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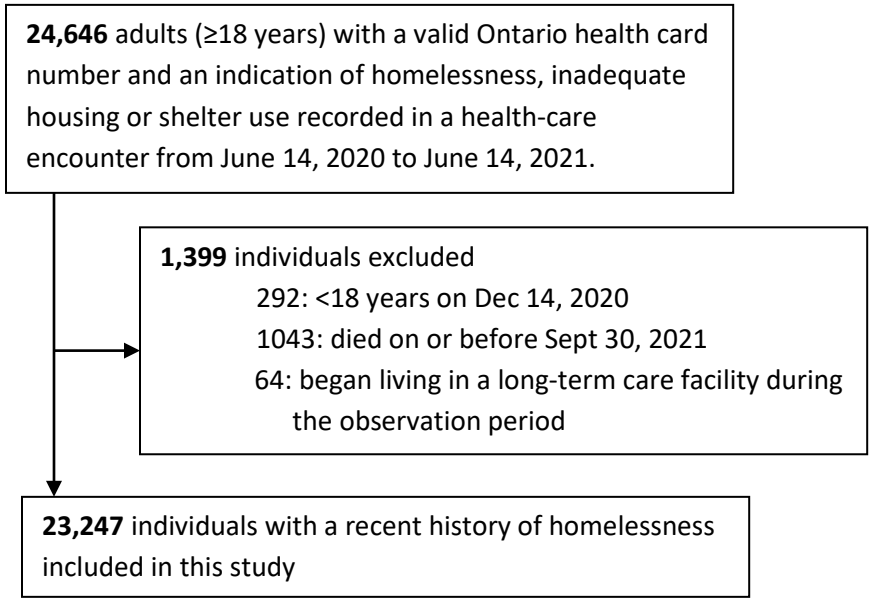
Supplementary appendix 2

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

Supplement to: Shariff SZ, Richard L, Hwang SW, et al. COVID-19 vaccine coverage and factors associated with vaccine uptake among 23 247 adults with a recent history of homelessness in Ontario, Canada: a population-based cohort study. *Lancet Public Health* 2022; published online March 9. https://doi.org/10.1016/S2468-2667(22)00037-8.

Appendix 1: Study flowchart



Appendix 2: RECORD statement

The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	A) Title/abstract B) Abstract methods and results	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and timeframe within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	1.1) Abstract (methods) 1.2) Title; Abstract (methods) 1.3) Abstract (background)
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction, par 1-2		
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction, par 2		
Methods					
Study Design	4	Present key elements of study design early in the paper	Methods, "Setting and Design"		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods, "Setting and Design" Appendix 3		

Participants	6	*(a) Cohort study* - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study* - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study* - Give the eligibility criteria, and the sources and methods of selection of participants *(b) Cohort study* - For matched studies, give matching criteria and number of exposed and unexposed *Case-control study* - For matched studies, give matching criteria and the number of controls per case	A) Methods, "Participants" B) No matching criteria (N/A)	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided. RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided. RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	6.1) Provided in Appendix 5 6.2) Validations are referenced
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	Methods "Outcome Measures" and "Characteristics of participants"	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	7.1) Provided in Appendices 4 & 5
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods "Data Sources" and Appendices 3, 4, & 5		

Bias	9	Describe any efforts to address potential sources of bias	N/A		
Study size	10	Explain how the study size was arrived at	N/A		
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	Appendices 4 &5		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) *Cohort study* - If applicable, explain how loss to follow-up was addressed *Case-control study* - If applicable, explain how matching of cases and controls was addressed *Cross-sectional study* - If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	Methods "Statistical Analysis"		
Data access and cleaning methods		..		RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population. RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	12.1) Methods "Setting and Design" 12.2) Appendix 3

Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	12.3) Methods "Setting and Design", Appendices 3, 4 & 5
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (*e.g.*, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram	Results; Appendix 1	RECORD 13.1: Describe in detail the selection of the persons included in the study (*i.e.,* study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	13.1) Results; Appendix 1
Descriptive data	14	(a) Give characteristics of study participants (*e.g.*, demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest (c) *Cohort study* - summarise follow-up time (*e.g.*, average and total amount)	Results; Table 1		
Outcome data	15	*Cohort study* - Report numbers of outcome events or summary measures over time *Case-control study* - Report numbers in each exposure category, or summary measures of exposure	Results; Table 1, Figure 2		

		Cross-sectional study - Report numbers of outcome events or summary measures			
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Results; Table 3, Figure 3		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	N/A		
Discussion					
Key results	18	Summarise key results with reference to study objectives	Discussion,		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	Discussion, limitations paragraph
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar	Discussion		

		studies, and other relevant evidence			
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion		
Other Information					
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Acknowledgements; Methods		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	Data sharing statement.

*Reference: Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.

Appendix 3: Data source descriptions

All data used in this study were accessed at ICES (www.ices.on.ca), an independent, non-profit organization that uses routinely collected health administrative data to conduct health services and population health outcomes research. All residents of Ontario are included in Ontario's health, administrative data, and >99% of residents have a health card which is presented at each healthcare encounter. ICES links records within and across datasets using encrypted Ontario health card numbers. A more fulsome description of ICES, its governance structure and linkage practices are available elsewhere[1].

Name	Data Provider	Description
Canadian Institute for Health Information Discharge Abstract Database (DAD)	Canadian Institute for Health Information (CIHI)	The DAD contains administrative, clinical (diagnoses and procedures/interventions), demographic, and administrative information from the chart abstraction of all admissions to acute care hospitals in Ontario. Records are sent from hospitals to the Canadian Institute for Health Information, where it is validated and cleaned before being sent to ICES for use in healthcare administrative research. At ICES, consecutive DAD records are linked together to form 'episodes of care' among the hospitals to which patients have been transferred after their initial admission. Similarly, it is possible to link all admissions for a given patient (or admissions to other data at ICES) using the individual's encrypted health card number. Although it is usually updated every quarter, since the start of the pandemic ICES has received more timely updates (up to weekly) to facilitate pandemic-related research.
Canadian Institute for Health Information Same Day Surgery (SDS)	Canadian Institute for Health Information (CIHI)	The SDS contains chart abstraction information for all same-day surgeries performed at acute care hospitals in Ontario. Every record corresponds to one same-day surgery or procedure stay. All records for an individual can be linked internally or with other datasets at ICES using the individual's encrypted health card number. Like with the DAD, records are sent from hospitals to the Canadian Institute for Health Information, where it is validated and cleaned before being sent to ICES for use in healthcare administrative research. Although it is usually updated every quarter, since the start of the pandemic ICES has received more timely updates (up to weekly) to facilitate pandemic-related research.

Name	Data Provider	Description
National Ambulatory Care Reporting System (NACRS)	Canadian Institute for Health Information (CIHI)	The NACRS contains administrative, clinical (diagnoses and procedures), demographic, and administrative information for all patient visits made to hospital- and community-based ambulatory care centres (emergency departments, day surgery units, hemodialysis units, and cancer care clinics) in Ontario. Records are sent from hospitals to the Canadian Institute for Health Information, where it is validated and cleaned before being sent to ICES for use in healthcare administrative research. At ICES, NACRS records are linked with other data sources (DAD, Ontario Mental Health Reporting System [OMHRS]) to identify transitions to other care settings, such as inpatient acute care or psychiatric care, and can be linked to other ICES data using the individual's encrypted health card number. Although it is usually updated every quarter, since the start of the pandemic ICES has received more timely updates (up to weekly) to facilitate pandemic-related research.
Ontario Mental Health Reporting System (OMHRS)	Canadian Institute for Health Information (CIHI)	The OMHRS contains administrative, clinical (diagnoses and procedures), demographic, and administrative information from the chart abstraction of all admissions to adult designated inpatient mental health beds across Ontario. This includes beds in general hospitals, provincial psychiatric facilities, and specialty psychiatric facilities. Clinical assessment data is ascertained using the Resident Assessment Instrument for Mental Health (RAI-MH). Multiple assessments may occur during the length of a mental health admission. Records are sent from eligible hospitals to the Canadian Institute for Health Information, where it is validated and cleaned before being sent to ICES for use in healthcare administrative research. At ICES, OMHRS records are linked with other data sources using the individual's encrypted health card number. OMHRS data is updated quarterly.

