium	Medium	Medium	Medium
Disease registries	Various derived from electronic health record systems, e.g., APPROACH	High	Low	Low	Low
Billing data	Practitioner Claims	Medium	Low	Low	Low
Patient surveys	Emergency Medical Services Patient Experience Survey	Low	Low	Low	Low
	Emergency Department Patient Experience of Care Survey	Low	Low	Low	Low

Abbreviations. APPROACH (Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease); NACRS (National Ambulatory Care Reporting System); PIN (Pharmaceutical Information Network)

Definitions. **Low**: Information available suggesting either no use, or very limited use of data for those purposes (for example, evidence of use in one-off report); **Medium**: Information available suggesting moderate use of data for those purposes (for example, data usage is possible, but infrequently used); **High**: Information available suggesting routine use of data for those purposes.

Integration of EMR data in EC

As part of a provincial initiative that aims to create a single access point for health records, Alberta is moving towards the integration of a unique EMR system, replacing health information systems with Connect Care, with rollout in waves from 2019 to 2024 across the different health zones by health facility (43). Hospitals using Connect Care can access standardized information from health records across sites for clinical, research, and quality improvement purposes. In zones that have not transitioned to Connect Care, approved staff can access health records data from other hospitals through Netcare, the provincial electronic health record system (44). Local experts believe that the unification of the EMR systems will enhance the data coverage across rural areas and standardize the data, including triage scores, and will allow users access to close to real-time data. **Table C6** describes the progress on the adoption of electronic medical records (EMRs) in the province and the integration of and access to EC data.

TABLE C6. Adoption of EMR systems in emergency departments in Alberta

Owner of EMR	Level of EMR adoption	Standardization of EMR systems	EMR data access (+ linkage) across EDs	EMR data access for research	Privacy considerations	Quality of EMR data
Alberta Health Services	In progress of connecting all EMR across province	Standardized through Connect Care	Connected across EDs, to date mainly in setting with Connect Care	Upon request	Access by authorized staff and under request	Some input errors

Summary

In general, the available EC data in Alberta is considered rich and accessible to people in the system; however, some challenges exist that some local experts noted, such as in accessing timely and systematic data for users outside the hospital system. Patients' journeys in the care system can be tracked across hospitals, however, there are challenges identifying if return visits are due to the same cause. Moreover, while EC data holds great potential for informing practice and system improvements in the province, some local experts consider that EC data is underleveraged, particularly the opportunities that exist to highlight geographic variation. Additionally, local experts noted that while there are frequent data requests for knowledge generation, including the creation of dashboards, the data is not always used for action and improvement of the EC and healthcare system.

Ontario

Main sources of EC data

We categorized the main sources of emergency care (EC) data in each province into five groups: 1) administrative, 2) health records, 3) disease registries, 4) billing, and 5) patient survey data. The two main types of EC data in Ontario are administrative and health records data. Administrative data includes NACRS[5] as the national hospital and community ambulatory care dataset. Reporting data to NACRS in the province is mandatory, although not all the data must be collected, and the information available (at the individual level) depends on the level of submission at each facility. In Ontario, emergency departments (ED) report level 3 data (except for one ED reporting level 1), which includes data for ED wait time indicators, presenting complaint, ED discharge diagnoses, and ICD-10-CA[6] diagnoses and interventions (48). Moreover, NACRS data can be linked to other datasets. Other administrative EC data includes datasets used for the Pay for Results Program (P4R), which aims to improve ED wait times and overall quality across ED in the province. The P4R datasets capture data in about 45% of the EDs in Ontario, representing about 85% of ED encounters, and include three datasets: the eCTAS (Electronic Canadian Triage and Acuity Scale) (58), the Emergency Room National Ambulatory Reporting System Initiative (ERNI) (59), and the ED Return Visit Quality Program (ED RVQP) (60). The P4R datasets are mandatory in that 45% of the EDs, with about 40 EDs voluntarily reporting on eCTAS and a smaller number to ERNI. eCTAS is derived from the electronic triage decision support tool eCTAS and collects individual-level metrics of triage and acuity. Despite eCTAS's ability to be linked to other datasets, the match is often poor since it was not designed for research purposes and patient-level identifiers such as health card insurance number, name, and birth date are not mandatory. ERNI is another individual-level EC dataset used for the P4R and measures patients' lengths of stay in the ED. ERNI data can be linked to other datasets internally only at the hospital level. The ED RVQP collects individual-level data on ED return visits and it can be linked to other datasets internally at the hospital level only. Most of the ERNI and ED RVQP data is available in NACRS.

