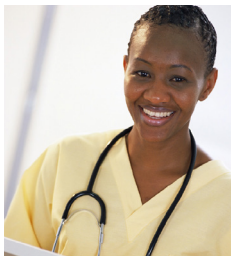
UBC CENTRE FOR
HEALTH SERVICES AND
POLICY RESEARCH

Methods to comprehensively identify emergency department visits using administrative data in British Columbia

January 2021



Sandra Peterson, MSc
Maeve Wickham, MSc
Ruth Lavergne, PhD
Jonathan Beaumier, RN MPH
Megan Ahuja, MPH
Dawn Mooney, MPH
Kimberlyn McGrail, PhD

THE UNIVERSITY OF BRITISH COLUMBIA

Methods to comprehensively identify emergency department visits using administrative data in British Columbia was produced by:

Centre for Health Services and Policy Research
School of Population and Public Health
University of British Columbia
201–2206 East Mall
Vancouver, BC V6T 1Z3
Email: chspr.reception@ubc.ca

Contents

About CHSPR

The Centre for Health Services and Policy Research (CHSPR) is an independent research centre based at the University of British Columbia. CHSPR's mission is to advance scientific enquiry into issues of health in population groups, and ways in which health services can best be organized, funded and delivered. Our researchers carry out a diverse program of applied health services and population health research under this agenda. The Centre's work is:

- Independent
- Population-based
- Policy relevant
- Interdisciplinary
- Privacy sensitive

CHSPR aims to contribute to the improvement of population health by ensuring our research is relevant to contemporary health policy concerns and by working closely with decision makers to actively translate research findings into policy options. Our researchers are active participants in many policy-making forums and provide advice and assistance to both government and non-government organizations in British Columbia (BC), Canada and abroad.

For more information about CHSPR, please visit *www.chspr.ubc.ca.*

Acknowledgements

All inferences, opinions, and conclusions drawn in this report are those of the authors, and do not reflect the opinions or policies of the Data Steward(s).

Executive summary

In British Columbia (BC), health researchers can access two separate but overlapping administrative databases that contain emergency department (ED) visits: the Medical Services Plan (MSP) and the National Ambulatory Care Reporting System (NACRS). The MSP data contain visits billed by fee-for-service physicians, while the NACRS data contain information on ED visits that took place in reporting facilities. These can be further combined with the Discharge Abstract Database (DAD), which indicates cases in which admission to hospital occurred through the ED.

The MSP data have been available since 1985, yet there has been no consensus approach among health researchers in how best to capture ED utilization in this database. Even if there was consensus, the MSP data are incomplete as they do not capture ED services not paid through fee-for-service unless an encounter claim (shadow billing) was submitted. In contrast, NACRS data in BC are limited to ED visits from participating EDs only. Though also not comprehensive, they provide a reference database to compare approaches to identifying ED visits using MSP data.

In this report, we describe the process we undertook to identify ED visits by combining the MSP and NACRS databases. In brief, we compared combinations of variables to identify ED visits (e.g., service location, fee items, admission to hospital through the ED) for patients captured by both MSP and NACRS (i.e., with a definite ED presentation). We then used that information to make recommendations on how to create the most comprehensive set of ED visits using routinely-collected administrative data.

Our recommendations are as follows:

1. For **2012-13 onward** (i.e., post introduction of NACRS data collection in BC), the combination of NACRS data with MSP data in which the service location is identified as being in an ED is sufficient to capture the majority of ED presentations, and both datasets should be used in combination where available. The addition of other approaches does not add sufficient value when both MSP and NACRS data are available to justify the coding and methodologic complexity. However, for projects wanting more complete capture of ED visits, we recommend using a combination of NACRS data and MSP data with ED service location, emergency care fee items, and/or Emergency Medical Specialist, and/or DAD records with Entry=E (i.e., admission through the ED).

2. For **2007-08 to 2011-12** NACRS data are not available, but where the MSP "service location" field is well-coded, we recommend using a combination of service location with emergency care fee items, and/or Emergency Medical Specialist, and/or DAD records with Entry=E.

3. For **1996-97 to 2006-07** data, where service location was poorly coded, we recommend the addition of on-call/on-site codes, call out codes, and the emergency visit fee item, only for when a patient is not in hospital, to the approach recommended for 2007-08 to 2011-12

Background

Emergency departments (ED) serve a crucial function in the health care system as the point of entry into the health system for many patients, as well as the primary location in which acute and unexpected medical issues are addressed, especially during hours in which primary care is unavailable. EDs can also provide a breadth of specialties and diagnostic capabilities that are not readily available in an outpatient setting.[1] Research suggests that Canadians report a higher frequency of ED use than people from other countries, with 41% of adults reporting using an ED within the prior two years.[2]

With a great amount of attention placed on the potential overuse of ED services and the importance of appropriate care settings to address issues (e.g., seeking primary care for a "family-practice sensitive condition") in an efficient and functional health system, EDs are an important setting to isolate for health services research.[1,3] Administrative databases, which contain routinely-collected and readily-accessible data, have facilitated such research and allow the identification of ED presentations as a component of health services use. However, no consensus approach exists to identify these visits in cases where multiple care settings and providers are contained in a single database.

In BC, researchers can access several databases that capture ED visits. Established in 1985, the Medical Services Plan (MSP) database contains records of fee-for-service (FFS) physician visits across BC, spanning practitioner type (e.g., physicians, other supplementary providers) and care settings (e.g., outpatient clinic, ED). However, not every ED operates on a FFS basis. The MSP data also contains encounter claims (shadow billing) submitted by alternatively paid physicians; however, not all alternatively paid physicians shadow bill or shadow bill completely, and the extent to which this is done varies by ED.

In 2012, the BC Ministry of Health mandated the implementation of the National Ambulatory Care Reporting System (NACRS) at 20 EDs in BC, some of which are funded through alternate payment schemes beyond FFS remuneration. The number of EDs submitting data to NACRS has grown over time, with 29 EDs reporting into that system as of 2018-19.[4] The addition of NACRS data to the data roster available to health service researchers allows for a more complete capture of ED data when combined with MSP data.

It is important to emphasize that even though ED visits in BC are captured in both MSP and NACRS, neither of these data sources contain a complete set of ED visits: MSP under-captures ED visits because some EDs/ED physicians are not FFS and do not report, or under-report, via shadow billings; and NACRS under-captures ED visits because not all EDs in BC submit to NACRS.

A third dataset, the Discharge Abstract Database (DAD), can be leveraged to help fill the gaps. While the DAD does not capture information on actual ED visits, it does indicate cases in which admission to hospital occurred through the ED. Combined, these three data sources partially overlap but also contain unique visits not found in the others. In addition, the set of variables captured in each varies; while NACRS was built to capture ED visits and so contains important information such as triage level, MSP and DAD were built for other purposes, so using them to identify ED visits is more complicated and they are not as content-rich as NACRS for ED-specific information.

Objectives

Given the overlapping and complementary nature of the two main administrative databases (NACRS and MSP) that capture ED visits in BC, we sought to investigate and validate these available data sources.

The objectives of this report were to:

1. Provide background details on the administrative data sources of ED visits in BC;
2. Discuss potential methods to identify ED visits in these data;
3. Provide recommendations for counting and costing ED visits using these data;
4. Provide code that can be used across projects; and,
5. Discuss the limitations of the recommended methods.

All inferences, opinions, and conclusions drawn in this report are those of the authors, and do not reflect the opinions or policies of the Data Steward(s).

Methods

Data sources

NACRS

NACRS[5] was developed by the Canadian Institute for Health Information (CIHI) to collect data on ED and other ambulatory visits (e.g., day surgeries). Across Canada, uptake has varied, with some provinces opting to submit only ED visits and others submitting combinations of ED visits, day surgeries, and other ambulatory care visits. Within some provinces, NACRS reporting has further differed between facilities. In BC, some EDs submit data to NACRS, while other facilities do not submit any data.

Prior to 2012-13, reporting to NACRS was voluntary for BC EDs, with few EDs electing to do so (Table 1). Starting in 2012, some EDs were mandated to report to NACRS, so coverage rose to an estimated 51% of the total ED visits that year. By 2015-16, of the 108 hospitals providing ED care in BC, 29 (27%) of these reported to NACRS, comprising an estimated 74% of total ED visits.[6] Coverage has remained just over 70% since then.

NACRS reporting is grouped into three levels, with Level 3 reporting the most detailed information.[7] Since 2014-15, participating BC EDs are required to submit Level 2 information to NACRS, for which the following data elements are available:

- Dates and times (e.g. registration date/time, triage date/time, disposition date/time)
- Demographic information
- Clinical information (e.g., triage level, ambulance arrival, visit disposition, presenting complaint (coded from 'pick-lists') and discharge diagnosis (a subset of the diagnosis codes available in Level 3 reporting))
- Administrative information (e.g. ED visit indicator, personal health number (PHN), practitioner number, medical record number, reporting facility number).

