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Analytical Studies: Methods and References

Statistics Canada British Columbia Opioid Overdose Analytical File: Technical Report

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Analytical Studies: Methods and References

Papers in this series provide background discussions of the methods used to develop data for economic, health, and social analytical studies at Statistics Canada. They are intended to provide readers with information on the statistical methods, standards and definitions used to develop databases for research purposes. All papers in this series have undergone peer and institutional review to ensure that they conform to Statistics Canada's mandate and adhere to generally accepted standards of good professional practice.

The papers can be downloaded free at www.statcan.gc.ca.

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“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).”

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Executive summary

Canada continues to experience an opioid crisis. While there is solid information on the demographic and geographic characteristics of people experiencing fatal and non-fatal opioid overdoses in Canada, there is limited information on the social and economic conditions of those who experience these events. To fill this information gap, Statistics Canada collaborated with existing partnerships in British Columbia, including the BC Coroners Service, BC Stats, the BC Centre for Disease Control and the British Columbia Ministry of Health, to create the Statistics Canada British Columbia Opioid Overdose Analytical File (BC-OOAF). This analytical file uses data and algorithms developed in British Columbia to identify illicit drug toxicity deaths (henceforth referred to as “fatal overdoses”) in order to compile fatal and non-fatal opioid overdoses that occurred between January 1, 2014, and December 31, 2016. Using data linkage capabilities at Statistics Canada, this information was integrated with data sources available at the agency (including tax, health care, immigration and justice data) to provide socioeconomic information regarding people experiencing overdoses. This technical report provides methodological details on how the BC-OOAF was created. Data integration activities were conducted at Statistics Canada using the Social Data Linkage Environment (SDLE)—a highly secure linkage environment established to support the creation of linked population data files.

The following administrative health data sources were used to identify fatal and non-fatal opioid overdoses: the British Columbia Medical Services Plan, BC Emergency Health Services (BCEHS), the BC Coroners Service database, the Discharge Abstract Database (DAD) and the National Ambulatory Care Reporting System (NACRS). Linkage rates using the SDLE environment and the British Columbia Ministry of Health’s Client Registry exceeded 97% for all databases except the BCEHS for which linkage rates were between 88% and 92% for the BCEHS data. Overall, 13,318 people who experienced 19,125 opioid overdose events between January 1, 2014, and December 31, 2016, are represented in the BC-OOAF. Linkage to a range of Statistics Canada data holdings was conducted to provide information on health service use (DAD, NACRS, BC PharmaNet), employment earnings and social assistance (T4, T5007 tax files), encounters with the justice system (i.e., via the incident-based Uniform Crime Reporting Survey, Integrated Criminal Court Survey and Integrated Correctional Services Survey), immigration status (Longitudinal Immigration Database) prior to the opioid overdose event, and death (Canadian Vital Statistics-Death Database) during the time period.

1 Introduction

Canada is currently experiencing an opioid crisis. The number of opioid-related deaths is rising steadily, with over 13,900 deaths occurring across the country between January 2016 and June 2019, with the highest rate occurring in British Columbia (Government of Canada 2018, 2020). While there is solid information on the demographic and geographic characteristics of people who experience fatal and non-fatal opioid overdoses in Canada, there is limited information on the social and economic conditions of those who experience these events. While policy makers, health practitioners and public safety practitioners have focused on addressing the immediate need for prevention and treatment in an effort to reduce harm and save lives, attention is turning toward better understanding the socioeconomic determinants of this crisis.

To fill this information gap, Statistics Canada partnered with the following organizations in British Columbia: the BC Coroners Service, BC Stats, the BC Centre for Disease Control (BCCDC) and the British Columbia Ministry of Health. This project was initiated originally by key stakeholders in the city of Surrey to address information gaps related to their efforts to address the opioid crisis. As such, the following partners were also involved: the City of Surrey, Surrey Fire Service, the Surrey Royal Canadian Mounted Police Detachment and the Fraser Health Authority. Administrative health and emergency response data provided to Statistics Canada have been integrated with national data, including hospital discharge, emergency room discharge, employment, income, social assistance, justice and immigration data. The following technical report provides details on the data, the linkage process and the methodology used to create the Statistics Canada British Columbia Opioid Overdose Analytical File (BC-OOAF). This analytical file is intended to be used to better understand the social determinants of opioid overdoses—both fatal and non-fatal—and is not intended to be used to generate official surveillance counts of overdoses.

2 Data sources

The following section describes the administrative databases provided by the Government of British Columbia and Statistics Canada to create the BC-OOAF. Some datasets were used to define opioid overdose episodes, while others were used to provide additional socioeconomic, justice and immigration information on those who experienced an opioid overdose during the observation period, which was defined as occurring between January 1, 2014, and December 31, 2016.

2.1 British Columbia data sources

British Columbia Ministry of Health’s Client Registry (2011 to 2017)

The British Columbia Ministry of Health’s Client Registry (“the Client Registry”) is the central registry that holds a Personal Health Number (PHN) for every person that receives a health care service in the province, including persons who do not have active health insurance coverage or who are not residents of British Columbia. A PHN is a unique, numerical identifier used to identify an individual client who has had any interaction with the British Columbia health care system. The Client Registry contains patient identifiers, including given name and surname, date of birth, sex, street address, postal code, city, census metropolitan area, census subdivision, and province of residence (British Columbia Ministry of Health 2011a) (Government of British Columbia n.d.a). The Client Registry was used by Statistics Canada to facilitate linkage, to obtain cohort members’ date of birth to derive age at first overdose, and to assign sex (if available).

Medical Services Plan

The Medical Services Plan (MSP) represents medical fee-for-service and alternate payment services provided by general practitioners and specialists in the province of British Columbia (British Columbia Ministry of Health 2011b, 2011c, 2011d). Also included in the file are MSP-insured services provided by other health practitioners, such as chiropractors, naturopaths, physical therapists, oral surgeons, podiatrists, optometrists, dental surgeons, oral medicine practitioners, orthodontists, massage practitioners, acupuncturists and midwives. MSP records include patient PHN, age, sex, place of residence, diagnostic codes, expenditure information (i.e., fee item, number of services provided) and service date. Practitioner type and identifying codes are recorded for service records in the MSP, as well as the practitioner's geographical location and the type of facility in which the service was rendered or the procedure was performed. More information on British Columbia's MSP can be found elsewhere (Government of British Columbia n.d.b).