Health records data is formed by patient health records at the hospital level and then collated to form the before mentioned administrative datasets. We identified additional sources of data that can also inform EC practice/system improvement; these complement core EC data, including the virtual urgent care dataset housed at the Schwartz/Reisman Emergency Medicine Institute (SREMI), created from a provincial pilot program of 14 ED-led virtual urgent care initiatives, the Ontario Trauma Registry, the OHIP Claims Database, and the Ontario ED Patient Experience Survey. Most of the EC datasets, like NACRS, can be linked to other non-EC data that provide relevant context information to enhance its interpretation, these additional datasets include the Discharge Abstract Database (DAD)[7], the Ontario Laboratory Information System (OLIS), and vitals statistics. **Table C7** summarizes the EC datasets available in the province and the characteristics related to their access.

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[5] See ***BOX 2.*** *Levels of care submitted to NACRS and their data elements* in the main report (p.6).

[6] International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada

[7] We excluded DAD metadata, even though it captures post-ED care for admitted patients, since the data are standardized across provinces and were not raised by local experts as central to analyzing and improving EC quality and outcomes; see *Limitations* on p.4.

TABLE C7. Access to EC data in Ontario

Data Category	Dataset	Access platform	Type of access	Ease of access	Frequency of updates	Aggregation level	Linkable to other datasets	Analytic or Visual Services
Administrative data	**NACRS** (level 3)	ICES; Hospitals (hospital-level data)	Upon request; restricted for hospitals	Medium	3 months; days for hospitals	Individual	Yes	Yes
	eCTAS	Hospitals	Restricted	Low	Daily	Individual	Yes, but poor match	Yes
	ERNI (NACRS level 1)	ICES, Hospitals	Upon request; restricted for hospitals	Medium	Monthly	Individual	Yes	No
	ED RVQP	Hospitals	Restricted for hospitals	Low	3 months	Individual	Yes	Yes
	Virtual urgent care	SREMI	Upon request; restricted for VUC sites	Low	n/a	Individual	Yes	No
Health records	**Health records**	Hospitals	Restricted for hospitals	Low	Daily	Individual	Yes	No
Disease registries	**Ontario Trauma Registry Metadata**	ICES	Upon request	Medium	ND	Individual	Yes	Yes
Billing data	**OHIP Claims Database**	ICES	Upon request	Medium	ND	Individual	Yes	Yes
Patient surveys	**Ontario ED Patient Experience Survey**	OHA	Restricted for hospitals	Medium	Annually	Hospital	No	Yes

Legend. **ND (Not Defined)**: Lack of any information on data usage, or conflicting information.

Abbreviations. eCTAS (Electronic Canadian Triage and Acuity Scale); ED RVQP (ED Return Visit Quality Program); ERNI (Emergency Room National Ambulatory Initiative); NACRS (National Ambulatory Care Reporting System); OHA (Ontario Hospital Association); OHIP (Ontario Health Insurance Plan); SREMI (Schwartz/Reisman Emergency Medicine Institute)