Name	Data Provider	Description
Community Health Centre	Alliance for Healthier Communities	Community health centres (CHC) deliver primary care services in combination with health promotion and illness prevention services in Ontario, primarily in high need areas to individuals who do not have a health care provider, are newcomers to Canada, face barriers to care, have mental health or addiction issues, require counseling or help with housing issues, and/or have no health insurance in Ontario. Care is provided by physicians, nurse practitioners, nurses, counsellors, community workers, and dietitians. The Community Health Centre dataset includes chart abstracted records for all visits in all such centres across Ontario. The dataset is compiled and validated by the Alliance for Healthier Communities before being sent to ICES for use in healthcare research. Data is updated annually and records are linked using individuals encrypted health card numbers. None of the care provided by CHCs is captured in OHIP and thus CHC data represents a separate source of primary care access, particularly by vulnerable Ontarians.
Ontario Laboratory Information System (OLIS)	Ministry of Health eHealth Ontario	The OLIS contains lab orders, test requests and lab results from most laboratories in Ontario. Starting April 7 2020, ICES began receiving daily cumulative updates of COVID-19 test orders from eHealth Ontario (eHO, now part of Ontario Health Digital Health Services). These data are a minimum dataset extracted from lab orders with COVID-19-specific test request (TR) or LOINC codes and other TR/LOINC codes indicative of viral or respiratory virus testing. Each record represents a testing event, with testing events linkable by encrypted individual health card numbers.
COVAXON	Ministry of Health Public Health Ontario	COVAXON is the central provincial database developed as a point-of-care system to support COVID-19 vaccination in Ontario. The Ministry of Health compiles and manages these data and Public Health Ontario provide ICES with a client-level dataset detailing vaccination records. Each record represents one individual. While vaccination records have been cleaned using data cleaning logic, in instances where multiple records remain present for an individual, the records are reconciled manually based on the most likely scenario (1. 2nd record represents a second vaccination event [ie. 2nd dose]; 2. Repeat record; 3. Incorrectly entered identifier (in which case the earliest record was selected)

Name	Data Provider	Description
OHIP Registered Persons Database	Ministry of Health	The OHIP RPDB contains basic demographic information (age, sex, location of residence, date of birth, and date of death for deceased individuals) for all individuals ever issued an Ontario health insurance number. The RPDB also indicates time periods for which an individual was eligible to receive publicly funded health insurance benefits and provides the best-known postal code for each registrant on July 1st of each year. This data is updated yearly by the Ministry of Health. Each record represents one individual and is linkable to all other ICES data holdings using the encrypted health card number.
Ontario Health Insurance Plan (OHIP)	Ministry of Health	The OHIP claims database contains information pertaining to inpatient and outpatient services provided to Ontario residents eligible for the province's publicly funded health insurance system by fee-for-service health care practitioners (primarily physicians) and "shadow billings" for those paid through non-fee-for-service payment plans. Billing codes on the claims (OHIP fee codes) identify the care provider, their area of specialization and the type and location of service. OHIP billing claims also contain a 3-digit diagnosis code - the main reason for the service - captured using a modified version of the ICD, 8th revision coding system.
Ontario Drug Benefit (ODB) database	Ministry of Health	The Ontario Drug Benefit (ODB) database, updated monthly, contains claims for prescription drugs received under the Ontario Drug Benefit program, which covers Ontarians over 65 years old as well as participants from eligible programs like Ontario Works (which provides financial and employment assistance for Ontarians in need) or the Ontario Disability Support Program (which provides financial and employment assistance for Ontarians with a disability). This database also includes a flag for individuals receiving prescriptions while in a long-term care facility.
PCCF+	Statistics Canada	The Postal Code Conversion File plus (PCCF+) provides a conversion template between Canada Post six-character postal codes and Statistics Canada's standard geographic areas. Through the link between postal codes and standard geographic areas, the PCCF permits the integration of data from various sources that are otherwise incompatible. It also permits the calculation of socioeconomic status proxies, such as neighbourhood-level income quintiles.