BC Emergency Health Services

The BC Emergency Health Services (BCEHS) data file provides information on emergency dispatch centre details, including date and time of dispatch, type of incident, location of incident, paramedic impressions (e.g., difficulty breathing), interventions performed (including whether Naloxone was administered), number of times, and dosage, and—if the patient was transported—details about the destination (e.g., hospital name and location). Records also include PHNs, age, sex and place of residence. More information on the BCEHS can be found elsewhere (Government of British Columbia n.d.c).

For the purposes of this project, BCEHS records shared with Statistics Canada were used to identify opioid overdoses using the same protocol as MacDougall et al. 2019 to define these: [Naloxone_Used] = '9042'.

PharmaNet

PharmaNet is a province-wide network that links all pharmacies in British Columbia to a central set of real-time data systems (British Columbia Ministry of Health 2011e, 2011f). It supports drug dispensing, monitoring and claims processing. This system captures all prescribed drugs and medical supplies dispensed from community pharmacies in British Columbia. It does not cover prescriptions dispensed in inpatient settings. It does include dispensations to federally insured clients. These data provide information about all dispensed drugs, including unique drug identification numbers, the quantity of each drug dispensed (days-supply), date of dispensation and directions for drug use. PharmaNet also records patient identifiers (i.e., PHN) and demographic information including address, name, date of birth and reported drug allergies. These data exclude antiretroviral medications dispensed from the Centre of Excellence for HIV/AIDS at St. Paul's Hospital and medications purchased without a prescription (i.e., over-the-counter medications).

BC Coroners Service database

The BC Coroners Service database is an extract from the BC Coroners Service Database (Tosca) for confirmed illicit drug overdose deaths in the province of British Columbia between January 1, 2007, and December 31, 2017, that was provided to Statistics Canada. The file contained name variables, dates of birth and death, PHNs, and geographic information (i.e., postal code, census subdivision, city of residence, census metropolitan area and province of residence).

2.2 Statistics Canada data holdings

Health services

Health administrative databases used in the development of the BC-OOAF include the Discharge Abstract Database (DAD) and the National Ambulatory Care Reporting System (NACRS). The DAD and NACRS are shared with Statistics Canada by the Canadian Institute for Health Information (CIHI) on an annual basis. The DAD is a census of all acute care discharges from public hospitals in Canada (excluding Quebec) and contains demographic, administrative and clinical data for approximately 3 million discharges annually. More information on the DAD can be found on the CIHI website (Canadian Institute for Health Information 2011a, 2011b).

The NACRS contains data about visits to health care facilities for ambulatory care, including community-based services, day surgery procedures, emergency department visits, diagnostic imaging and selected clinic visits (e.g., oncology care). Information provided in NACRS includes patient demographics, clinical information (e.g., diagnoses, surgical interventions), and administrative, financial and service-specific data. More information on the NACRS can be found on the CIHI website (Canadian Institute for Health information 2011c). Considerable variation across jurisdictions and by year for numbers of ambulatory facilities reporting to the NACRS that impact coverage were documented by the CIHI (Canadian Institute for Health information 2015, 2017).

Canadian Vital Statistics Death Database

The Canadian Vital Statistics Death Database contains information on all deaths in Canada, with data obtained annually from all provincial and territorial vital statistics registries (Statistics Canada 2018a). The death records contain patient characteristics, as well as date and major cause of death.

Justice

Information on justice contacts was derived from the following databases:

The incident-based Uniform Crime Reporting Survey (UCR) collects detailed information on criminal incidents that have been reported to and substantiated by Canadian police services. This information includes characteristics pertaining to criminal incidents, victims and accused persons.

The Integrated Criminal Court Survey (ICCS) collects information on adult and youth court cases involving the *Criminal Code* and other federal statute offences. The primary unit of analysis in the ICCS is a case, which is defined as one or more charges against an accused person or company that were processed by the courts at the same time and received a final decision. A case combines all charges against the same person having one or more key overlapping dates (e.g., date of offence, date of initiation, date of first appearance, date of decision or date of sentencing) into a single case.

The Integrated Correctional Services Survey (ICSS) collects microdata on adults and youth under the responsibility of the federal, provincial and territorial correctional systems. Data include sociodemographic characteristics (e.g., age, sex, Indigenous identity), as well as information pertaining to correctional supervision, including admissions and releases by legal hold status (e.g., remand, sentenced, probation). More information on the justice data is provided elsewhere (Statistics Canada n.d.a).

Employment and social assistance

Information on employment income and social assistance was derived from the following administrative data sources:

The Longitudinal Worker File (LWF) is an administrative database that integrates tax file data provided by the Canada Revenue Agency (CRA) to Statistics Canada, including the T1 Personal Master File, T4 Statement of Remuneration Paid files, and T4E Statements of Employment Insurance and Other Benefits, as well as the Record of Employment file provided by Employment and Social Development Canada and business-level data from Statistics Canada's Longitudinal Employment Analysis Program (LEAP). Information derived from the LWF data for the BC-OOAF includes T4 employment earnings, employment history and industry of employment. More information on the LWF and LEAP files is provided elsewhere (Statistics Canada n.d.b, n.d.c).

Social assistance income data come from the CRA's T5007 Statement of Benefits file. Social assistance refers to "payments made to beneficiaries or third parties based on a means, needs, or income test and include payments for food, clothing, and shelter requirements" (Canada Revenue Agency n.d.). The T5007 form contains basic personal information about the recipient (e.g., name, address and social insurance number [SIN]), the name and address of the payer, and the total amount of social assistance income received in a year. Information on the type of support is not provided. The T5007 form is issued for people who received \$500 or more in assistance payments in a tax year. The measure of social assistance used excludes disability assistance payments from the Government of British Columbia and Canada Pension Plan disability benefits.

Immigration

The Longitudinal Immigration Database (IMDB) is a national database that represents a census of immigrants and temporary residents who have arrived in Canada since 1980. The IMDB combines linked administrative immigration and tax data files obtained from Immigration, Refugees and Citizenship Canada and the CRA, respectively. Information available in the IMDB includes date of entry, country of birth, admission category (i.e., economic class, family class, refugee) and principal applicant status. More information on the IMDB is provided elsewhere (Statistics Canada n.d.d).