Definitions: **Data category**: Refers to the categories of the main sources of EC data; **Access platform**: Platform that provides access to the EC data; **Type of access**: Indicates whether data is restricted for approved staff, available upon request, or publicly available; **Ease of access**: Considers potential barriers to access the EC data, including time, fees, length of request application, clarity in the process, among others. For datasets that are internally held by a hospital or organizations, access may be very easy for internal data users, such as senior leadership or analysts. Other data platforms may have long waits for access.; **Low**: Speed of access is low, data users may be waiting months for access and request processes are inconvenient. **Medium**: Speed of access for data users may be a couple of weeks or a month with request processes relatively simple. **High**: Access to datasets is either instantaneous or takes only a few days. **Fees**: Fees associated with accessing the data; **Frequency of updates**: Frequency on which data is updated. **Aggregation level:** Minimum level that data can be accessed: Individual: Data available at the patient level (record level) or at the physician level in the case of billing data. **Aggregated**: Data is available at levels other than individual (e.g., hospital); **Linkable to other datasets**: Whether data can be linked to variables in other data sources; **Analytic or visual services:** Interactive visuals and analytics, including predictive models and tableau visualizations

Accessibility of EC Data

There are different ways to access EC data in Ontario, including access through provincial data repositories and directly from the hospitals. Provincial datasets (i.e., NACRS and the OHIP Claims Database) can be accessed by researchers through the data repository ICES with an application process that is straightforward but outdated once it is obtained, particularly for NACRS. A local expert mentioned that sometimes the data can be a couple years old when retrieved. These delays make it inconvenient for timely health system performance reporting or time-sensitive decision-making at hospitals. ICES offers analytical services for additional costs. In addition to provincial data repositories, updated hospital-level administrative data (NACRS, eCTAS, ERNI, and ED RVQ) and health records data, are accessed more quickly through hospitals' data systems by approved staff, such as senior leadership or analyst. While most of the data can be accessed in a dataset for analysis, participating hospitals in the ED RVQ receive data reports that help inform quality improvement. External researchers and other users can request access to EC data through each hospital's internal processes, although this can be an onerous process. To address these access challenges, Cancer Care Ontario was developing a system to obtain eCTAS data through requests; however, the plan was put on hold with the 2019 health reform that merged provincial health agencies into Ontario Health. Virtual urgent care data is not integrated with the rest of virtual care services in the province and is available to the research group that collects the data (housed at SREMI). This dataset is not updated as it contains all virtual urgent care (VUC) encounters from the 14 participating ED-led sites from December 2020-September 2021.

Use of EC data to inform practice/system improvements

Different EC datasets in Ontario are often used for research, though only health records data are consistently used for EC quality improvement and performance reporting. Because of the challenges to access timely and updated EC data, administrative datasets, disease registries, and billing data in the province are generally used for research and to inform areas of opportunity for health system improvement. One example of EC data use in the province is the work of Chartier et al., (2021) that described the return inpatient visits during the first 3 years of the ED RVQ program based on a novel classification of adverse events, finding several EDs adopting quality improvement projects, mainly training, and identifying the program as a promising tool to enhance EC in the province (38). Another example is the provincial evaluation of the implementation of eCTAS and its impact on hospital admission, rate of left without being seen, and time from triage to physician initial assessment, finding small differences in the admission rates for some acuity levels (39). Nonetheless it is no longer updated, the VUC data was used to inform provincial policy decisions on how to best structure and support VUC services for low acuity complaints, including the role of EDs (40). Updated hospital-level administrative data (NACRS, eCTAS, ERNI, and ED RVQ) and health records data, are used by approved staff for quality improvement, performance reporting, and time-sensitive decision-making at hospitals. In relation to patients' perspective, data from the Ontario ED Patient Experience Survey is often generated from a small sample of patients and is not often used to inform research, quality improvement, or performance reporting. **Table B8** summarizes the different uses of EC data use in the province.