Name	Data Provider	Description
Chronic Obstructive Pulmonary Disease (COPD) dataset	Canadian Institute for Health Information (CIHI)	The Ontario COPD Database is created using two separate algorithms applied to inpatient hospitalization (DAD), same day surgery (SDS) records, and physician billing claims (OHIP) data to determine the diagnosis date for incident cases of chronic obstructive pulmonary disease in Ontario. In an algorithm which maximizes sensitivity, the definition for COPD is any physician billing claim with a diagnosis for COPD (OHIP diagnosis codes: 491, 492, 496) or any inpatient hospitalization or same day surgery record with a diagnosis for COPD (ICD-9 diagnosis codes: 491, 492, 496; ICD-10 diagnosis codes: J41- J44; in any diagnostic code space). When using expert panel review of primary care charts as the reference standard, this definition has been shown to have the following performance characteristics: Sensitivity (85.0%), Specificity (78.4%), Positive Predictive Value (57.5%), and Negative Predictive Value (93.8%).(2) In an algorithm which maximizes specificity, the definition for COPD is ≥3 physician billing claims with a diagnosis for COPD (OHIP diagnosis codes: 491, 492, 496) or ≥1 inpatient hospitalization or same day surgery record with a diagnosis for COPD (ICD-9 diagnosis codes: 491, 492, 496; ICD-10 diagnosis codes: J41, J42, J43, J44; in any diagnostic code space) in a two-year period. When using expert panel review of primary care charts as the reference standard, this definition has been shown to have the following performance characteristics: Sensitivity (57.5%), Specificity (95.4%), Positive Predictive Value (81.3%), and Negative Predictive Value (86.7%).(2)
Ontario Asthma dataset	Canadian Institute for Health Information (CIHI)	The Ontario Asthma Database is created using two separate algorithms applied to inpatient hospitalization (DAD), same day surgery (SDS) records, and physician billing claims (OHIP) data to determine the diagnosis date for incident cases of asthma in Ontario. In the algorithm which maximized sensitivity, the definition for Asthma is receipt of one hospital admission with an asthma diagnosis or two OHIP claims with asthma diagnosis within two years. This definition has been shown to have the following performance characteristics in adults: Sensitivity (80.6%), Specificity (81.4%), Positive Predictive Value (72.5%), and Negative Predictive Value (87.3%).(3)

Name	Data Provider	Description
Ontario Diabetes Database (ODD)	Canadian Institute for Health Information (CIHI)	The ODD is created using algorithms applied to inpatient hospitalization (DAD) records, same day surgery (SDS) records, and physician billing claims (OHIP) data to determine the diagnosis date for incident cases of diabetes in Ontario. For adults aged 19 years and greater, the definition for diabetes is 2 physician billing claims with a diagnosis for diabetes (OHIP diagnosis code: 250) or 1 inpatient hospitalization or same day surgery record with a diagnosis for diabetes (ICD-9 diagnosis code: 250; ICD-10 diagnosis codes: E10, E11, E13, E14; in any diagnostic code space) within a 2-year period. Physician claims and hospitalizations with a diagnosis of diabetes occurring within 120 prior to and 180 days after a gestational hospitalization record were excluded. When using primary care chart abstraction as the reference standard, this definition has been shown to have the following performance characteristics: Sensitivity (86.1%), Specificity (97.1%), Positive Predictive Value (79.8%), and Negative Predictive Value (98.1%).(4)
Ontario CHF Database (CHF)	Canadian Institute for Health Information (CIHI)	The Ontario CHF Database is created using a definition of ≥2 physician billing claims with a diagnosis of congestive heart failure (OHIP diagnosis code: 428) and/or ≥1 inpatient hospitalization or same day surgery record with a diagnosis of congestive heart failure (ICD-9 diagnosis code: 428; ICD-10 diagnosis code: I50; in the primary diagnostic code space) in a two-year period applied to hospitalization (DAD), same day surgery (SDS), and physician billing claims (OHIP) data to determine the diagnosis date for incident cases of CHF in Ontario. When using electronic medical record data abstraction as the reference standard, the above definition has been demonstrated to have the following performance characteristics: Sensitivity (84.8%), Specificity (97.0%), and Positive Predictive Value (55.3%).(5)