3 Record linkage

3.1 Methodology

The linkage was conducted at Statistics Canada using the Social Data Linkage Environment (SDLE). The SDLE is a highly secure linkage environment established to support the creation of linked population data files for analysis through linkage to a central depository called the Derived Record Depository (DRD)—a dynamic relational database containing only basic personal identifiers (Statistics Canada n.d.e). Data are linked to the DRD using G-Link, a SAS-based generalized record linkage software that supports deterministic and probabilistic linkage and that was developed at Statistics Canada (Statistics Canada n.d.f).

The linkages were conducted using a range of methods (i.e., probabilistic, hierarchical deterministic and deterministic) based on the availability of unique identifiers in each database. Table 1 summarizes the details of the linkage methodology for each database. The databases were linked using a multi-phase approach, with an aim to append a derived key that uniquely identifies a given individual (i.e., DRD_ID) to all database sources to facilitate the full integration of the data at the person level:

- **Phase 1:** Linkage of the Client Registry—An internal linkage of the Client Registry was conducted to identify duplicate entities. Next, the unduplicated Client Registry was linked to the DRD in the SDLE to associate the unique identifier (DRD_ID) used within Statistics Canada to each entity in the Client Registry to facilitate linkages to other databases.
- **Phase 2:** Linkage of British Columbia’s administrative health databases (i.e., MSP, BCEHS, PharmaNet)—British Columbia’s three administrative health databases were linked to the DRD in the SDLE to associate each record in the data files with a DRD_ID.
- **Phase 3:** Linkage of other administrative health databases held at Statistics Canada—The CVSD, DAD and the NACRS were linked to the DRD directly to obtain the DRD_ID. Preliminary validation results revealed lower-than-expected linkage rates for opioid-related records in the DAD and NACRS. As a result, the remaining unlinked DAD and NACRS records were linked to the Client Register and subsequently re-linked to the DRD, which resulted in improved linkage rates.
- **Phase 4:** Linkage of Statistics Canada’s justice databases—Policing (UCR) and corrections (ICSS) data were linked deterministically to the Client Registry using a combination of Soundex, sex and date of birth. The courts (ICCS) data were linked to the DRD directly in the SDLE. All linkages resulted in appending a DRD_ID to the justice records.
- **Phase 5:** Linkage of employment and social assistance records—The T4 and T5007 files were linked using SINS derived from the DRD to associate a DRD_ID with each SIN.
- **Phase 6:** Linkage of the immigration data—The IMDB data had been linked previously to the DRD at Statistics Canada (Statistics Canada 2018c).

Table 1
Summary of the linkage methodology

Data files—Health files	Linkage variables	Record linkage methodology
British Columbia Ministry of Health Client Registry ¹	Date of birth, names (given names and surnames), PHN, sex, surnames of parents, postal code, city, CMA, CSD, province	Probabilistic linkage to the DRD
British Columbia Coroners Service ²	Dates of birth and death, names (given names and surnames), surnames of parents, PHN, postal code, CSD, city, CMA, province	Probabilistic linkage to the DRD
British Columbia Emergency Health Services ³	Date of birth, names (given names and surnames), PHN, sex, surnames of parents, postal code, city, CMA, CSD, province	Probabilistic linkage to the DRD
Medical Services Plan (MSP) ⁴	First step: Date of birth, names (given names and surnames), PHN, sex, surnames of parents, postal code, city, CMA, CSD, province. Second step: Deterministic process of linkage to physician claim file used CLNT_LABEL, MRG_CLIENT_LABEL	Probabilistic linkage of BC Ministry of Health Client Registry system roster to DRD, then deterministic linkage to MSP payment information for provider services
PharmaNet ⁵	Date of birth, names (given names and surnames), Personal Health Number (PHN), sex, surnames of parents, postal code, city, CMA, CSD, and province. Second step: Deterministic process of linkage to physician claim file used CLNT_LABEL, MRG_CLIENT_LABEL	Probabilistic linkage of BC Ministry of Health Client Registry system roster to DRD, then deterministic linkage to MSP payment information for provider services
Discharge Abstract Database (2014 to 2016) ⁶	Date of birth, sex, postal code, PHN	Deterministic linkage to the DRD; if nonlinking, then linkage to DRD via the BC Ministry of Health system roster
National Ambulatory Care Reporting System (2014 to 2016) ⁷	Date of birth, sex, postal code, PHN	Deterministic linkage to the DRD; if nonlinking, then linkage to DRD via the BC Ministry of Health system roster

Notes: BC: British Columbia, CMA: census metropolitan area; CSD: census subdivision; DRD: Derived Record Depository; MSP: Medical Services Plan; PHN: personal health number. CLNT_LABEL: Client_Label (this is not an acronym, it is the name of a variable in the database). MRG_CLIENT_LABEL: Merge_Client_Label (this is not an acronym, it is the name of a variable in the database).

Sources: 1. British Columbia Ministry of Health [creator] (2011): Consolidation File (Medical Services Plan Registration and Premium Billing). BC Ministry of Health [publisher]. Data extract. Ministry of Health (2011). 2. BC Coroners Service extract of confirmed illicit drug deaths, extract of data from the BC Coroners Service database (Tosca) between January 1, 2007 and December 31, 2017, for confirmed illicit drug overdose deaths in the province of British Columbia. 3. BC Centre for Disease Control and BC Emergency Health Services extract of BC Ambulance Service patient care reports from January 1, 2014, to December 31, 2016. 4. British Columbia Ministry of Health [creator] (2011): Medical Services Plan Payment Information File. British Columbia Ministry of Health [publisher]. Data extract. Ministry of Health (2011). 5. British Columbia Ministry of Health [creator] (2011): PharmaNet. British Columbia Ministry of Health [publisher]. Data extract. Ministry of Health (2011). 6. Canadian Institute of Health Information [creator] (2011): Discharge Abstract Database (hospital separations). British Columbia Ministry of Health [publisher]. Data extract. Ministry of Health (2011). 7. Canadian Institute for Health Information. National Ambulatory Care Reporting System.