TABLE C8. Use of EC data in Ontario

Data Category	Dataset	**Research** *Data used to answer specific research questions and generate knowledge*	**Quality Improvement** *Data used to improve the quality of EC*	**Performance reporting: Health system** *Data used for public reporting on EC progress based on indicators*	**Performance reporting: Physician** *Data used to report on the performance of individual physician practice in the ED*
Administrative data	NACRS (level 3)	High	Medium	Medium	Low
	eCTAS	Medium	High	High	Low
	ERNI (NACRS level 1)	Low	High	High	Low
	ED RVQP	Medium	High	High	Medium
	Virtual urgent care	Medium	High	Low	Low
Health records	Health records	High	High	High	Low
Disease registries	Ontario Trauma Registry Metadata	Medium	Low	Low	Low
Billing data	OHIP Claims Database	Medium	Low	Low	Low
Patient surveys	Ontario ED Patient Experience Survey	Low	Low	Low	Low

Definitions. **Low**: Information available suggesting either no use, or very limited use of data for those purposes (for example, evidence of use in one-off report); **Medium**: Information available suggesting moderate use of data for those purposes (for example, data usage is possible, but infrequently used, or is only available for a select few to use); **High**: Information available suggesting routine use of data for those purposes.

Abbreviations. eCTAS (Electronic Canadian Triage and Acuity Scale); ED RVQP (ED Return Visit Quality Program); ERNI (Emergency Room National Ambulatory Initiative); OHIP (Ontario Health Insurance Plan)

Integration of EMR data in EC

Ontario's hospitals are at different levels of digitalization regarding the use of electronic medical records (EMR), with several EDs using paper-based health records. For those hospitals that use EMRs, the structure across hospitals is not standardized and accessing EMRs from other hospitals is usually not possible due to privacy concerns and differences in the vendors; regardless, return visits to any EDs and their complaints can be tracked in an aggregate level in hospitals enrolled in the pay-for-results program (38). Moreover, although it is not possible to access EMR between hospitals, the platform Connecting Ontario aggregates EMR data into a single patient record solely to inform clinical practice (45). **Table C9** summarizes the adoption of EMR systems in EDs in Ontario.

TABLE C9. Adoption of EMR systems in emergency departments in Ontario.

Owner of EMR	Level of EMR adoption	Standardization of EMR systems	EMR data access (+ linkage) across EDs	EMR data access for research	Privacy considerations	Quality of EMR data
Hospitals	EMR in some urban hospitals	ND	EMR not connected between EDs but return visits to different EDs can be tracked in hospitals enrolled in the pay-for-results program	Available for research upon request	Each hospital requires its own ethics and privacy approval process with variable requirements	ND

Legend. **ND (Not Defined):** Lack of any information on data usage, or conflicting information.

Summary

Overall, there are various EC datasets across Ontario with relatively good quality, that allow assessing and improving EC services from triage to EC and identifying patients returning to emergency services across EDs and the reasons for their return. Nevertheless, updated data to inform timely decisions is mostly available only to people with leadership roles at the hospital level and access to other users is more challenging.

Quebec

Main sources of EC data

We categorized the main sources of emergency care (EC) data in each province into three groups: 1) administrative, 2) health records, and 3) patient survey data. Collection of NACRS[8] data within the province is uncertain; while CIHI reports that 115 Facilities in Quebec report level 1 data to NACRS, two of our local experts and Statistics Canada report that Quebec does not report hospitalization data for comparison with other provinces (31). It is clear that NACRS is not a dataset that is used within the province. Level 1 NACRS data contains information for wait-time indicators, while level 3 additionally contains information on presenting complaints, ED discharge diagnoses, and ICD-10-CA[9] diagnoses and interventions (48). RAMQ is the chief point of access for provincial health and EC datasets in Quebec, including the Banque de Données Communes des Urgence (BDCU), or Common Emergency Room Data Bank. This administrative dataset contains information on episodes of care given to people presenting to EDs in the province, and is linkable to other administrative databases (e.g., physician billing, hospital) using unique patient identification numbers. Aside from administrative sources, health records are recorded and maintained by individual hospitals, with strict privacy guidelines limiting the sharing of data between facilities. Health records are not linkable to other data sources, but they are available in real-time for hospital employees who have been granted access. We identified additional sources of data that can also inform EC practice/system improvement; these complement core EC data, including disease registries, such as the Quebec Trauma Registry. **Table C10** summarizes the EC datasets available in the province and the characteristics related to their access.