Note: Level 3 data, collected in some provinces, contain additional information, such as intervention (CCI) codes, Comprehensive Ambulatory Classification System (CACS) variables, and more diagnoses fields (submitted using ICD-10-CA). However, starting with the 2018-19 data, Level 2 may also include coding of ED

Table 1. The number of BC EDs submitting data to NACRS over time

Year	No. EDs submitting to NACRS	No. visits reported to NACRS	Estimated ED visits coverage[a]
2006-07	3	51,024	
2007-08	4	89,105	
2008-09	3	67,389	
2009-10	2	21,332	
2010-11	0	0	0%
2011-12	6	291,593	16%
2012-13[b]	20	1,002,467	51%
2013-14[c]	29	1,260,771	62%
2014-15	29	1,477,772	70%
2015-16	29	1,570,180	74%
2016-17	29	1,588,895	72%
2017-18	30	1,638,487	73%
2018-19	29	1,654,880	72%

Sources: CIHI NACRS data quality documentation, 2006-07 to 2010-11,[8-12] Emergency Department Visits and Inpatient Hospitalizations, 2011-12,[13] and Emergency Department Visits and Length of Stay by Province/Territory, 2012-13 to 2018–2019.[14-18,4]

[a] Estimated coverage is based on total estimated ED visits from the year prior and is reported for the years this information was contained in the CIHI source material.

[b] NACRS data can be requested from Population Data BC for 2012-13 onward.

[c] Between 2013-14 and 2014-15 the reporting level changed from Level 1 to Level 2, meaning more information is provided (specifically Presenting Complaint and ED Discharge Diagnosis (completion of at least one is mandatory)). The reporting of provider number also markedly improved between these years although the improvement does not appear to be due to the change in reporting level since both levels 1 and 2 indicate provider number is optional.

intervention pick-lists and ED investigative technology interventions.[19]

Due to the limited years of NACRS data availability and less than complete participation by BC ED facilities, other sources of data must be used to improve the capture of ED visits.

MSP

The MSP data[20] captures FFS payments made to physicians, and any encounter claims submitted for services provided by physicians who are paid through Alternative Payment Plans (APP). Thus, to the extent that ED visits are paid for through FFS or shadow-billed (i.e., claims submitted by providers otherwise on APP), ED visits are captured in MSP data. The challenge lies in identifying these ED visits, as there are a number of ways in which they can be billed, and they can be submitted by more than one physician specialty.

A complication is that the MSP data will miss ED visits that are provided by an APP provider who does not shadow bill. In BC, both Emergency Medical Specialists (specialty code 28) and Family Physicians (FP) (specialty code 00)* can work in EDs. In addition, other specialists can practice in the ED as needed. The proportion of Emergency Medical Specialists' payments that were APP was 77% in 2005-06 and 59% in 2011-12; for FPs, it was 16% in both years; and it varied for other specialists (e.g., General Surgery was 20% and 16% in 2005-06 and 2011-12, respectively).[21] Thus, MSP data on its own will undercount ED visits, so we look to using a combination of datasets to identify all ED visits.

MSP data contain elements on:

- Date (service date, paid date)
- Demographic information
- Clinical information (e.g., ICD-9 diagnostic codes)
- Administrative information (e.g. PHN, practitioner number, service location, paid amount)
- Service information (e.g. billed fee item, service code (groupings of fee items), claim specialty, service location code).

Note: While MSP data contain information on service location, there is no facility identification number to indicate specifically where the claim was billed.

DAD

The DAD[22] does not contain specific ED data, but does indicate whether the patient arrived through the ED of the reporting hospital (Entry code=E). While this variable can be used to identify an ED visit, it will only capture ED visits that resulted in admission to hospital or to day surgery. While it does not provide a complete picture, it may be useful in filling some gaps.

Identifying ED visits

Data discussed in this section cover the years 1999-00 to 2015-16 (MSP and DAD) and 2012-13 to 2015-16 (NACRS).

NACRS

Identifying ED visits in the NACRS data is a straightforward process. Currently the only data submitted

* Specialty code 00 is labelled 'GP'; we use the term Family Physician in this report.

to NACRS for BC are for ED visits, both scheduled and unscheduled. Counts of emergency (unplanned) ED visits would consider just the unscheduled visits, which represent acute and unexpected problems. In the NACRS data these can be identified using the flag EDVisit=1, although there is no information available on the quality or completeness of this field.

There are three possible scenarios in which more than one record for an ED visit for a patient may be reported on the same day:

1. Duplicates of the same visit (>1 physician seeing patient but same registration number)
2. Multiple visits on the same day (e.g. AM/PM)
3. ED to ED transfers on the same day.

For data in which the registration number is not received (e.g. through Population Data BC), it may be possible to remove the first situation but keep in the latter two, by using the date-time variables. However, for this report we combined the NACRS data with MSP data for which there are no times available, and for which we reduced visits to one visit per day, so we decided to reduce the number of visits in the NACRS data as well. This decision was made in an attempt to improve consistency when reporting across provinces, where each province might have a different proportion of ED visits in NACRS data compared to other data sources, and over time within BC. Therefore, when we report ED counts throughout this report, there will be a slight underestimate of the ED count for BC. In the 2015-16 NACRS data, this approach resulted in a 1.8% decrease in NACRS records from 1,533,546 to 1,505,617.

MSP

Identifying ED visits in the MSP data is not as straightforward, as there is no definitive flag to indicate an ED visit. In fact, the BC Ministry of Health provides a tutorial to instruct providers on billing for ED visits in MSP, which illustrates this complexity.[23]

The closest information available to an ED flag in MSP data is Service Location=E (i.e., Hospital emergency room (unscheduled patient)). However, coding of service location has changed over time. The service location=E code was used for only 148,647 to 244,753 unique-patient-day visits per year for 1999-00 to 2005-06, respectively; 874,785 in 2006-07, when new codes were introduced (March 1, 2006) and coding of service location became mandatory (Oct 1, 2006); and 1,287,156 to 1,909,199 for 2007-08 to 2015-16 (with consistently increasing numbers for the intervening years). Prior to the changes enacted in 2006-07, ED visits were mostly coded as a Service Location=H (Hospital); however, that same location code was used for the majority of hospital inpatient visits as well.

Other important sources of information in the MSP data include fee items, which are used to indicate what service was provided, and service codes, which are groupings of fee items. The MSP Payment Schedule[24] contains a set of fee items that can only be billed by physicians working in Emergency Departments (Appendix A, Table 1), which have remained consistent over time. They are easily identified in the data since they are the only fee items in the Payment Schedule that start with '018', for the years confirmed (1996-97 to 2017-18). The set of Level I to Level III emergency care fee items are consistently grouped into service code '06 Emergency Visits.' The Payment Schedule section for Emergency Medicine also

includes '00180 Emergency Medicine Consultation,' which can only be billed by Royal College Certified Emergency Physicians, and five surgical fee items which are grouped into '22 Consultation' and '43 Surgery,' respectively.

Service code '06 Emergency Visits' also consistently includes three 'on-call, on-site' fee items, fee item '00112 Emergency Visit' and fee item '00111 Emergency Home Visit' (Appendix A, Table 2). The details of item 00111 indicate it is used for emergency visits to the patient's home or accident site immediately followed by a trip to the hospital for an emergency admission. The fee items 00111, 00112 and the on-call, on-site fee items can be billed for both services that take place in the ED and outside the ED (e.g. for a patient who is inpatient in hospital).

Physicians paid APP through Alternative Payments Branch (APB) have a separate set of emergency care fee items (Appendix A, Table 3). These fee items are mostly grouped into service code '08 Miscellaneous and Other Visits' or '67 APB' depending on the year of data. Nurse practitioners also have a separate set of emergency care fee items, which get grouped into service code '65 Nurse Practitioner' (Appendix A, Table 3). Emergency care fee items for APB physicians were first used in 2001-02, and for nurse practitioners in 2005-06.

Additionally, for some Population Data BC releases the MSP data contain the workers' compensation emergency fee item '19921 WorkSafeBC hospital emergency per diem rate,' grouped into service code 60 'Form Fees and WCB Misc Items' (and in earlier years into 99 'Miscellaneous or incentive items') and 00129 'WCB Emergency Call Out', grouped into service code '06 Emergency Visits.' However, Population Data BC does not release workers' compensation data for every project.

Emergency visits provided by specialists are consistently grouped into service code '26 Emergency Visits (specialists)' (Appendix A, Table 4). However, specialists can claim emergency visits to other locations (e.g. for a patient who is inpatient in hospital), thus use of this service code would result in overestimating ED visits unless also used in combination with other indicators (e.g. service location=E for the years in which this was better coded, and for earlier years perhaps service location=E or H and also removing people who were inpatients on the date of the service).