3.2 Protecting privacy

The linkage was approved by Statistics Canada’s Strategic Management Committee (Statistics Canada 2018b) and the use of the data is governed by the Directive on Microdata Linkage (Statistics Canada n.d.g). Participants’ privacy during record linkage and the use of the linked files are ensured by Statistics Canada. Access to the unique identifying information (e.g., names) was limited to employees directly involved in linking the databases, and these individuals did not access the complete data files with information on person-level characteristics. After record linkage, all identifying information was removed and a de-identified analytical file was created for subsequent use and analysis.

4 Opioid overdose case definition

Case ascertainment of fatal and non-fatal opioid overdose events was conducted based on the protocol developed by MacDougall et al. (2019). Administrative health records related to coroner-confirmed fatal and non-fatal opioid events were identified based on data and the criteria defined below. Select databases used by the Government of British Columbia to define the official British Columbia Provincial Overdose Cohort that were not available to Statistics Canada included the BC Drug and Poison Information Centre information and case-based reporting by emergency departments used in three of British Columbia's five health authorities.

- **BCEHS:** Ambulance-attended events in which patients were coded as receiving naloxone by paramedics.
- **BC Coroners Service:** Deaths attributable to overdoses involving illicit drugs (e.g., heroin, cocaine, MDMA, methamphetamine), medications that were not prescribed to the deceased, combinations of the above (except prescribed medications) and those overdoses where the origin of the drug is not known. Only closed, confirmed cases were included.
- **MSP:** Records with the following International Classification of Diseases, Version 9 (ICD-9) codes in the primary diagnostic field: 965.0 – poisoning by opiates and related narcotics, E850.0 – accidental poisoning by opiates and related narcotics.
- **DAD:** Records with the following ICD-10 codes in the primary discharge diagnosis field: T40.0 – poisoning by opium, T40.1 – poisoning by heroin, T40.2 – poisoning by other opioids, T40.3 – poisoning by methadone, T40.4 – poisoning by other synthetic narcotics, T40.6 – poisoning by other and unspecified narcotics.
- **NACRS:** Emergency department records with the following ICD-10 codes in the emergency department discharge diagnosis field: T40.1 – poisoning by heroin, T40.6 – poisoning by other and unspecified narcotics.

All overdose records occurring between January 1, 2014, and December 31, 2016, were identified in the separate databases. Records were then organized at the individual level using the unique DRD_ID. Multiple records from different data sources could exist for a single opioid overdose event (e.g., ambulance attendance followed by an emergency room visit are related to the same overdose event). To avoid double counting, all records for a given person occurring within a 24-hour period were considered to be associated with a single opioid overdose event.

5 Results

5.1 Linkage results

Results of the linkage of health databases used to identify fatal and non-fatal opioid overdoses are provided in Table 2. Overall, the linkage rates of each database to the DRD exceeded 97% for the MSP, DAD, NACRS and BC Coroners Service databases. Linkage rates were between 88% and 92% for the BCEHS data. Linkage rates were similar for records related specifically to opioid overdose events indicating no signs of bias. More information on the methodological details and results of the record linkage can be provided upon request (Statistics Canada 2018d, 2018e, 2018f, 2018g, 2018h).

Table 2**Results of the linkage process for data sources used to create the Statistics Canada British Columbia opioid overdose analytical file**

Data source and year	Number of records in source	Percent linked to DRD	Number of OD records	Number of OD records linked to DRD	Percent of OD records linked to DRD
BCEHS¹					
2014	25,985	91.9	2,720	2,458	90.4
2015	29,424	91.5	3,922	3,548	90.5
2016	38,121	87.8	6,601	5,881	89.1
Total	93,530	90.1	13,243	11,887	89.5
MSP²					
2014	91,878,799	99.8	616	614	99.7
2015	94,572,650	99.7	1,145	1,138	99.4
2016	97,586,790	99.7	3,134	3,104	99.0
Total	284,038,239	99.7	4,895	4,856	99.2
DAD³					
2014	1,074,220	99.3	549	542	98.4
2015	889,342	99.3	545	536	98.3
2016	677,917	99.2	461	452	98.0
Total	2,641,479	99.3	1,555	1,530	98.4
NACRS⁴					
2014	1,833,673	98.2	1,441	1,376	95.5
2015	1,570,180	98.1	2,143	2,034	94.9
2016	1,188,981	97.8	3,011	2,888	95.9
Total	4,592,834	98.1	6,595	6,298	95.5
BC Coroners Service⁵					
2014	362	99.2	362	359	99.2
2015	490	97.1	490	476	97.1
2016	658	97.3	658	640	97.3
Total	1,510	97.7	1,510	1,475	97.7

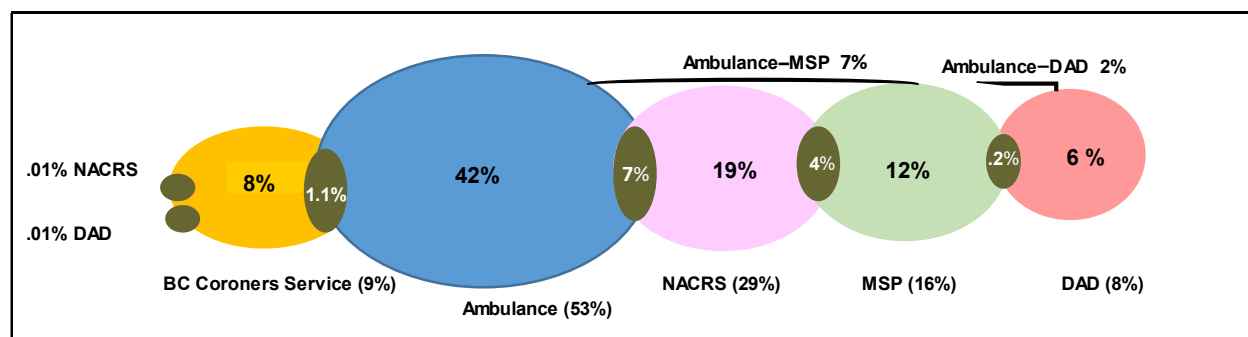
Notes: DRD: Derived Record Depository; OD: overdose; BCEHS: British Columbia Emergency Health Services; MSP: Medical Services plan; DAD: Discharge Abstract Database; NACRS: National Ambulatory Care Reporting System; BC: British Columbia. The reference period was January 1, 2014, to December 31, 2016. For the DAD and NACRS, this uses fiscal 2013/2014 and 2016/2017 databases, but cuts admission dates at greater or equal to January 1, 2014, and discharge dates less than January 1, 2017, for submitting province British Columbia. Only 26% of all NACRS records in the reference period contained diagnostic content. BC Coroners Service extract included confirmed, closed cases with a certified cause of death of Illicit drug toxicity (overdose).