Accessibility of EC data

Quebec has two main points of access to EC data. The Institut de la Statistique du Québec (ISQ) is the chief point of access for provincial health and EC datasets in Quebec, including the BDCU and the Quebec trauma registry, which includes information on patients admitted to Quebec's trauma centers. Contributing to NACRS collection and to provincial-level reporting, each hospital also collects their own data which typically services in-house analyses. Accessing data through the hospital is usually the easiest means of access for researchers and hospital administrators working within the system, although data cannot be shared for comparison of patient-level information outside of the facility. In some cases, users identified specific cases where aggregate-level data is visible between facilities. Individual patient information and identifiers, however, are not transferable across hospitals, nor are patient-level identifiers the same. In-house research and leadership within the hospitals tends to use these datasets to inform physician performance and QI initiatives. Analytic and visualization services are available in-house for leadership and administrators to make sense of the health data presented to them. Public dashboards hosted on PowerBI describe the current state of various healthcare system metrics to the public, including some information on ED wait times (28).

[8] See ***BOX 2.*** *Levels of care submitted to NACRS and their data elements* in the main report (p.6).

[9] International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada

Table C10. Access to EC data in Quebec

Data Category	Dataset	Access platform	Type of access	Ease of access	Frequency of updates	Aggregation level	Linkable to other datasets	Analytic or Visual Services
Administrative data	NACRS (level 1)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Common Emergency Room Data Bank	Upon request and payment	High, if permission is granted	Yearly	Individual	Yes	No	Upon request and payment
Health records	ED EMR data	Restricted	High	Real-time to monthly	Individual	No	Yes	Restricted
Disease registries	Quebec Trauma Registries	Upon request and payment	Low	ND	ND	Yes	No	Upon request and payment

Legend. **n/a (not applicable)**: Local experts indicated these are not used in EC in the province; **ND (Not Defined)**: Lack of any information on data usage, or conflicting information.

Definitions: **Data category**: Refers to the categories of the main sources of EC data; **Access platform**: Platform that provides access to the EC data; **Type of access**: Indicates whether data is restricted for approved staff, available upon request, or publicly available; **Ease of access**: Considers potential barriers to access the EC data, including time, fees, length of request application, clarity in the process, among others. For datasets that are internally held by a hospital or organizations, access may be very easy for internal data users, such as senior leadership or analysts. Other data platforms may have long waits for access.; **Low:** Speed of access is low, data users may be waiting months for access and request processes are inconvenient. **Medium**: Speed of access for data users may be a couple of weeks or a month with request processes relatively simple. **High:** Access to datasets is either instantaneous or takes only a few days. **Fees**: Fees associated with accessing the data; **Frequency of updates**: Frequency on which data is updated. **Aggregation level:** Minimum level that data can be accessed: Individual: Data available at the patient level (record level) or at the physician level in the case of billing data. **Aggregated**: Data is available at levels other than individual (e.g., hospital); **Linkable to other datasets**: Whether data can be linked to variables in other data sources; **Analytic or visual services:** Interactive visuals and analytics, including predictive models and tableau visualizations.

Use of EC data to inform practice/system improvement

There is a strong emphasis on the use of hospital-collected health records and patient flow metrics to inform system improvement. This has been described as the fastest and easiest method of data access for researchers connected to hospitals. Other groups, such as Urgences Sante, use their own pre-hospital data holdings (61) and RAMQ historical administrative data holdings for projects, such as one pilot looking to predict risk levels of patients calling ambulances based upon historical hospitalizations and comorbidities. Within government, INESSS (Institut National d'Excellence en Santé et en Services Sociaux) conducts analyses with near real-time administrative data, informing other government bodies on key indicators such as COVID-19 hospitalization rates. There is not currently much research being done to explore QI from the perspective of patient experiences. We are not aware of any patient experience surveys conducted within the province, nor any research initiatives focusing on patient experience with the EC system. **Table C11** summarizes the different uses of EC data use in the province.