Name	Data Provider	Description
Ontario Hypertension dataset	ICES	The Ontario hypertension Dataset contains all Ontario hypertension patients identified since 1991. The case definition is one hospital admission/SDS record with a hypertension diagnosis (ICD 9 dxcodes: 401x, 402x, 403x, 404x, 405x or ICD 10 dx10codes: I10, I11, I12, I13, I15), or 1 OHIP claim (401, 402, 403, 404, or 405) with a hypertension diagnosis followed by either an OHIP claim or a hospital admission/SDS record with a hypertension diagnosis within two years. If the hypertension record is between 120 days before and 180 days after a gestational admission date, the hypertension record was considered to be gestational hypertension, and was excluded. This definition has been shown to have the following performance characteristics in adults: Sensitivity (72%), Specificity (95%), Positive Predictive Value (87%)(6)
Ontario Dementia Dataset	ICES	The Ontario Dementia Dataset contains all Ontario patients who were identified as having Alzheimer's or related dementia in ICES data holdings between the ages of 40 and 110 years. The case definition is ≥3 physician billing claims with a dementia diagnosis at least 30 days apart in a 2 year period, or one hospitalization or same day surgery with a dementia diagnosis recorded, or at least one prescription claim in ODB with a dementia medication. This definition has been shown to have the following performance characteristics in adults: Sensitivity (79.3%), Specificity (99.1%), Positive Predictive Value (80.4%)(7)

Name	Data Provider	Description
Ontario Rheumatoid Arthritis Dataset	ICES	The Ontario Rheumatoid Arthritis Dataset (ORAD) contains all Ontario rheumatoid arthritis patients identified since 1991. The case definition is ≥3 physician billing claims, and at least 1 claim billed by a musculoskeletal specialist, with a diagnosis of rheumatoid arthritis (OHIP diagnosis code: 714) and/or ≥1 inpatient hospitalization or same day surgery record with a diagnosis of rheumatoid arthritis (ICD-9 diagnosis code: 714; ICD-10 diagnosis codes: M05, M06; in any diagnostic code space) in a two-year period applied to hospitalization (DAD), same day surgery (SDS), and physician billing claims (OHIP) data to determine the diagnosis date for incident cases of rheumatoid arthritis in Ontario. When using rheumatologist-confirmed diagnosis as the reference standard, this definition has been shown to have the following performance characteristics: Sensitivity (97%), Specificity (85%), Positive Predictive Value (76%), and Negative Predictive Value (98%).(13) Using primary care records as the reference standard, the performance statistics were: Sensitivity 78%, Specificity 100%, PPV 78%, and NPV 100%.(8)