In addition, the MSP Payment Schedule has a set of 'out-of-office hours premiums' (service code 09) (Appendix A, Table 5) which consists of 'call out' fee items (which may be billed when the physician is specially called to provide emergency or non-elective services and only when the physician must travel from one location to another) and continuing care surcharges. These fee items cannot be billed by physicians who are on duty in the ED. The latter are not as relevant for ED visits but the former might be used by physicians called to the ED, but since they can also be used when physicians are called to the hospital or other locations, these fee items would result in overestimating ED visits unless also used in combination with other indicators.

As mentioned above, both FPs and Emergency Medicine specialists can work in EDs. Claim specialty=00 'GP' is more than likely to actually take place outside of an ED and so provides no useful information, but records with Claim Specialty=28 'Emergency Medicine' likely took place in an ED.

One last set of fee items, a set of three minor and extensive laceration codes (13610, 13611, and 13612 (Appendix A, Table 6)), are not ED specific, but were included in criteria for identifying ED visits in BC in the 2002 McKendry report,[3] which was written prior to the existence of NACRS data. The latter two codes are also are mentioned in the preamble of the Emergency Medicine section of the MSP Payment Schedule. These three codes are assessed below along with the other potential ED flags identified above.

DAD

Emergency visits can be found from both inpatient and day surgery records coded with Entry=E (i.e., patient arrived through the ED of the reporting hospital). Below we will determine whether this adds additional information beyond the other data sources. Another important component of the DAD data are the dates for which a patient is an inpatient in hospital. For dates falling between hospital admission and separation dates, we should not be detecting ED visits (although ED visit dates corresponding to admission or separation may arise). This bit of information will be helpful in assessing potential ED flags.

Combining data sources to identify ED visits

The McKendry report recommended a complex set of criteria for identifying ED visits which included many of the above flags, as well as others. These criteria, while appropriate for the years for which they were created, and for a project focusing on ED visits, have since proven too complex to code for many projects that aim to provide a quick estimate of number or cost of ED visits. In addition, the coding of the service location variable has improved dramatically, and NACRS data that will identify 50% to 70% of ED visits are now available for more recent years.

Thus, this report updates the McKendry report by:

1. Determining how to identify ED visits in the MSP data and combine with NACRS data to capture a more complete set of ED visits for the years **2012-13 onward** (when NACRS data is available);
2. Assessing methods to identify ED visits in the MSP data in the absence of NACRS data but after the service location coding improvement (**2007-08 to 2011-12**);
3. Re-assessing methods to identify ED visits for **1996-97 to 2006-07** when service location coding was unreliable; and
4. Determining if Entry=E records from the DAD data capture additional ED visits over and above those identified in MSP and NACRS.

First, the MSP data elements that may potentially identify ED visits are examined in relation to dates when that person was in hospital, and in relation to service location as coded on the record, to determine if records with that data element primarily take place in ED. Second, linked MSP-NACRS records are used to further test which of the potential MSP ED flags, separately and then in combination, best capture visits in ED. Based on this information, for each time period (2012-13 onward, 2007-08 to 2011-12 and 1996-97 to 2006-07), algorithms to identifying ED visits are proposed and tested and the contribution of other data elements are assessed to find the best algorithm. As well, the total number of ED visits identified per year using the most promising algorithms are compared to ED visit counts from the Health Authority Management Information System (HAMIS) via the Health System Matrix[25] and other sources when available, to assess the proportion of all ED visits captured.

Results

Counting ED visits

2012-13 onward

For these years, we hypothesized that using service location=E in combination with NACRS data would identify most ED visits. We assess this hypothesis in the following analyses, and assess each of the potential ED visit flags to determine if the additional number of ED visits captured by each flag justifies the flag's inclusion in the final algorithm. The underlying rationale in developing the algorithm was that keeping it simple would be both a benefit for coding and explaining the approach, but not at the expense of missing many ED visits.

To combine MSP data with NACRS, the 2015-16 MSP data were first summarized into one record per service-day, with flags created to capture the following information, indicating if the given criteria was met for any record on that day:

- If service location=E for any record on that day (locED=1)
- If any of the emergency care (Level I to III) fee items were billed on that day (EmergCare=1), including those that can be billed by alternatively paid physicians and nurse practitioners
- If 00180 'Emergency Medicine Consultation' was billed that day (EMconsult=1)
- If any of the other fee items beginning with 018 (from the Emergency Medicine section of the Payment Schedule) were billed on that day (Other018fitm=1)
- If any of the claims made that day were billed with claim specialty 28 'Emergency Medicine Specialist' (EMspec=1)

In addition, flags for the following were developed, although they may be billed in other locations and were assessed with that in mind:

- If service code=26 'Emergency Visits (specialists)' on any record that day (ServCode26=1)
- If any 'on-call, on-site' fee items were billed that day (OnCallOnSite=1)
- If the 00112 'Emergency Visit' fee item was billed that day (fitm00112=1)
- If the 00111 'Emergency Home Visit' (recall this is followed by a trip to hospital) was billed that day (fitm00111=1)
- If any 'call out' fee items were billed that day (CallOut=1)
- If any of the three laceration fee items were billed that day (laceration=1)

To assess the potential of each of the above flags to identify unplanned visits to the ED and not capture emergency care provided to patients who were already in hospital (a particular worry for the second set above), dates of services with each of the above flags were compared to inpatient admission and discharge dates, as shown in Table 2.

In Table 2, a high proportion of records in the final column indicates that that potential ED flag is frequently used for people who are inpatient in hospital. As already learned, some of these codes can be billed for both ED visits and inpatient visits. For this reason, the following potential ED flags will only be used in combination with DAD data: ServCode26, OnCallOnSite, fitm00112, fitm00111 and CallOut. That is, these flags will only be used when we limit to

Table 2. Comparison of service dates (MSP) with inpatient admission and discharge dates (DAD), 2015-16

Potential ED flag	No inpatient hospitalization on service date	Service date= date of admission to hospital	Service date= date of discharge from hospital	Admission date < service date < discharge date
Percent of records				
locED	86.7	10.6	0.6	2.2
EmergCare	88.4	11.3	0.2	0.1
EMconsult	76.0	22.0	0.9	1.1
Other018fitm	95.0	4.7	0.1	0.2
EMSpec	87.7	11.4	0.3	0.6
ServCode26	37.6	33.3	3.0	26.1
OnCallOnSite	88.6	4.6	0.8	6.0
fitm00112	76.8	18.1	1.0	4.1
fitm00111	80.2	14.6	0.0	5.2
CallOut	43.9	33.6	2.4	20.0
Laceration	98.7	1.1	0.1	0.2

Table 3. Comparison of service location by potential ED visit flag, 2015-16

Potential ED flag	ED	Hospital inpatient	Hospital outpatient	Practitioner's office	Other
Percent of records					
EmergCare	96.3	2.0	1.6	0.05	0.05
EMconsult	97.1	2.1	0.8	0.0	0.0
Other018fitm	85.9	1.4	0.0	12.4	0.3
EMSpec	88.0	1.1	2.7	7.8	0.4
ServCode26	26.4	53.9	5.4	13.2	1.1
OnCallOnSite	84.6	9.9	5.5	0.0	0.0
fitm00112	69.7	18.9	1.3	7.3	2.8
fitm00111	0.0	9.4	1.0	40.6	49.0
CallOut	39.2	45.8	3.2	5.7	6.1
Laceration	46.8	0.9	0.3	51.5	0.5

service dates when the person is not an inpatient in hospital.