TABLE C11. Use of EC data in Quebec

Data Category	Dataset	**Research** *Data used to answer specific research questions and generate knowledge*	**Quality Improvement** *Data used to improve the quality of EC*	**Performance reporting: Health system** *Data used for public reporting on EC progress based on indicators*	**Performance reporting: Physician** *Data used to report on the performance of individual physician practice in the ED*
Administrative data	NACRS (level 1)	n/a	n/a	n/a	n/a
Other administrative data (other datasets)	Common Emergency Room Data Bank	Medium	Medium	ND	Low
Health records	ED EMR data	Medium	Medium	Low	Medium
Disease registries	Quebec Trauma Registries	High	ND	ND	ND

Legend. **n/a:** Local experts indicated these are not used in EC in the province; **ND**: Lack of any information on data usage, or conflicting information.

Definitions: **Low**: Information available suggesting either no use, or very limited use of data for those purposes (for example, evidence of use in one-off report); **Medium**: Information available suggesting moderate use of data for those purposes (for example, data usage is possible, but infrequently used); **High**: Information available suggesting routine use of data for those purposes.

Integration of EMR data in EC

The use of EMR data in Quebec EDs is tightly controlled due to strict privacy regulations in the province. With few exceptions, clinicians and hospital managers are not allowed to access patient information across facilities, and so information is not sharable within the health system. EMR data is not accessible for research purposes either, although the degree to which EMR data is linkable within hospitals is uncertain. **Table C12** summarizes the adoption of EMR systems in EDs in Quebec.

TABLE C12. Adoption of EMR systems in emergency departments in Quebec

Owner of EMR	Level of EMR adoption	Standardization of EMR systems	EMR data access (+ linkage) across EDs	EMR data access for research	Privacy considerations	Quality of EMR data
ND	ND	Three companies providing ED software to Quebec, not used in the rest of Canada	Data at individual level across EDs is not shareable by law	Not available for research, except at a hospital level	Does not allow clinicians/hospital managers to access patient information across EDs	ND

Legend. **ND (Not Defined)**: Lack of any information on data usage, or conflicting information.

Summary

Within Quebec, although there may be alternative methods to accessing data, it appears that most EC research and analysis makes use of in-house data holdings at hospitals. System-level improvement is also facilitated through hospital-level initiatives, except for some groups that provide larger scale evidence within the province such as Urgences Santé and INESSS. Data access for internal users (such as hospital administrators) is relatively easy, but questions remain about the use and accessibility of data for academic and other researchers operating externally to hospitals, such as university-based researchers, for example.

Nova Scotia

Main sources of EC data

We categorized the main sources of emergency care (EC) data in each province into three groups: 1) administrative, 2) health records, and 3) patient survey data. A chief source of administrative data is NACRS,[10] the collection of which is not mandated by the province, but which nonetheless covers four facilities at level 1, and four facilities at level 3 out of a total of 38 emergency departments (EDs) in the province. Data shared through NACRS is linkable to other provincial sources. Level 1 NACRS data contains information for wait-time indicators, while level 3 additionally contains information on presenting complaints, ED discharge diagnoses, and ICD-10-CA[11] diagnoses and interventions (48). Emergency Department Information System (EDIS) and STAR databases (depending on the facility) are also important sources of administrative data, capturing information such as patient admission, transfers, discharges, and some lab data. They are linkable to patient records, but not easily, and although they supply information for the NACRS reporting, they are not easily re-linked to finalized NACRS datasets. These databases also feed into a new co-ordination system known as C3 (Care Coordination Centre) at one hospital in the Halifax region, which serves to provide decision makers with real-time information on hospital capacity and patient flow. Administrative data also flows back to the public with the Action for Public Health Reporting dashboard (62), which provides information on the status of key EC indicators to the public. The final category of our data collection is patient surveys, which are conducted in the central region every 12 months, but cannot be linked to admin data or other sources. We identified additional sources of data that can also inform EC practice/system improvement; these complement core EC data, including disease registries, such as the Nova Scotia Trauma Registry. **Table C13** summarizes the EC datasets available in the province and the characteristics related to their access.