Name	Data Provider	Description
Ontario Crohn's and Colitis Cohort Database	ICES	The Ontario Crohn's and Colitis Cohort Database (OCCC) includes all Ontario patients who were identified with Crohn's disease or Ulcerative Colitis which means Inflammatory Bowel Disease (IBD) when they were aged 0-105 years. The case definition for adults (18+) is one of the following: a) At least two years of OHIP eligibility AND ≥ 5 health contacts including hospital admissions/OHIP claims/NACRS visits with IBD diagnosis within four years, or b) <two years of OHIP eligibility AND ≥3 hospital admissions/OHIP claims/NACRS visits with IBD diagnosis The case definition for elderly (65+ years) patients is one of the following: a) at least two years of OHIP eligibility AND ≥ 5 health contacts including hospital admissions/OHIP claims/NACRS visits with IBD diagnosis within four years AND ≥ 1 ODB claim with IBD medication , or b) <two years of OHIP eligibility AND ≥ 3 hospital admissions/OHIP claims/NACRS visits with IBD diagnosis AND ≥ 1 ODB claim with IBD medication This definition has been shown to have the following performance characteristics in adults: Sensitivity (76.8%), Specificity (96.2%), Positive Predictive Value (81.4%); and in elderly: Sensitivity (59.3%), Specificity (99.0%), Positive Predictive Value (71.1%)(9)
Ontario HIV Database	ICES	The Ontario HIV Database contains all Ontario patients identified as having HIV. The case definition is ≥1 hospitalization (ICD-10 codes: B20-B24) or ≥3 physician billing claims with a diagnosis of HIV (OHIP diagnosis codes: 042-044) in a three-year period applied to physician billing claims (OHIP) data to determine the diagnosis date for incident cases of HIV in Ontario. When using primary care chart abstraction as the reference standard, the above definition has been demonstrated to have the following performance characteristics: Sensitivity (96.2%) and Specificity (99.6%).(10)

Appendix 4: Case definition of recent history of homelessness

Any record between June 14, 2020 and June 14, 2021 from any of the below databases that includes any of the positive ("homeless") indicator values is sufficient evidence to indicate an individual had a recent history of homelessness (IRHH). This case definition is adapted from Richard et al 2019 (citation below). In this validation, it is noted that because sensitivity is moderate, records without evidence of homelessness cannot be interpreted as evidence for *not* being homeless. Further, as individuals may transition across states of housing and homelessness, and their housing status can only be captured when accessing specific health services, the algorithm has demonstrated poor precision in capturing homelessness at a specific point in time. Therefore, individuals captured using this algorithm are more accurately referred to as "individuals with a recent history of homelessness". Since completion of the validation work, the Canadian Institute for Health Information has made it mandatory for hospital coders to indicate homelessness where evidence is present in the chart (since 2018)[11-12].

Database	Variable Name	Indicator Value	Description
DAD	INSTTYPE	"SH"	Institution Type = Supportive Housing
	DX10CODE1 to DX10CODE25	"Z590" or "Z591"	ICD-10 diagnosis codes for "Homelessness" and "Inadequate housing"
	CMGDIAG	"Z590" or "Z591"	ICD-10 diagnosis codes for "Homelessness" and "Inadequate housing"
	PSTLCODE	"XX"	Used in earlier years to indicate transient/homeless patients and still occasionally seen in records
NACRS	DX10CODE1 to DX10CODE10	"Z590" or "Z591"	ICD-10 diagnosis codes for "Homelessness" and "Inadequate housing"
	RESTYPE	"3" or "4"	Residence Type = "Homeless" or "Shelter"
	PSTLCODE	"XX"	Used in earlier years to indicate transient/homeless patients and still occasionally seen in records
OMHRS	PREDX10CODE to PREDX10CODE11	"Z590" or "Z591"	ICD-10 diagnosis codes for "Homelessness" and "Inadequate housing"
	POSTDX10CODE1 to POSTDX10CODE24	"Z590" or "Z591"	ICD-10 diagnosis codes for "Homelessness" and "Inadequate housing"
	PRIOR_RESIDENCE	"6"	Prior residential status = "Homeless (with or without shelter)"
	USUAL_RESIDENCE	"8"	Usual residential status = "Homeless (with or without shelter)"
	ADMITFROM	"8"	Admitted from = "Homeless (with or without shelter)"
	DISCHLIVING	"8"	Living arrangement at discharge = "Homeless (with or without shelter)"
	P5_Retired_2009	"6"	(Variable retired in 2009) Living arrangement = "Homeless (with or without shelter)"
	PSTLCODE	"XX"	Used in earlier years to indicate transient/homeless patients and still occasionally seen in records
CHC	ICD10_code	"Z590" or "Z591"	ICD-10 diagnosis codes for "Homelessness" and "Inadequate housing"