Sources: 1. BC Centre for Disease Control extract of BC Emergency Health Services BC Ambulance Service patient care reports, January 1, 2014, to December 31, 2016. 2. British Columbia Ministry of Health [creator] (2011): Medical Services Plan Payment Information File. British Columbia Ministry of Health [publisher]. Data extract. Ministry of Health (2011). 3. Canadian Institute of Health Information [creator] (2011): Discharge Abstract Database (hospital separations). British Columbia Ministry of Health [publisher]. Data extract. Ministry of Health (2011). 4. Canadian Institute for Health Information. National Ambulatory Care Reporting System. 5. BC Coroners Service extract of confirmed illicit drug deaths and extract of data from the BC Coroners Service database (Tosca) between January 1, 2007, and December 31, 2017, for confirmed illicit drug overdose deaths in the province of British Columbia.

5.2 Cohort results

Results of the cohort creation are presented in Table 3 and Figure 1. Overall, 13,318 people experienced 19,125 opioid overdose events between January 1, 2014, and December 31, 2016. Only 13.8% of first overdose events were identified in more than one database. The BCEHS (ambulance) data were the greatest contributor to identifying opioid cases (see Figure 1).

Figure 1
Distribution of individuals in the Statistics Canada British Columbia Opioid Overdose Analytical File, by data source used to identify their index overdose,¹ January 2014 to December 2016



1. The total Statistics Canada British Columbia Opioid Overdose Analytical File included N=13,318 individuals, each having one index (first) opioid overdose within the study reference period of January 1, 2014, to December 31, 2016. For these individuals, a total of 19,125 overdose events were recorded over the reference period.

Notes: MSP: Medical Services Plan, DAD: Discharge Abstract Database, NACRS: National Ambulatory Care Reporting System. Percentages inside the ovals indicate the percentage of the cohort that has only the source (ovals) as the source that entered the person into the cohort. Percentages under the ovals indicate the percentage of the cohort that has the source (oval) as either only the source or in combination with other sources for first overdose. At the overlapping edge of each oval is the percentage of people who have two overlapping sources only.

Source: Statistics Canada British Columbia Opioid Overdose Analytical File, Statistics Canada.

Overall, 1,475 events were fatal as identified in the BC Coroners Service database, representing 11.1% of people and 7.7% of events. Overall, males represented 65% of persons who experienced an opioid overdose and 79% of fatal events. Approximately 47% of individuals were aged between 20 and 39 at the time of their first opioid overdose in the observation period. The majority of people (78%) experienced only one event, rather than several during the study period (see Table 3).

Table 3
Demographic characteristics of people in the Statistics Canada British Columbia Opioid Overdose Analytical File, January 1, 2014 to December 31, 2016

	Total overdose cohort				Non-fatal overdoses				Fatal overdoses			
	Number of individuals	Percent	Number of events	Percent	Number of individuals	Percent	Number of events	Percent	Number of individuals	Percent	Number of events	Percent
Total for British Columbia	13,318	100	19,125	100	11,843	100	17,249	100	1,475	100	1,876	100
Sex												
Male	8,682	65	12,714	67	7,515	64	11,254	65	1,167	79	1,460	78
female	4,626	35	6,388	33	4,318	36	5,972	35	308	21	416	22
Not available	10	0.1	23	0.1	10	0.1	23	0.1	0	0	0	0
Age group												
0 to 14 years	71	0.5	85	0	71	1	85	0	0	0	0	0
15 to 19 years	511	4	675	4	473	4	624	4	38	3	51	3
20 to 29 years	3,092	23	4,773	25	2,778	23	4,330	25	314	21	443	24
30 to 39 years	3,180	24	4,755	25	2,780	23	4,258	25	400	27	497	26
40 to 49 years	2,490	19	3,634	19	2,154	18	3,224	19	336	23	410	22
50 to 59 years	2,196	16	3,006	16	1,885	16	2,621	15	311	21	385	21
60 years and older	1,778	13	2,197	11	1,702	14	2,107	12	76	5	90	5
Number of overdose episodes per person												
1	10,389	78	10,389	54	9,158	77	9,158	53	1,231	83	1,231	66
2	1,706	13	3,412	18	1,544	13	3,088	18	162	11	324	17
3	587	4	1,761	9	540	5	1,620	9	47	3	141	8
4	270	2	1,080	6	253	2	1,012	6	17	1	68	4
5	143	1	715	4	134	1	670	4	9	1	45	2
6 or more ¹	223	2	1,768	9	214	2	1,701	10	9	1	67	4

1. Upper limit was 30 episodes (events).

Source: Source: Statistics Canada British Columbia Opioid Overdose Analytical File, Statistics Canada.

5.3 Linkage of ancillary files to the cohort

Results of the linkage of individuals experiencing an opioid overdose to the ancillary health, tax and justice files are provided in Tables 4, 5 and 6, respectively. Over 80% of people who experienced an opioid overdose were linked to at least one MSP record in each year between 2011 and 2016, resulting in over 3.65 million MSP records. Between 20% and 33% of people who experienced an opioid overdose were linked to a DAD record in each year between 2011 and 2016, for a total of 46,100 hospital discharges. Between 11.7% and 62.5% of people who experienced an opioid overdose were linked to a NACRS record over this same time period, for a total of 31,400 records. Approximately 80% of BC-OOAF members per year were linked to a PharmaNet record, representing over 9.46 million prescriptions (see Table 4).