Accessibility of EC data

There are two main ways to access EC data in Nova Scotia. Through the Nova Scotia Health Authority and the Health Data Nova Scotia (HDNS) repositories, researchers and interested parties can access datasets such as NACRS, the Discharge Abstract Database (DAD)[12], the Trauma Registry, and other datasets that are aggregated for the entire province. The typical data users of the HDNS are researchers, as the delay in data aggregation and access for standardized measures such as NACRS and DAD is typically too great to make the platform useful for time-sensitive decision making at hospitals. HDNS offers descriptive and inferential analytical services, and charges fees for accessing data. The second means of accessing data is through the hospitals themselves, where continuously updated EDIS and STAR systems are used to inform ongoing clinical decision making. Although researchers and administrators working within hospitals can access internal data, sharing between organizations makes system-level surveillance and improvement difficult for many key metrics. Within hospitals offering this

[10] See ***BOX 2.*** *Levels of care submitted to NACRS and their data elements* in the main report (p.6).

[11] International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada

[12] We excluded DAD metadata, even though it captures post-ED care for admitted patients, since the data are standardized across provinces and were not raised by local experts as central to analyzing and improving EC quality and outcomes; see *Limitations* on p.4.

real-time data, administrators and managers have access to performance analytics professionals who develop and execute queries based on questions. Results are usually presented as Tableau dashboards, held for internal use. The use of data for the purposes of public reporting seems to be minimal, except for the Action for Public Health Reporting dashboard hosted by Tableau. This is public facing, updated continuously, and contains information on various healthcare metrics relevant to the EC system in the province, although a critique is that there are not enough relevant metrics provided.

Use of EC data to inform practice/system improvement

Aside from the activities of academic researchers using HDNS repositories, the use of this data in the health system is effectively limited to hospital-level improvement. Patient experience surveys are conducted in the central region, with an aim of improving quality in the surveyed hospitals. Restrictions around data sharing and low uptake of electronic-record keeping make it difficult to explore system-level outcomes. Within facilities, however, there are interesting examples of data being used to inform system improvement. A specific example is the development and planned expansion of the C3 platform at the QEII Health Sciences Centre in Halifax (42). C3 was designed to optimize the flow of patients within a hospital by looking at the day-to-day logistics. A significant quality component is embedded within the platform, including quality markers to assess the effectiveness of C3 in improving patient care metrics. The C3 platform will eventually be expanded to other hospital sites in the province. Additionally, performance metrics are routinely sent to physicians providing care in emergency settings. Within departments, physicians are sent summaries of key metrics like return-visits, laboratory and diagnostic imaging orders, acuity level of patients, and other metrics drawn from the EDIS/STAR systems. Results are anonymized for the whole department, but an individual physician can view their own records to track their performance metrics. **Table C14** summarizes the different uses of EC data use in the province.

Table C13. Access to EC data in Nova Scotia

Data Category	Dataset	Access platform	Type of access	Ease of access	Frequency of updates	Aggregation level	Linkable to other datasets	Analytic or Visual Services
Administrative data	NACRS (level 1, 3)	HDNS	Upon Request	Medium	Yearly	Individual	Yes	Yes
	Action for Public Health Reporting	Nova Scotia Tableau	Public	High	Daily	Aggregate	No	Yes
	Care Coordination Centre (C3)	Selected hospitals, internally	Restricted	High	Real-time	Individual	ND	No
	EDIS/STAR database (facility-dependent)	Selected hospitals	Restricted	Low	Real-time	Individual	Yes, but difficult	Yes
Disease registries	Nova Scotia Health Trauma Program	Nova Scotia Health Authority	Upon Request	ND	ND	Both	ND	ND
Patient surveys	Patient Experience Surveys	Nova Scotia Health Authority	ND	ND	Yearly	Individual	No	ND

Legend. **ND (Not Defined):** Lack of any information on data usage, or conflicting information.