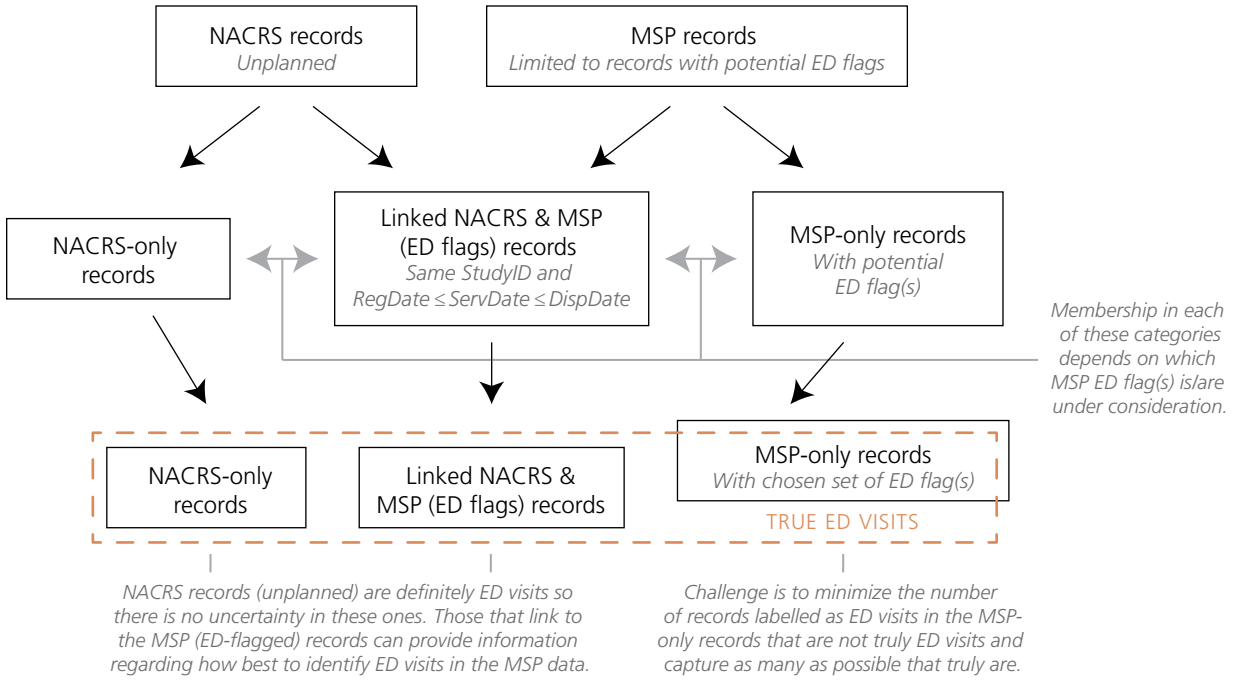
Note that Table 2 can't assess the opposite issue, that the service actually took place outside of an ED or hospital location—such as in a physician's office. To assess this, the distribution of service location for all records containing the above flags was found (Table 3).

Two of the potential ED flags frequently took place outside an ED or hospital: laceration and fee item 00111 'Emergency Home Visit.' Since the purpose of fee item 00111 is to record cases where a physician

accompanies a patient from a home/accident site to the hospital, it's not surprising that it was frequently coded with the service locations of 'Home' and 'Accident Site', and so was retained for further analyses. Laceration, on the other hand, was discarded from this point onward, due to the high proportion of these visits occurring outside of an ED. Several other flags had low to moderate proportions of non-ED locations, such as Service Code 26 'Emergency Visits, Specialists,' 'Call Outs,' and fee item 00112 'Emergency Visit.' These flags should be used with caution because while they would appropriately flag some ED use, they would also inappropriately include services taking place elsewhere. Other018fitm, EMSpec and OnCall-lOnSite should also be used with caution, as a not insignificant proportion of these visits were billed in locations other than the ED.

We retained the ED flags with the exception of laceration, then combined the one-record per day summarized MSP data with the NACRS data, taking into account overlap where ED visits might be in both sets of data. The steps to link the MSP data to the NACRS data are described in Appendix B. For this analysis, the NACRS data has been limited to EDVisit=1 (unscheduled visits), in an attempt to identify the MSP variables that best identify unplanned visits. The linked MSP-NACRS data (when the patient-service date was in both data sources) comprises one component of the ED visit data. The other components were made up of the records in the NACRS data that do not link to the potential ED flagged MSP records (this would mostly consist of records for services provided in EDs where the physicians are alternatively paid and neither FFS nor encounter billing take place), and ED visits which are captured in the MSP data only (i.e. from EDs that do not submit to NACRS, after removing patient-dates that link to visits indicated as planned in NACRS). This is depicted in Figure 1.

Figure 1. Linkage process between NACRS and MSP data



In addition, though not depicted in Figure 1, DAD records with Entry=E were added to the combination of NACRS and MSP data, after removing records that linked to planned NACRS visits. These overlap with some of the ED visits already found (i.e. NACRS only, linked NACRS/MSP-ED or MSP-only) and in addition may identify other ED visits. As preliminary information, the set of data which are in both NACRS and MSP were examined, to see which flags in the MSP data most often identify known ED visits in the NACRS data (Table 4a).

Some of the potential flags are not frequently used in this linked NACRS-MSP data: EMconsult, Other-018fitm, OnCallOnSite, fitm00112, fitm00111 and ServCode26. CallOut is used slightly more. The most promising ED flags are locED, EmergCare, EMSpec and DAD record with Entry=E. Table 4b shows the proportion of linked NACRS-MSP records that are identified using the flags in combination, from the highest proportion captured (from Table 4a) to the lowest.

Using ED service location and the set of emergency care fee items in combination identifies nearly 100% of records that are in both NACRS and MSP, with the other flags capturing few additional records. A similar analysis was undertaken for records in the NACRS data that were planned. Of the 23,805 planned ED visits in the NACRS data, only 392 (1.6%) linked to records in the MSP (based on the same StudyID and date combination). Of these 392, 95% were identified with locED (and the same proportion with locED/EmergCare combination). However, this is just a small proportion of the planned ED visits.

Table 4a. Comparison of ED flags in MSP records that were linked to NACRS data, 2015-16

Potential ED flag	No. of NACRS records also in MSP data that are identified by each flag	% of NACRS records also in MSP data that are identified by each flag
Any billing of:		
locED	1,254,162	96.6
EmergCare	1,224,729	94.3
EMconsult	4,920	0.4
Other018fitm	1,324	0.1
EMSpec	315,735	24.3
Billings only when patient is not in hospital:[a]		
ServCode26	1,546	0.1
OnCallOnSite	2,275	0.2
fitm00112	1,399	0.1
fitm00111	12	0.0
CallOut	20,683	1.6
DAD record w/ Entry=E	183,728	14.1

[a] In-hospital dates determined by addate <= servdate <= sepdate (level='A' or 'S')

Notes: Using just level=A yields highly similar results, indicating flags are not as often used when the patient is in day surgery.

Using servdate = addate and servdate = sepdate may over exclude, since these may be legitimate ED visits prior to or just after a hospitalization, but because they may also just be services that happened during the hospitalization, they are excluded to err on the side of caution.

Table 4b. Comparison of combinations of the most promising ED flags in MSP records that were linked to NACRS data, 2015-16

Potential ED flag	No. of NACRS records also in MSP data that are identified by each flag combination	% of NACRS records also in MSP data that are identified by each flag combination
locED	1,254,162	96.56
… plus EmergCare	1,293,737 (39,575 more)	99.60
… plus EMSpec	1,294,019 (282 more)	99.63
… plus DAD records with Entry=E	1,295,855 (1,836 more)	99.77

Given locED itself captures over 96% of the NACRS records, and only appears to capture a few ED visits that were in fact planned, this is used as a starting point to identify ED visits in the MSP data. To be clear, the starting point for ED visits, which are further evaluated below, will be the combination of:

- Records in the NACRS data (excluding planned visits), plus
- Records in the MSP data with service location in the ED.

Table 5 shows the number of ED visits identified in this manner for 2012-13 to 2015-16, by source of identification, and compares to the total number where known from the HAMIS data.[6,25]

Using the above-described method, the total number of ED visits found is 90.5% of the expected number for 2012-13 from HAMIS, and 91.1% for 2015-16. Since these methods only count one visit per person per day, 100% capture is not expected. It is worth nothing that the NACRS-only row contains an important subset of ED data—visits made to EDs when the physician is paid though alternative payments and does not submit encounter claims. In some cases such ED visits might be detected in the MSP data through a claim submitted by a different physician using service location= E (in which case it would be contained in the NACRS and MSP row), but not all visits are identified in the MSP data that way. Visits made to EDs that submit to NACRS and have either shadow billing or physicians paid via FFS will also be in the NACRS and MSP row. ED visits made to EDs that do not submit to NACRS may be in the MSP-only row if service location was coded as ED, but may be missed altogether if a different service location was coded. This last set may also unintentionally include some planned ED visits.

Table 5. Number of ED visits identified per year compared to the total number of ED visits, where known

Year	Source	No. of ED visits (MSP/NACRS combined data)	No. from HAMIS	% captured[a]
2012-13	MSP servloc=E only	875,980 (47.5%)	2,037,123	90.5
	NACRS & MSP servloc=E	756,826 (41.0%)		
	NACRS only	211,981 (11.5%)		
	Total	1,844,787		
2013-14	MSP servloc=E only	725,789 (37.4%)	Unknown	
	NACRS & MSP servloc=E	988,860 (51.0%)		
	NACRS only	223,862 (11.6%)		
	Total	1,938,511		
2014-15	MSP servloc=E only	606,982 (29.9%)	Unknown	
	NACRS & MSP servloc=E	1,152,619 (56.7%)		
	NACRS only	272,532 (13.4%)		
	Total	2,032,133		
2015-16	MSP servloc=E only	637,264 (29.7%)	2,352,747	91.1
	NACRS & MSP servloc=E	1,254,438 (58.6%)		
	NACRS only	250,701 (11.7%)		
	Total	2,142,403		

[a] Without further investigation we cannot be sure the all of the ED visits identified correspond to actual ED visits. That is, some non-ED visits may be identified as ED visits, while some legitimate ED visits may be missed.