Table 4
Summary of linkage rates for ancillary health data sources used to create the Statistics Canada British Columbia Opioid Overdose Analytical File

Data source and year	Number of records in raw source	Number of records linked to DRD	Number of records linked to OD cohort	Number of OD cohort members linked to given source year	Percent of overall OD cohort members linked to given source, given year
MSP¹					
2011	84,787,868	84,588,424	497,379	10,967	82.3
2012	87,466,435	87,265,260	546,613	11,117	83.5
2013	90,140,985	89,918,957	592,146	11,315	85.0
2014	91,878,799	91,638,249	635,613	11,609	87.2
2015	94,572,650	94,316,239	676,754	11,496	86.3
2016	97,586,790	97,297,229	697,490	11,033	82.8
Total	546,433,527	545,024,358	3,645,995	12,869	96.6
DAD²					
2011	817,199	812,294	5,160	2,794	21.0
2012	830,450	825,408	5,710	2,898	21.8
2013	849,868	844,467	6,861	3,348	25.1
2014	853,938	847,853	9,043	4,256	32.0
2015	875,018	868,801	9,554	4,382	32.9
2016	895,208	887,868	9,822	4,444	33.4
Total	5,121,681	5,086,691	46,150	9,533	71.6
NACRS³					
2011	209,196	208,362	5,139	1,554	11.7
2012	732,961	731,058	13,214	4,024	30.2
2013	887,951	885,727	17,715	5,144	38.6
2014	1,833,673	1,800,976	42,847	8,329	62.5
2015	1,570,180	1,540,013	40,405	8,305	62.4
2016	1,188,981	1,163,057	31,391	7,343	55.1
Total	6,422,942	6,329,193	150,711	11,768	88.4
PharmaNet⁴					
2011	62,375,180	62,007,390	1,192,015	10,359	77.8
2012	65,171,004	64,793,898	1,396,992	10,576	79.4
2013	67,927,746	67,547,444	1,596,150	10,842	81.4
2014	69,564,838	69,186,524	1,713,849	11,114	83.4
2015	71,468,190	71,057,538	1,781,392	10,950	82.2
2016	73,911,802	73,447,722	1,781,201	10,373	77.9
Total	410,418,760	408,040,516	9,461,599	12,937	97.1

Notes: BC: British Columbia; OD: overdose; MSP: Medical Service plan; DAD: Discharge Abstract Database; NACRS: National Ambulatory Care Reporting System.

Sources: 1. British Columbia Ministry of Health [creator] (2011): Medical Services Plan Payment Information File. British Columbia Ministry of Health [publisher]. Data extract. Ministry of Health (2011). 2. Canadian Institute of Health Information [creator] (2011): Discharge Abstract Database (hospital separations). British Columbia Ministry of Health [publisher]. Data extract. Ministry of Health (2011). 3. Canadian Institute for Health Information. National Ambulatory Care Reporting System. 4. British Columbia Ministry of Health [creator] (2011): PharmaNet. British Columbia Ministry of Health [publisher]. Data extract. Ministry of Health (2011).

Individuals who experienced an opioid overdose were eligible to link to annual employment (T4) and social assistance (T5007) records for a maximum of five years preceding their overdose if there was a valid SIN available for them. For each calendar year, 99% of people had a valid SIN. Among them, over 40% linked to the T4 and/or T5007 files.

Table 5
Summary of linkage rates for employment and social assistance data appended to the Statistics Canada British Columbia Opioid Overdose Analytical File

Data source and year	Cohort members eligible to link	Cohort members with a valid SIN	Number of OD cohort members linked to given source year	Percent of overall OD cohort linked to given source, given year
T4 forms (from the Longitudinal Worker File)				
2009	3,329	3,294	1,432	43.0
2010	7,379	7,311	3,100	42.0
2011	13,318	13,184	5,771	43.3
2012	13,318	13,184	5,812	43.6
2013	13,318	13,184	5,798	43.5
2014	13,318	13,184	5,625	42.2
2015	9,989	9,890	4,102	41.1
2016	5,939	5,873	2,333	39.3
T5007 forms				
2009	3,329	3,294	1,251	37.6
2010	7,379	7,311	2,943	39.9
2011	13,318	13,184	5,388	40.5
2012	13,318	13,184	5,515	41.4
2013	13,318	13,184	5,799	43.5
2014	13,318	13,184	6,006	45.1
2015	9,989	9,890	4,756	47.6
2016	5,939	5,873	3,061	51.5

Notes: SIN: social Insurance Number; OD: overdose.

Sources: Longitudinal Worker File, Longitudinal Employment Analysis Program, Statistics Canada; Statistics Canada British Columbia Opioid Overdose Analytical File, Statistics Canada; Social Assistance, Canada Revenue Agency.

Individuals who experienced opioid overdoses were linked to justice data for the two years prior to their index overdose event: results are provided in Table 6.

Approximately 7% of cohort members linked to the IMDB and 23% linked to the Canadian Vital Statistics Death Database.

Table 6
Summary of linkage rates for police contact data appended to the Statistics Canada British Columbia Opioid Overdose Analytical File

Data source and year	Cohort members eligible to link	Number of records linked to OD cohort in given source year	Number of OD cohort members linked to given source year	Percent overall of OD cohort members linked to given source, given year
UCR microdata, police contacts in the 24 months prior to the first overdose event, by year of charge date, 2012 to 2016¹				
2012	3,329	1,213	509	15.3
2013	7,379	4,277	1,493	20.2
2014	13,318	7,330	2,637	19.8
2015	9,989	7,362	2,512	25.1
2016	5,939	3,400	1,326	22.3
UCR microdata, all police contacts, by year of charge date, 2010 to 2016²				
2010	13,318	7,947	2,999	22.5
2011	13,318	8,227	3,071	23.1
2012	13,318	8,647	3,082	23.1
2013	13,318	9,781	3,344	25.1
2014	13,318	11,274	3,475	26.1
2015	13,318	12,151	3,601	27.0
2016	13,318	13,019	3,598	27.0

1. Includes links between members of the cohort and policing incidents with a charge date in the 24 months preceding their first overdose event, e.g., individuals were eligible to link to a criminal incident with a charge date in 2012 if the date of their first overdose event was between January 1, 2012, and December 31, 2014. Includes incidents with a charge date in the years 2012 to 2016 and reported in survey years 2011 to 2016.

2. Includes links between members of the cohort and policing incidents in British Columbia both prior to and subsequent to the first overdose event. Includes incidents with a charge date in the years 2010 to 2018, reported in survey years 2009 to 2016. Within the policing data, there are six individuals involved in six criminal incidents with an unknown or erroneous charge date.

Notes: OD: overdose; UCR: Uniform Crime Reporting Survey.