ICD=International Classification of Diseases. Case definition adapted from: Richard, L., Hwang, S. W., Forchuk, C., Nisenbaum, R., Clemens, K., Wiens, K., ... & Shariff, S. Z. (2019). Validation study of health administrative data algorithms to identify individuals experiencing homelessness and estimate population prevalence of homelessness in Ontario, Canada. BMJ open, 9(10), e030221.

Appendix 5: Variable definitions

Variable	Data Source	Definition Description
Age as of Dec 14, 2020	RPDB	Age of the individual at index, calculated from the date of birth recorded on the individual's health card. Categories for this variable include: 18-29 years (reference); 30-39 years; 40-49 years; 50-59 years; and 60 years and older.
Sex as of Dec 14, 2020	RPDB	Biological sex of the individual as recorded in the individual's health card. Reference category=Male
Level of urbanicity as of Dec 14, 2020	PCCF	Adapted from CSIZEMIZ variable which categorizes individuals based on presence and size of census metropolitan area (CSIZE), using the best available postal code for the individual at index. Medium and small CMAs (0-500K pop) are grouped together, as are non-CMA areas. Categories include Large CMA (over 500K population)(reference category); Small to medium CMA (0-500K population); and non-CMA areas. Relies on best known postal code of the individual, which may not be current and/or accurate.
Method of identification as IRHH between June 14, 2020 and June 14, 2021	DAD/SDS NACRS OMHRS CHC	Method of identification as IRHH: through the CHC and/or hospital-based databases; or through hospital-based encounters only. Reference category=Hospital-based encounter only
Chronic obstructive pulmonary disease by Dec 14, 2020	COPD[2] CHC	Inclusion in the database or where ICD10 code (J41-J44) present in a CHC record before index indicates the individual has a history of COPD
Asthma by Dec 14, 2020	ASTHMA[3] CHC	Inclusion in the database or where ICD10 code (J45-J46) present in a CHC record before index indicates the individual has a history of asthma
Diabetes by Dec 14, 2020	ODD[4] CHC	Inclusion in the database or where ICD10 code (E10-E14) present in a CHC record before index indicates the individual has a history of diabetes
Congestive heart failure by Dec 14, 2020	CHF[5] CHC	Inclusion in the database or where ICD10 code (I500 I501 I509) present in a CHC record before index indicates the individual has a history of congestive heart failure
Hypertension by Dec 14, 2020	HYPER[6] CHC	Inclusion in the database or where ICD10 code (I10-I13, I15) present in a CHC record before index the individual has a history of hypertension
Dementia by Dec 14, 2020	DEMENTIA[7] CHC	Inclusion in the database or where ICD10 code (F00-F03, G30) present in a CHC record before index the individual has a history of dementia