To test the assumption that identifying ED visits using the combination of NACRS data and MSP records with service location=E was sufficient, Table 6 shows the number of additional records that would be flagged as ED visits above those already captured by the combination of NACRS and MSP (service location=E) data, by adding in each of the additional ED flags separately. Note the categorization into the categories of 'MSP only', 'NACRS and MSP' and 'NACRS only' shifts depending on the MSP flags used, so this breakdown is not shown for each additional flag. DAD records with Entry=E (through ED) were added to the combination of NACRS and MSP data, after removing records that linked to planned NACRS visits. This was repeated for both 2012-13 and 2015-16.

Based on the results of the linked NACRS–MSP–DAD data, the combinations of "EmergCare+EMSpec," "EmergCare+DAD Entry=E" and the same combination plus EMSpec were also examined to see what they contributed over locED alone. "EmergCare+EMSpec" contributes 3.8% and 2.1% (for 2012-13 and 2015-16 respectively) more ED visits over and above those found in NACRS and MSP data with service location=E, and the percent of the total reported in HAMIS would rise from 90.5% to 94.0% for 2012-13 and from 91.1% to 93.0% for 2015-16. The combination of "EmergCare+DAD Entry=E" contributes slightly less. The combination of "EmergCare+EMSpec+DAD Entry=E" results in capturing 95.7% and 94.3% of the total reported in HAMIS (for 2012-13 and 2015-16 respectively).

Table 6. Additional number of ED visits identified using supplemental ED flags in 2012-13 and 2015-16

ED flag	2012-13		2015-16	
	Additional no. of ED visits	Percent more	Additional no. of ED visits	Percent more
Any billing of:				
EmergCare	23,182	1.3%	10,812	0.5%
EMconsult	52	0.003%	107	0.005%
Other018fitm	220	0.01%	727	0.03%
EMSpec	48,605	2.6%	33,854	1.6%
Billings only when patient is not in hospital:[a]				
ServCode26	3,397	0.2%	4,054	0.2%
OnCallOnSite	2,482	0.1%	3,214	0.2%
fitm00112	4,474	0.2%	5,177	0.2%
fitm00111	85	0.005%	61	0.003%
CallOut	17,387	0.9%	20,101	0.9%
DAD record with Entry=E	38,039	2.1%	33,097	1.5%
Combinations:				
EmergCare or EMSpec	70,811	3.8%	44,635	2.1%
EmergCare or DAD Entry=E	57,317	3.1%	43,268	2.0%
EmergCare or EMSpec or DAD Entry=E	104,894	5.7%	77,078	3.6%
Any of the above	132,666	7.2%	110,141	5.1%

[a] Service dates that overlap with hospital dates are removed (addate <= servdate <= sepdate (level='A' or 'S'))

Based on these small gains, we conclude the combination of NACRS plus MSP records with service location=E are sufficient to capture most ED visits. The other reliable methods of detecting ED visits in the MSP data might not add sufficient value when both NACRS and MSP data are available to make the additional coding and methodologic complexity worthwhile for most projects. Projects for which a more complete capture of ED visits is important are encouraged to additionally include ED visits which can be identified by the combination of "EmergCare+EMSpec+DAD Entry=E." SAS code for this method is provided in Appendix C. For projects that have not received NACRS data for 2012-13 onward that want to count ED visits using only MSP or MSP and DAD data, please refer to the following section.

2007-08 to 2011-12

These are the years prior to NACRS data becoming available, but for which coding of service location was mandatory. Using the same flags as the previous section, we summarized the MSP data for 2011-12 by day. As before, the flags were assessed to determine whether they captured services that took place when the patient was actually in hospital. Results were very similar to those found for 2015-16, so we drew the same conclusions with respect to which ED flags to retain. The 2011-12 distribution of service location for each ED flag was also found to be similar as per that found for 2015-16, with the exception that more EmergCare appeared to take place in hospital inpatient (5.5%) or hospital outpatient (5.8%), so less was in ED (88.6%), and less EMSpec took place in ED (76.9%), as more was in the practitioner's office (15.6%).

With the absence of NACRS data but mandatory coding for service location, the number of ED visits identified using service location=E only are shown in Table 7 and compared to the total numbers, where known.[6,25]

Table 7. Number of ED visits identified per year and proportion of total captured using the service location field in MSP data

Year	No. of ED visits (MSP servloc=E)	Total no. from HAMIS	% captured
2007-08	1,287,156		
2008-09	1,361,119	1,875,118	72.6%
2009-10	1,479,318	1,963,714	75.3%
2010-11	1,522,759	1,951,292	78.0%
2011-12	1,567,613	1,984,953	79.0%
2012-13	1,641,912	2,037,123	80.6%
2013-14	1,726,813		
2014-15	1,775,011		
2015-16	1,909,199	2,352,747	81.1%

As above, the other potential ED flags (with the exception of fitm00111 since it is so infrequently used) are assessed to see if they would make a valuable contribution over and above service location=E (Table 8).

For years during which NACRS is not available but service location coding improved, it appears to be beneficial to use additional ED flags beyond service location to identify ED visits. From Table 8, it appears that the combination of service location with emergency care fee items, and/or Emergency Medical Specialist, and/or DAD records with Entry=E will capture approximately 86.9% of ED visits (2015-16); whereas, using service location alone only captures 81% of ED visits in that year. The additional extra (~1-2%) from including call-outs is perhaps not worth the extra coding (additional coding is required to link to the DAD data to remove call-outs when patient is in hospital).

Table 8. Additional no. of ED visits identified using supplemental ED flags for 2007-08, 2011-12, and 2015-16

ED flag	2007-08		2011-12		2015-16[a]	
	Add'l no. of visits	% more	Add'l no. of visits	% more	Add'l no. of visits	% more
Any billing of:						
EmergCare	123,522	9.6	125,921	8.0	49,195	2.6
EMconsult	89	0.01	47	0.002	133	0.01
Other018fitm	240	0.02	260	0.02	760	0.04
EMSpec	65,001	5.0	61,950	4.0	39,507	2.1
Billings only when patient is not in hospital:[b]						
ServCode26	7,108	0.6	3,975	0.3	4,210	0.2
OnCallOnSite	3,923	0.3	3,583	0.2	3,265	0.2
fitm00112	4,976	0.4	4,763	0.3	5,231	0.3
CallOut	27,214	2.1	20,594	1.3	22,339	1.2
DAD record with Entry=E	58,332	4.5	58,734	3.7	56,229	2.9
Combinations:						
EmergCare or EMSpec	171,583	13.3	172,823	11.0	83,362	4.4
EmergCare or EMSpec or DAD Entry=E	219,383	17.0	219,629	14.0	135,649	7.1
EmergCare or EMSpec or DAD Entry=E or CallOut[b]	245,957	19.1	239,564	15.3	157,624	8.3
Any of the above	261,932	20.3	251,879	16.1	170,896	9.0

[a] Note the additional records found for 2015-16 are more than in the table above because these records overlap with NACRS data so in the table above they were already found and thus were not counted as 'additional'.

[b] Service dates that overlap with hospital dates are removed (addate <= servdate <= sepdate (level='A' or 'S'))

Table 9. Number of ED visits identified per year and proportion of total captured using MSP and DAD data

Year	No. of ED visits[a]	Total no. from HAMIS	% captured[b]
2007-08	1,502,801		
2008-09	1,580,637	1,875,118	84.3%
2009-10	1,706,181	1,963,714	86.9%
2010-11	1,753,206	1,951,292	89.8%
2011-12	1,782,822	1,984,953	89.8%
2012-13	1,843,456	2,037,123	90.5%
2013-14	1,889,709		
2014-15	1,908,529		
2015-16	1,909,199	2,352,747	86.6%

[a] MSP locED &/or EmergCare, &/or EMSpec &/or DAD Entry=E.

[b] Without further investigation we cannot be sure the all of the ED visits identified correspond to actual ED visits. That is, some non-ED visits may be identified as ED visits, while some legitimate ED visits may be missed.

Table 9 summarizes the number of ED visits that would be identified per year using this recommended method.

1996-97 to 2006-07

These are the years for which, in addition to the absence of NACRS data, service location was poorly coded in MSP. Although only data from 1999-00 is currently available to test these methods, fee items back to 1996-97 have been reviewed and no additional fee items relevant to ED visits were found.

We summarized MSP data for 2005-06 by day, using the same flags as above. We did not use 2006-07, as that was a transition year when new service locations were introduced (March 1, 2006) and stricter

expectation on their use was introduced (October 1, 2006). As before, we assessed the flags by comparing to DAD hospitalization dates, and found a similar distribution. ServCode26 and CallOut are frequently used for hospital inpatients, but rather than discarding them for these early years when we have less information available, we looked at their contribution when they are limited to days when the patient is not admitted to hospital. The distribution of service location for each ED flag is no longer as useful, since the majority of ED visits were coded as 'H Hospital' (e.g. 85% of EmergCare is coded with service location=H in 2005-06, and only 14% in 'E').