Sources: Uniform Crime Reporting Survey, Statistics Canada British Columbia Opioid Overdose Analytical File, Statistics Canada.

6 Discussion

The collaboration between partners in British Columbia and Statistics Canada has led to the development of the BC-OOAF—a unique dataset providing information on individuals experiencing opioid overdoses in the province of British Columbia. The creation of the BC-OOAF cohort and its analysis has additionally integrated information from federal data sources using the secure platform and linkage methodologies developed at Statistics Canada. Information on employment, income, social assistance, health care use, immigration and contacts with police have been linked successfully to a cohort of individuals who experienced fatal and non-fatal overdoses in British Columbia between 2014 and 2016.

As indicated, the identification of opioid overdose events was conducted according to the protocol developed by MacDougall et al. (2019) from the BCCDC. Results based on the analytical data file created as part of this project (i.e., BC-OOAF) were similar to those published by the BCCDC. The total number of opioid overdose events were within a reasonable range: the BCCDC identified 10,456 people and 14,292 overdose events between January 1, 2015, and November 30, 2016, compared with 13,318 people and 19,125 overdose events between January 1, 2014, and December 31, 2016, in the BC-OOAF. In both cases, the majority of opioid overdose cases were identified via BCEHS (ambulance) data. The overall characteristics of the cohort were similar, with a greater representation of opioid overdoses among males, particularly among fatal cases;

the proportion was 79% and 80% in the Statistics Canada BC-OOAF and the BCCDC's British Columbia provincial overdose cohort, respectively. Age distributions among fatal and non-fatal overdoses were also similar. These similarities provide evidence of the validity of the BC-OOAF created by Statistics Canada.

7 Limitations

Censoring for deaths using the Canadian Vital Statistics Death Database was not conducted. Therefore, people who did not link to ancillary files would not be counted if they had died in the reference period as a result of non-overdose causes. Although the overdose case ascertainment methods used sources covering much of the spectrum of healthcare services within two years of observation, overdoses are likely undercounted since some overdoses may not have had any medical health services contact. By one estimate for a region of British Columbia within 2015-2017, this was the case for 44% of overdoses that had received naloxone via bystander(s). (Karamouzian, Kuo, Crabtree, Buxton 2019) For the present study, while the index overdose event was the first observed within the observation period, it may not have been peoples' first overdose. Furthermore, the analysis did not include a comparative group of people, among whom no overdose was detected. Work by others has shown that in British Columbia First Nations people are over-represented among people experiencing overdoses and overdose deaths. (First Nations Health Authority 2017. Overdose data and First Nations in BC: *Preliminary findings*) Information to identify Indigenous peoples or other ethno-cultural groups as a demographic characteristic for members of the BC-OOAF was not available for this study. Housing circumstance is another important characteristic relating to health generally that was not available for this study, yet could be developed in future. (Statistics Canada n.d.h) Finally, since this study's observation period, there may have been changes to overdose circumstances in the overdose crisis.

8 Conclusion

Data integration provides tremendous opportunities to bring together existing health and non-health databases to better understand complex sub-populations. The BC-OOAF developed by Statistics Canada in collaboration with Government of British Columbia stakeholders can be used to further understand the heterogeneity of individuals experiencing opioid overdose events, which can hopefully lead to more targeted policy and program responses to more effectively reduce the burden of this crisis. The project serves as model that could be replicated in other jurisdictions across Canada and for other (illicit) drug-related events.

References

- British Columbia Ministry of Health [creator] (2011): Consolidation File (MSP Registration & Premium Billing). BC Ministry of Health [publisher]. Data Extract. MOH (2011). (2011a). Available at: <https://catalogue.data.gov.bc.ca/dataset/metadata-for-health-registration-and-premium-billings>.
- British Columbia Ministry of Health [creator] (2011): Medical Services Plan (MSP) Payment Information File. British Columbia Ministry of Health [publisher]. Data Extract. MOH (2011). (2011b). Available at: <https://catalogue.data.gov.bc.ca/dataset/metadata-for-health-medical-services-plan-msp-payment-information-file>.
- British Columbia Ministry of Health [creator] (2011): Mental Health. British Columbia Ministry of Health [publisher]. Data Extract. MOH (2011). (2011c). Available at: <https://catalogue.data.gov.bc.ca/dataset/mental-health-and-substance-use-health-services>.
- British Columbia Ministry of Health [creator] (2011): Home & Community Care (Continuing Care). British Columbia Ministry of Health [publisher]. Data Extract. MOH (2011). (2011d). Available at: <https://catalogue.data.gov.bc.ca/organization/ministry-of-health?q=home+and+community+careprevious>.
- BC Ministry of Health [creator] (2011): PharmaNet. British Columbia Ministry of Health [publisher]. Data Extract. MOH (2011). (2011e). Available at: <https://catalogue.data.gov.bc.ca/dataset/metadata-for-health-pharmanet-program>.
- British Columbia Ministry of Health [creator] (2011): PharmaCare. British Columbia Ministry of Health [publisher]. Data Extract. MOH (2011). (2011f). Available at: <https://catalogue.data.gov.bc.ca/dataset/metadata-for-health-pharmacare-program>.
- Canada Revenue Agency. n.d. Line 14500-Social assistance payments. Available at: <https://www.canada.ca/en/revenue-agency/services/tax/individuals/topics/about-your-tax-return/tax-return/completing-a-tax-return/personal-income/line-145-social-assistance-payments.html> (accessed July 23, 2019).
- Canadian Institute for Health Information [creator] (2011a): Discharge Abstract Database (Hospital Separations). British Columbia Ministry of Health [publisher]. Data Extract. MOH (2011). Available at: <https://catalogue.data.gov.bc.ca/dataset/metadata-for-health-discharge-abstracts-database-hospital-separations->.
- Canadian Institute for Health Information. (2011b). Discharge Abstract Database metadata (DAD). Available at: <https://www.cihi.ca/en/discharge-abstract-database-metadata> (accessed September 16, 2018).
- Canadian Institute for Health information. (2011c). National Ambulatory Care Reporting System. Available at: <https://www.cihi.ca/en/national-ambulatory-care-reporting-system-metadata> (accessed September 16, 2018).
- Canadian Institute for Health Information. (2015). *Data Quality Documentation: National Ambulatory Care Reporting System, Current year information 2014 to 2015*. Ottawa: Canadian Institute for Health Information. Available at: https://www.cihi.ca/sites/default/files/nacrs-dataquality_2014-2015_en_0.pdf (accessed September 16, 2018).