Abbreviations. **NACRS**: National Ambulatory Care Reporting System; **HDNS:** Health Data Nova Scotia.

Definitions: **Data category**: Refers to the categories of the main sources of EC data; **Access platform:** Platform that provides access to the EC data; **Type of access**: Indicates whether data is restricted for approved staff, available upon request, or publicly available; **Ease of access**: Considers potential barriers to access the EC data, including time, fees, length of request application, clarity in the process, among others. For datasets that are internally held by a hospital or organizations, access may be very easy for internal data users, such as senior leadership or analysts. Other data platforms may have long waits for access.; **Low:** Speed of access is low, data users may be waiting months for access and request processes are inconvenient. **Medium**: Speed of access for data users may be a couple of weeks or a month with request processes relatively simple. **High:** Access to datasets is either instantaneous or takes only a few days. **Fees**: Fees associated with accessing the data; **Frequency of updates**: Frequency on which data is updated. **Aggregation level**: Minimum level that data can be accessed: Individual: Data available at the patient level (record level) or at the physician level in the case of billing data. **Aggregated**: Data is available at levels other than individual (e.g., hospital); **Linkable to other datasets**: Whether data can be linked to variables in other data sources; **Analytic or visual services:** Interactive visuals and analytics, including predictive models and tableau visualizations

TABLE C14. Use of EC data in Nova Scotia

Data Category	Dataset	**Research** *Data used to answer specific research questions and generate knowledge*	**Quality Improvement** *Data used to improve the quality of EC*	**Performance reporting: Health system** *Data used for public reporting on EC progress based on indicators*	**Performance reporting: Physician** *Data used to report on the performance of individual physician practice in the ED*
Administrative data	NACRS (level 1, 3)	High	Medium	Medium	Low
	Action for Public Health Reporting	ND	ND	ND	ND
	Care Coordination Centre (C3)	ND	High	Low	ND
	EDIS/STAR database (facility-dependent)	High	Medium	Medium	Low
Disease registries	Nova Scotia Health Trauma Program	ND	ND	ND	ND
Patient surveys	Patient Experience Surveys	Low	Low	Low	Low

Legend. **ND (Not Defined)**: Lack of any information on data usage, or conflicting information.

Abbreviations. **NACRS**: National Ambulatory Care Reporting System; **HDNS**: Health Data Nova Scotia.

Definitions. **Low**: Information available suggesting either no use, or very limited use of data for those purposes (for example, evidence of use in one-off report); **Medium**: Information available suggesting moderate use of data for those purposes (for example, data usage is possible, but infrequently used, or is only available for a select few to use); **High**: Information available suggesting routine use of data for those purposes.

Integration of EMR data in EC

None of the hospitals in Nova Scotia have electronic record keeping that would qualify as EMRs since the existing systems are generally scanned records that cannot be linked with other records within hospitals. However, there is a plan to implement a system of having one record for each patient, moving forward (46). The lack of EMR integration has ramifications beyond the purposes of research and QI, as it makes it difficult for physicians to track their patients throughout the healthcare system, denying them potentially important knowledge on care pathways.

Summary

The lack of standard collection of EMR data in the province is cited as a major drawback of the data landscape in Nova Scotia, as is the inability to link datasets. The strength of the EDIS and STAR databases used in some hospitals is their ability to provide real-time access to hospitals, and the availability of C3 to operationalize those datasets into real-time facility optimization. However, data users suggest that the real issue facing the province is not a lack of rich data, but rather in policymaking and system-level improvements, where there is insufficient will to act upon data-driven conclusions.

www.NAOhealthobservatory.com

naobservatory@utoronto.ca

nao_health