Given we would only find 244,753 ED visits (2005-06) if we used service location=E only, it makes sense to also include other ED flags for the starting point. The number of ED visits found per year using the combination of LocED and/or EmergCare and/or EMSpec and/or DAD record with Entry=E are in Table 10.

Table 10. Number of ED visits identified per year and proportion of total captured (where known) using MSP and DAD data

Year	No. of ED visits[a]	Total no. fr. HAMIS	% captured
1999-00	906,841	1,425,963[b]	63.6%
2000-01	928,164		
2001-02	896,123		
2002-03	887,255		
2003-04	906,153		
2004-05	970,191		
2005-06	1,065,366		
2006-07	1,339,480		

[a] Using MSP locED &/or EmergCare &/or EMSpec &/or DAD Entry=E

[b] Total from McKendry report[3]

As above, the other potential ED flags are assessed to see if they would make a valuable contribution (Table 11).

Table 11. Additional number of ED visits identified using supplemental ED flags for 1999-00 and 2005-06

ED flag	1999-00		2005-06	
	Additional no. of visits	% more	Additional no. of visits	% more
Any billing of:				
EMconsult	5	0.0%	14	0.001%
Other018fitm	1,045	0.1%	1,144	0.1%
Billings only when patient is not in hospital:*				
ServCode26	6,176	0.7%	8,044	0.8%
OnCallOnSite	132,606	14.6%	70,308	6.6%
fitm00112	40,854	4.5%	27,093	2.5%
CallOut	128,119	14.1%	80,556	7.6%
Combinations:				
OnCallOnSite[a] or CallOut[a]	259,008	28.6%	150,047	14.1%
OnCallOnSite[a] or CallOut[a] or fitm00112[a]	299,095	33.0%	176,696	16.6%
Any of the above	306,260	33.8%	185,787	17.4%
Any of the above	261,932	20.3	251,879	16.1

[a] Service dates that overlap with hospital dates are removed (addate <= servdate <= sepdate (level='A' or 'S'))

Given the high additional number captured when including OnCallOnSite, CallOut and fitm00112 records (all three only for when patient is NOT in hospital), the recommended method for these early years of data also include these flags. Table 12 summarizes the number of ED visits that would be identified per year using this recommended method.

Table 12. Number of ED visits identified per year and proportion of total captured (where known) using the recommended combination of ED flags

Year	No. of ED visits[a]	Total no. fr. HAMIS	% captured[b]
1999-00	1,200,247	1,425,963[c]	84.2%
2000-01	1,207,779		
2001-02	1,118,264		
2002-03	1,085,022		
2003-04	1,094,733		
2004-05	1,152,187		
2005-06	1,236,931		
2006-07	1,418,875		

[a] MSP servloc=E and/or EmergCare and/or DAD record with Entry=E and/or EMSpec and/or OnCallOnSite* and/or CallOut* and/or fitm00112.*

* Service dates that overlap with hospital dates are removed (addate <= servdate <= sepdate (level='A' or 'S')).

[b] Without further investigation one can't be sure the all of the ED visits being identified correspond to actual ED visits. That is, some non-ED visits may be identified as ED visits while some legitimate ED visits may be missed.

[c] Total from McKendry report.[3] When the EDs staffed by physicians paid for through alternative payments were removed, this number was reduced to 1,250,263.

Projects spanning multiple years

For projects that contain data that falls into more than one of the above date ranges (1996-97 to 2006-07, 2007-08 to 2011-12 and 2012-13 onward), the method that can be consistently applied across all years of data should be chosen if changes across years are of interest. However if the interest is just within years (and comparisons will not be made between years with different methods applied) then the recommended method applicable for each year can be used.

Costing ED visits

The "Unit Costs for the Health System Matrix Project" document outlines methods used in the BC Ministry of Health's Health System Matrix 6.0.[26] ED visits are costed in two components—an ED facility cost (Table 13) and ED physician costs (Table 14). The facility cost they chose was the standard BC Interprovincial billing rates established by CIHI and the provinces.

Table 13. Facility costs for ED visits from 2002-2016

Year	CIHI Interprovincial billing rate
2002-03	$110
2003-04	$110
2004-05	$153
2005-06	$158
2006-07	$164
2007-08	$169
2008-09	$231
2009-10	$238
2010-11	$238
2011-12	$260
2012-13	$270
2013-14	$287
2014-15	If up to date values cannot be found, could use CPI index to inflate to the needed year.
2015-16	

Table 14. Physician costs for ED visits

Source	Costing method
FFS physician billings	FFS cost as recorded in variable PaidAmt. Note FFS payments vary by categories of time of day and three levels of care.
Shadow billings by APP physicians	Est. fee based on reported categories of time of day and levels of care translated to MSP categories, and MSP average (mode) fees.
NACRS ED visit	Included any NACRS ED visits that were not already counted in MSP and APP streams, based on the patient identifier and date. NACRS does not report costs. Estimate fee based on reported categories of time of day and levels of care translated to MSP categories, and MSP average (mode) fees.

Note: In future data, if the Comprehensive Ambulatory Classification System (CACS) grouping methodology is applied to Level 2 NACRS data, it may become possible to cost using RIWs similar to DAD data.

Discussion

Table 15 provides a summary of approaches for identifying ED visits using routinely-collected administrative data in BC. This is followed by a series of figures that depict differences in the application of these methods.

Figure 2 shows the number of ED visits identified by method over the years available for this analysis. As expected, the 'quick' methods find fewer ED visits than the more in-depth methods that include other criteria.

Figure 3 shows the contribution of each criterion for Method 3, displaying why other criteria are needed in addition to service location=E, especially in the earlier years prior to the improvement made to the service location variable.

Figure 4 shows the contribution of each criterion for Method 1. The quick method of service location=E plus NACRS tracks closely to the more complex method that uses other information from MSP and DAD. Projects for years 2012-13 onward with NACRS data may find it sufficient to use MSP locED + NACRS, but if a more complete capture of ED visits is important, the latter method is recommended (MSP locED + EmergCare + EMSpec + DADE + NACRS).

Limitations

There are limitations to our approach for different datasets and data-years under study. First, using our recommended approach for the combination of MSP and NACRS data will undercount ED visits, given that some visits will not be present in NACRS data, and either not coded with service location of ED or paid for through APP and not shadow billed. However, based on our findings in taking this approach, we anticipate this number of missed ED visits to be relatively small.

Second, in using the MSP data it is possible that the same ED visit can be double counted if it spanned more than one service date (e.g., presented to ED at 11:50 pm and was billed by another physician at

Table 15. Summary of approaches to identify ED visits

Shorthand name	Years of data	Data available	Method to identify ED visits
Method 1 (best method)	2012-13 onward	NACRS MSP DAD	• All (non-scheduled) NACRS records • Plus additional MSP records with ServLoc=E or EmergCare=1 or EMSpec=1 (additional after linking to NACRS by StudyID, RegDate/ServDate) • Plus additional DAD records with Entry=E (additional after linking to the combined NACRS/MSP data by StudyID, RegDate/ServDate/AdDate)
Method 1q (quick method)	2012-13 onward	NACRS MSP	• All (non-scheduled) NACRS records • Plus additional MSP records with ServLoc=E
Method 2	2007-08 onward	MSP DAD	• All MSP records with ServLoc=E or EmergCare=1 or EMSpec=1 • Plus additional DAD records with Entry=E
Method 2q (quick method)	2007-08 onward	MSP	• All MSP records with ServLoc=E
Method 3	1996-97 to 2006-07	MSP DAD	• All MSP records with ServLoc=E or EmergCare=1 or EMSpec=1 • Plus MSP records with OnCallOnSite=1, CallOut=1 or fitm00112=1, when considering only records that do not have service dates that overlap with hospital dates (i.e. exclude those with addate <= servdate <= sepdate (level='A' or 'S')). • Plus additional DAD records with Entry=E