Canadian Institute for Health Information. (2017). *Data Quality Documentation: National Ambulatory Care Reporting System, Current year information 2016 to 2017*. Ottawa: Canadian Institute for Health Information. Available at: https://www.cihi.ca/sites/default/files/document/nacrs_dataquality_2016_2017_en.pdf (accessed September 16, 2018).

First Nations Health Authority. 2017. Overdose data and First Nations in BC: Preliminary findings. August. Available at: https://www.fnha.ca/AboutSite/NewsAndEventsSite/NewsSite/Documents/FNHA_OverdoseDataAndFirstNationsInBC_PreliminaryFindings_FinalWeb_July2017.pdf (accessed September 9, 2020).

Government of British Columbia. n.d. Introduction to the Client Registry – ECR.01. Available at: <https://www2.gov.bc.ca/gov/content/health/practitioner-professional-resources/software/user-training-material/client-registry-education-material-for-medical-practices/introduction-to-the-client-registry-ecr-01> (accessed July 23, 2019).

Government of British Columbia. n.d. Medical Services Plan. Available at: <https://www2.gov.bc.ca/gov/content/health/health-drug-coverage/msp> (accessed July 23, 2019).

Government of British Columbia. n.d. Patient Care Records. Available at: <http://www.bcehs.ca/health-info/patient-care-records>. (accessed July 23, 2019).

Government of Canada. 2018. National report: Apparent opioid-related deaths in Canada (released March 2018). Available at: <https://www.canada.ca/en/public-health/services/publications/healthy-living/national-report-apparent-opioid-related-deaths-released-march-2018.html> (accessed February 27, 2019).

Government of Canada. 2020. Opioid-related harms in Canada (September 2020). Available at: <https://health-infobase.canada.ca/substance-related-harms/opioids> (accessed Oct 30, 2020).

Karamouzian M, Kuo M, Crabtree A, Buxton JA. Correlates of seeking emergency medical help in the event of an overdose in British Columbia, Canada: Findings from the Take Home Naloxone program. *International Journal of Drug Policy* 2019; 71:157-63.

MacDougall, L., K. Smolina, M. Otterstatter, B. Zhao, M. Chong, D. Godfrey, A. Mussavi-Rizi, J. Sutherland, M. Kuo, and P. Kendall. 2019. "Development and characteristics of the Provincial Overdose Cohort in British Columbia, Canada." *PLoS One* 14 (1): e0210129. Available at: <https://doi.org/10.1371/journal.pone.0210129>

Statistics Canada. 2018a. Canadian Vital Statistics-Death Database (CVSD). February 23. Available at: <http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=433426&dis=1> (accessed August 8, 2018).

Statistics Canada. 2018b. Surrey Opioid Data Collection and Community Response Project: Linking Surrey. Opioids data with income, health, and immigration data. (008-2018). Available at: <https://www.statcan.gc.ca/eng/record/2018> (accessed July 2019).

Statistics Canada. 2018c. Social Data Linkage Environment (SDLE) Methodology Report. Linkage between the Landing file (2014 to 2016) and the SDLE Derived Record Depository (Version 11). January 2018. Ottawa: Statistics Canada. Methodology report.

Statistics Canada. 2018d. Medical Services Plan – Social Data Linkage Environment (SDLE) Methodology Report. External linkage between the British Columbia Ministry of Health file (2011 to 2017) for the Surrey Opioids project and the SDLE Derived Record Depository (Version 21). December 2018. Ottawa: Statistics Canada. Methodology report.

Statistics Canada. 2018e. British Columbia Emergency Health Services – Social Data Linkage Environment (SDLE) Methodology Report. External linkage between the British Columbia Centre for Disease Control file (2014 to 2017) for the Surrey Opioids project and the SDLE Derived Record Depository. August 31, 2018. Ottawa: Statistics Canada. Methodology report.

Statistics Canada. 2018f. BC Coroner’s Database – Social Data Linkage Environment (SDLE) Methodology Report. Linkage between British Columbia Coroner’s Database (2007 to 2017) and the SDLE Derived Record Depository (Version 16). May 23, 2018. Ottawa: Statistics Canada. Methodology report.

Statistics Canada. 2018g. Discharge Abstract Database – Social Data Linkage Environment (SDLE) Methodology Report: Linkage between the DAD (Discharge Abstract Database, 1994 to 2016) and the SDLE Derived Record Depository (versions 13 and 14). May 1, 2018. Ottawa: Statistics Canada, Methodology report.

Statistics Canada. 2018h. National Ambulatory Care Reporting System – Social Data Linkage Environment (SDLE) Methodology Report. External linkage between the National Ambulatory Care Reporting System (2002 to 2016, versions 1 and 2) and the SDLE Derived Record Depository (versions 13 and 14). May 1, 2018. Ottawa: Statistics Canada, Methodology report.

Statistics Canada. n.d.a Uniform Crime Reporting Survey (UCR). Available at: <https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=3302> (accessed July 23, 2019).

Statistics Canada. n.d.b Longitudinal Worker File. Available at: <https://www.statcan.gc.ca/eng/rdc/lwf> (accessed July 2019).

Statistics Canada. n.d.c Longitudinal Employment Analysis Program. Available at: <https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=8013> (accessed July 2019).

Statistics Canada. n.d.d Longitudinal Immigration Database. Available at: <https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5057> (accessed September 16 2018).

Statistics Canada. n.d.e Social Data Linkage Environment. Available at: <https://www.statcan.gc.ca/eng/sdle/index> (accessed August 1, 2018).

Statistics Canada. n.d.f G-Link Version 3.0 User Guide. Ottawa: Statistics Canada. Internal document.

Statistics Canada. n.d.g Directive on Microdata Linkage Available at: <https://www.statcan.gc.ca/eng/record/policy4-1> (accessed July 2019).

Statistics Canada. n.d.h Pathfinder projects to lead to our modernization initiative. Canadian Housing Statistics Program. Ottawa: Statistics Canada. Available at: <https://www.statcan.gc.ca/eng/about/dp/2018-2019/s04> (accessed July 2019).