Figure 2. Number of ED visits identified by each method

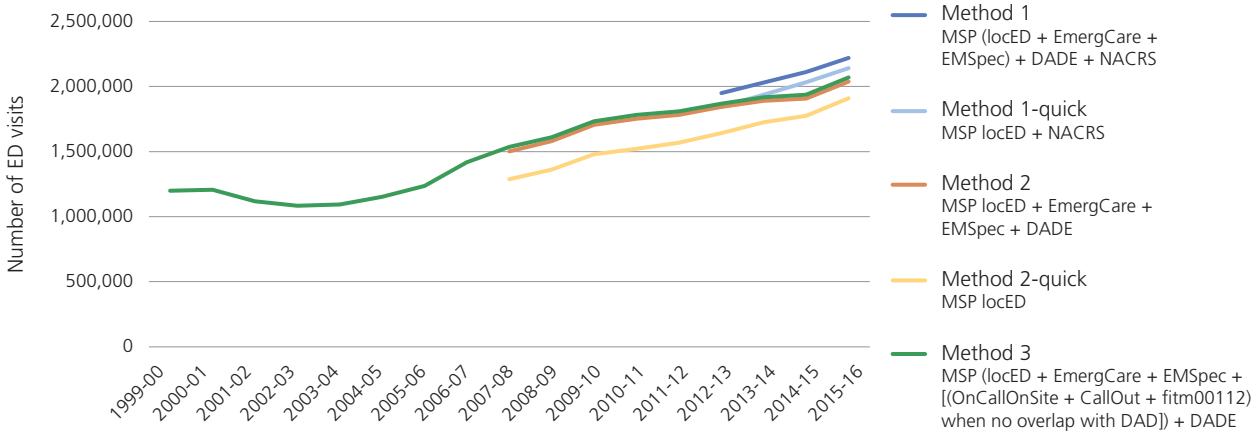


Figure 3. Method 3: Contribution of each criterion

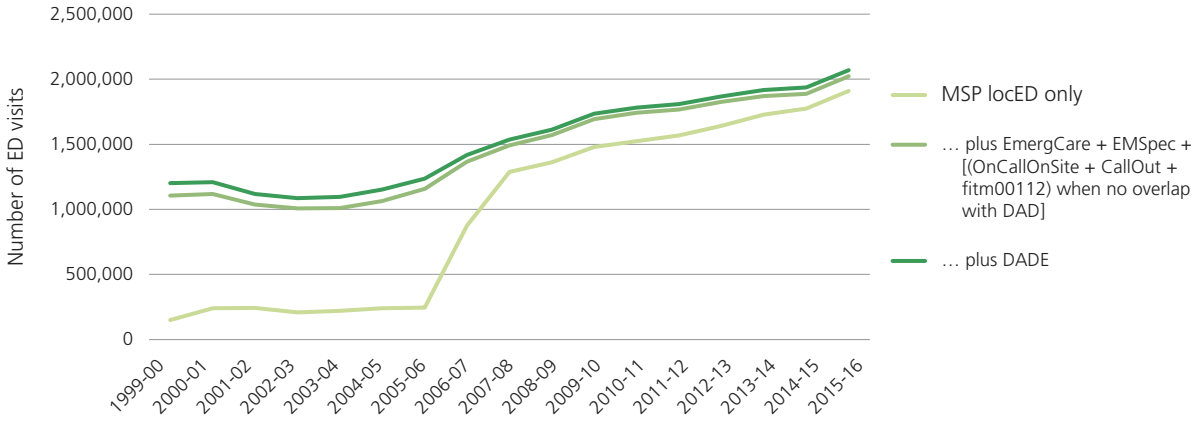
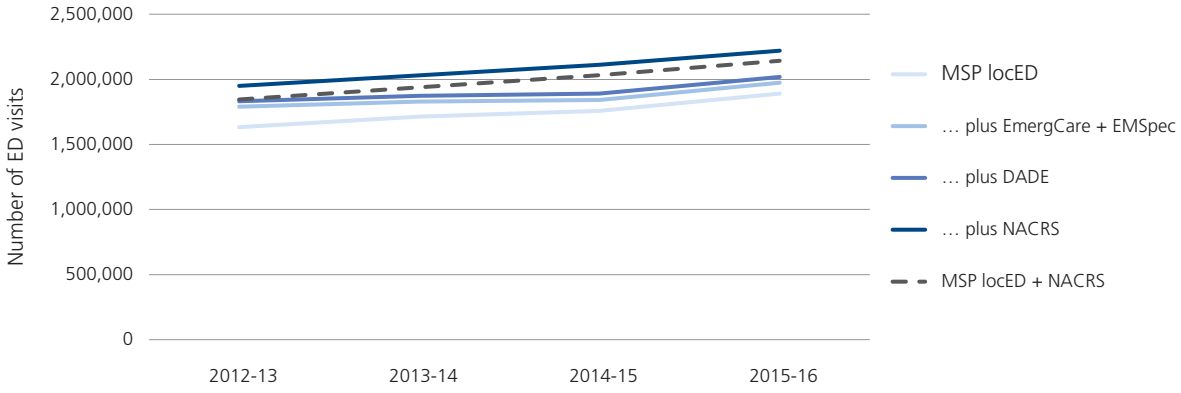


Figure 4. Method 1: Contribution of each criterion



12:50 am); however, this is an unavoidable limitation without knowing the time of service, which is not captured in MSP. Third, these methods count one ED visit per person per day; and as people can legitimately have more than one visit per day this will result in an undercount. Additionally, it is possible the ED flags in the MSP data may be capturing visits that did not actually take place in an ED; as we cannot access the facility in which the service was billed, it is impossible to know truly whether certain records were billed for in an ED.

An additional consideration is that some visits that take place in an ED are planned—that is, scheduled ahead of time. While the above work attempted to develop methods for capturing unplanned ED visits, given there is no information in the MSP capturing that distinction, some of the ED visits detected might have been planned. Some researchers may in fact want to include planned visits. The NACRS data has a variable meant to capture that information, but the MSP (and DAD Entry=E) data does not.

Finally, specifically for projects that use data from 1996-2007, there is an undercount of ED visits due to the poor coding of service location in the MSP data. Additionally, due to excluding some of the flags when the DAD data indicated the patients were in hospital, ED visits on the day of discharge from being an inpatient will be missed (this is mitigated on the day of admission due to included DAD records with Entry=E).

Recommendations

Our recommendations are as follows:
For **2012-13 onward** (i.e. post introduction of NACRS data collection in BC) the combination of NACRS data with MSP data in which the service location is identified as being in an ED is sufficient to capture the majority of ED presentations, and both datasets should be used in combination where available.[27] The addition of other approaches does not add sufficient value when both MSP and NACRS data are available to justify the coding and methodologic complexity. However for projects wanting more complete capture of ED visits, we recommend using a combination of NACRS data and MSP data with ED service location, emergency care fee items, and/or Emergency Medical Specialist, and/or DAD records with Entry=E.

1. For **2007-08 to 2011-12** NACRS data are not available but where the MSP service location field is well-coded, we recommend using a combination of service location with emergency care fee items, and/or Emergency Medical Specialist, and/or DAD records with Entry=E.

2. For **1996-97 to 2006-07,** where service location was poorly coded, we recommend the addition of on-call/on-site codes, call out codes, and the emergency visit fee item, only for when patient is not in hospital, to the approach recommended for 2007-0 to 2011-12.

3. For projects spanning these years, if changes across years are of interest, we recommend using the method relevant to the earliest year that can be consistently applied across all years. However if the interest is just within years (and comparisons will not be made between years with different methods applied) then the recommended method applicable for each year can be used.

References

1. Canadian Institute for Health Information. *Sources of Potentially Avoidable Emergency Department Visits*. Ottawa, ON: Canadian Institute for Health Information; 2014.
2. Osborn R. *The Commonwealth Fund 2013 International Health Policy Survey in Eleven Countries—Appendices*. New York, NY: The Commonwealth Fund; 2013.
3. McKendry R, Reid RJ, McGrail KM, Kerluke KJ. *Emergency Rooms in British Columbia: A Pilot Project to Validate Current Data and Describe Users*. Vancouver, BC: UBC Centre for Health Services and Policy Research; 2002.
4. Canadian Institute for Health Information. *NACRS Emergency Department Visits and Length of Stay by Province/Territory, 2018–2019.* Ottawa, ON: Canadian Institute for Health Information; 2019.
5. Canadian Institute for Health Information [Creator]. National Ambulatory Care Reporting System (NACRS). Population Data BC [Publisher]; 2019. Available at: *http://www.popdata.bc.ca/data*
6. Child Health BC. *Children's Emergency Department Services*. Vancouver, BC: Child Health BC; 2018.
7. Canadian Institute for Health Information. *National Ambulatory Care Reporting System Metadata (NACRS)* [Internet]. Canadian Institute for Health Information.
8. Canadian Institute for Health Information. Executive Summary: Database Background and General Data Limitations Documentation, National Ambulatory Care Reporting System (NACRS), FY 2006–2007. Ottawa, ON: Canadian Institute for Health Information; 2007.
9. Canadian Institute for Health Information. Database Background and General Data Limitations Documentation, National Ambulatory Care Reporting System (NACRS), 2007–2008—Executive Summary. Ottawa, ON: Canadian Institute for Health Information; 2008.
10. Canadian Institute for Health Information. Database Background and General Data Limitations Documentation, National Ambulatory Care Reporting System, 2008–2009—Executive Summary. Ottawa, ON: Canadian Institute for Health Information; 2009.
11. Canadian Institute for Health Information. Data Quality Documentation, National Ambulatory Care Reporting System, 2009–2010—Executive Summary. Ottawa, ON: Canadian Institute for Health Information; 2011.
12. Canadian Institute for Health Information. Data Quality Documentation for External Users: National Ambulatory Care Reporting System, 2010–2011. Ottawa, ON: Canadian Institute for Health Information; 2011.

13. Canadian Institute for Health Information. *Highlights of 2011–2012 Emergency Department Visits and Inpatient Hospitalizations.* Ottawa, ON: Canadian Institute for Health Information; 2013.

14. Canadian Institute for Health Information. NACRS Emergency Department Visits and Length of Stay by Province/Territory, 2013–2014. Ottawa, ON: Canadian Institute for Health Information; 2014.

15. Canadian Institute for Health Information. NACRS Emergency Department Visits and Length of Stay by Province/Territory, 2014–2015. Ottawa, ON: Canadian Institute for Health Information; 2015.

16. Canadian Institute for Health Information. NACRS Emergency Department Visits and Length of Stay by Province/Territory, 2015–2016. Ottawa, ON: Canadian Institute for Health Information; 2016.

17. Canadian Institute for Health Information. *NACRS Emergency Department Visits and Length of Stay by Province/Territory, 2016–2017*. Ottawa, ON: Canadian Institute for Health Information; 2017.

18. Canadian Institute for Health Information. *NACRS Emergency Department Visits and Length of Stay by Province/Territory, 2017–2018*. Ottawa, ON: Canadian Institute for Health Information; 2018.

19. Canadian Institute for Health Information. *NACRS Data Elements 2018–2019.* Ottawa, ON: Canadian Institute for Health Information; 2018.

20. BC Ministry of Health [Creator]. Medical Services Plan (MSP) Payment Information File. V2. Population Data BC [Publisher]; 2019. Available from: *http://www.popdata.bc.ca/data*

21. El-Adam S, Ahuja M, Lavergne MR, Peterson S, McGrail KM. *Alternative Payment Plan Remuneration Trends in British Columbia*. Vancouver, BC: UBC Centre for Health Services and Policy Research; 2020.

22. BC Ministry of Health [Creator]. Discharge Abstract Database (Hospital Separations). Population Data BC [Publisher]; 2019. Available from: *http://www.popdata.bc.ca/data*

23. BC Ministry of Health. *Services Provided in the Emergency Room* [Internet]. BC Ministry of Health. Accessed 2020.

24. BC Ministry of Health. *Medical Services Commission Payment Schedule, March 31, 2019.* Victoria, BC: BC Ministry of Health; 2019.

25. BC Ministry of Health. Health System Matrix v. 5.0. Victoria, BC: BC Ministry of Health; 2014.

26. BC Ministry of Health. Unit Costs for the Health System Matrix Project. Victoria, BC: BC Ministry of Health; 2014.

27. Langton JM, Wong ST, Burge F, Choi A, Ghaseminejad-Tafreshi N, Johnston S, Katz A, Lavergne MR, Mooney D, Peterson S, McGrail KM. *Population segments as a tool for health care performance reporting: an exploratory study in the Canadian province of British Columbia.* BMC Family Practice. 2020;21(1):98.

Appendix A: Potential MSP ED visit flags

Excel tables containing details on the variables and values in the MSP data, over and above ServLoc=E, that could potentially be used to identify emergency department visits are *available for download*. The tables also provide details on the ED visit flags that are used throughout this document. The frequencies shown in the tables are from 1999-00 to 2015-16 MSP data combined.

Appendix B: Linking NACRS and MSP data

Two versions of the ED visits macro have been written. The first follows the procedures described above, summarizing the MSP data by StudyID and ServDate, and linking in the NACRS data by StudyID and RegDate. The second version retains PracNum in the MSP summary, and uses PracNum in the link to NACRS data where possible. The first version outputs ED visits from the patient perspective; while the second is more useful from the physician perspective (or if one is interested in linking back to the MSP data to get more information about the ED visit, e.g. ICD9, where it might be helpful to have PracNum to include in the link).

Macro 1 (patient perspective)

For the analyses above, and in the first macro, the NACRS data is prepared for linking to the MSP data via the following steps:

- Keeping only records with registration date (RegDate) in the year of analysis;
- Keeping only records with EDVisit=1 (unscheduled); then
- Reducing to one record per StudyID–RegDate combination.

The one record per StudyID–service day summarized MSP data is then linked to the NACRS data requiring a match on StudyID and RegDate <= ServDate <= DispDate. MSP records that were not previously identified as ED are flagged as an ED visit. Records in the NACRS data not in the MSP data are retained as additional ED visits. A combined dataset is created from MSP records that appear to be ED visits plus the NACRS visits, linked when they appear to be the same ED visit (same date).

Macro 2 (physician perspective)

In the second macro, the NACRS data is prepared for linking to the MSP data via the following steps:

- Keeping only records with registration date (RegDate) in the year of analysis;
- Keeping only records with EDVisit=1 (unplanned); then
- Subdividing the data according to missing or non-missing RespPhys. Only approximately 3% of records in 2012-13 have non-missing RespPhys. This increases to 70% in 2013-14, then 92% for 2014-15 & 2015-16.
- The set of data with non-missing RespPhys is reduced to one record per StudyID–RegDate–RespPhys combination.
- The set of data with missing RespPhys is reduced to one record per StudyID–RegDate combination.

The one record per StudyID–ServDate–PracNum summarized MSP data is then linked to the NACRS data with non-missing RespPhys, requiring a match on StudyID, PracNum=RespPhys and RegDate=ServDate. MSP records that were not previously identified as ED are flagged as an ED visit. Records in the NACRS data not in the MSP data are retained as additional ED visits. A combined dataset is created from MSP records that appear to be ED visits plus the NACRS visits, linked when they appear to be the same ED visit (same date/physician).

This combined dataset is then linked to the NACRS data with missing RespPhys, requiring a match on StudyID and RegDate=ServDate. Again, records in NACRS not linking to the combined data are retained.

For each macro, after the link to NACRS, the data contains three components:

1. Records in the MSP data that are also in the NACRS data (same StudyID with RegDate <= ServDate <= DispDate and for second macro, same StudyID-date-physician);
2. Records in the NACRS data that did not link to the MSP records (this would mostly consist of records for services provided in EDs where the physicians are alternatively paid and FFS and/or encounter billing does not take place); and
3. ED visits that are captured in the MSP data only (i.e. from EDs that do not submit to NACRS). This last set (MSP-only) could be cleaned up slightly by removing records that are also in the NACRS-planned visits data (same StudyID – Date combination).

In addition, DAD records with Entry=E (through ED) are added to the combination of NACRS+MSP(ED flags) data, after removing records that linked to planned NACRS visits

The user may wish to make improvements to the second macro by considering the following limitations to the above steps:

- ED visits can sometimes span > 1 day. While the first macro accounts for this, the second macro only links via RegDate = ServDate, so a second MSP record on the following date would be counted as a second visit even if the ED visit extended into that second day. If DispDate (Disposition Date) is available, and it is different from RegDate, the user may wish to combine MSP records when RegDate <= ServDate <= DispDate, so that what appears as two ED visits on consecutive days is counted as one ED visit. This was done for the first (patient perspective) macro, but adding in RespPhys to the link, with some missing, quickly complicated the linkages in the second macro. A method that looked promising was to first perform the link for RegDate = ServDate, then for the remaining MSP records that did not link, by linking with RegDate < ServDate < DispDate, then for the remaining linking with ServDate = DispDate.
- In the second macro, the NACRS data with missing RespPhys was only linked to the set of data containing MSP records that were already flagged as ED, plus NACRS records with non-missing RespPhys. It is possible that those NACRS records might link to an MSP record that was previously discarded (i.e. not retained in the final data) due to not having any indication it might be an ED visit. The user may wish to examine the 'NACRS only' records for links to the MSP data, to determine if the MSP records may contain more information about the ED visit. (In some instances, it may; in others, it might reflect a non-ED visit on the same date).

Appendix C: SAS code

SAS macro code has been developed to implement the recommend ED methods (see Table 15 and recall that method choice depends on the years of analysis and data availability). Note that the code may need to be adapted to your data and purpose.

Three versions of the ED visits macro are *provided for download*. Please see Appendix B for details about the differences between the patient and physician perspective. The code for the patient perspective using Methods 1, 2 or 3 is in tab 'Appendix C Macro 1 code' and the code for the physician perspective (with methods similar to Methods 1, 2 or 3) is in tab 'Appendix C Macro 2 code'. A separate SAS macro has been developed to implement the the quick methods (1q and 2q), in tab 'Appendix C Macro Quick code'. The quick methods are in a separate macro to increase readability/interpretability of the code, and are from the patient perspective.

Advancing world-class health services and policy research and training on issues that matter to Canadians

UBC Centre for Health Services and Policy Research
The University of British Columbia
201-2206 East Mall
Vancouver, B.C. Canada V6T 1Z3
Email: chspr.reception@ubc.ca

www.chspr.ubc.ca