Variable	Data Source	Definition Description
Evidence of autoimmune disease between Dec 14, 2019 and Dec 14, 2020	ORAD[8] OCCC[9] DAD OHIP CHC	A composite variable indicating any of the following autoimmune conditions: 1) Rheumatoid Arthritis: Inclusion in the Ontario Rheumatoid Arthritis (ORAD) database or where ICD10 code (M05-M06) present in a CHC record before index 2) Crohn's/Colitis: Presence in the Ontario Crohn's and Colitis cohort (OCCC) database or where ICD10 code (K50-K51) present in a CHC record before index 3) Psoriasis: Evidence of psoriasis (ICD-10 code L40, M070, M071, M072, M073, M090 or at least 3 billings with diagnostic code 696 or 721) or multiple sclerosis (ICD-10 code G35 or at least 3 billings with diagnostic code 340) within a year in any of the listed databases
Evidence of being immunocompromised between Dec 14, 2019 and Dec 14, 2020 (or before Dec 14, 2020, in the case of presence in the HIV database)	HIV[10] DAD OHIP NACRS CHC	A composite variable that indicates any of the following immunocompromised states: 1) HIV: presence in the ICES derived dataset HIV or where ICD10 code (B20-B24) present in a CHC record before index 2) Cancer treatment (ICD-10 code Z510, Z511, Z512) within the past year 3) Evidence of sickle-cell disease (ICD-10 code D570, D571, D572 or D578) in the past year 4) Evidence of allogenic bone marrow transplant (CCI code 1WY19, 1LZ19HHU7, 1LZ19HHU8 or OHIP feecode Z246) in the past year 5) Evidence of other immunocompromised conditions (ICD-10 code D80, D81, D82, D83, D84, D89 or billing with diagnostic code 279) in the past year
Number of comorbidities	N/A	Aggregate variable summarizing the number of comorbidities of the patient, categorized into zero (reference category), one, or two or more comorbidities.
SARS-CoV-2 test between March 1, 2020 and Sept 30, 2021	OLIS	Number of unique non-cancelled or rejected COVID-19 tests recorded in OLIS since March 2020. Also reported as Tested (yes vs no).
COVID Infection or hospitalization from March 1, 2020 to Sept 30, 2021	OLIS DAD	A composite variable indicating that the individual either tested positive for COVID-19 in OLIS (result = "P") and/or was hospitalized with an ICD-10 code indicating COVID-19 positive status (ICD-10 code U071). This variable only includes infections that received a positive test.

Variable	Data Source	Definition Description
Receipt of an influenza vaccine in the 2019-20 or 2020-21 seasons	ODB OHIP CHC	Any billing in ODB (DIN: 02015986, 02223929, 02269562, 02346850, 02362384, 02365936, 02420643, 02420686, 02420783, 02426544, 02428881, 02432730, 09857501) OR any evidence in OHIP (feecode: G590, G591, G592, Q130, Q590, Q690, Q691) OR evidence in CHC (presence in Immunization file with category="Influenza"). This variable does not include immunizations by public health units, in workplaces or through school clinics.
• **Outpatient visits with a general practitioner or CHC from Dec 14, 2018 to Dec 14, 2020 (historical use of health services)** • **Outpatient visits with a general practitioner or CHC from Dec 14, 2020 to Sept 30, 2021 (recent use of health services)**	OHIP CHC	Evidence of care in CHC or OHIP by a general practitioner (OHIP spec="00"). Excludes laboratory-only visits (visit only includes L0-L99 or G0-G99 feecodes)[13]. Most frequent cause of visits include care for addictions and substance use, mental health or mental illness, and various acute and chronic conditions managed on an outpatient basis.
Mental health care encounter from Dec 14, 2019 to Dec 14, 2020	DAD NACRS OMHRS OHIP CHC	1 hospitalization OR 2 physician/CHC claims within 1 year or less of any of the following eligible codes: ICD-10: F06, F07, F08, F09, F1, F2, F30, F31, F32, F33, F34, F38, F39, F4, F50, F51, F52, F531, F538, F539, F54, F59, F6, F7, F8, F90, F91, F92, F930, F931, F932, F933, F934, F938, F939, F94, F95, F98, F99, or X6, X7, X80, X81, X82, X83, X84, Y1, Y28 if dx10code1 not in F codes above DSM-V: 290, 291, 292, 29381, 29382, 295, 296, 297, 298, 300, 303, 304, 305, 311, 312.51, 29383, 29384, 30113, 30921, 31323, 6254 OHIP dx: 291, 292, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 306, 307, 309, 311, 313, 314, 315 OHIP fee code: A680, C680, K680, K682, K683, K684, Q021
Psychosis related mental health care from Dec 14, 2019 to Dec 14, 2020	DAD NACRS OMHRS OHIP CHC	1 hospitalization, ED visit or physician/CHC claim within 1 year of the index date with any of the following eligible codes: ICD-10: F060, F061, F062, F20, F22, F23, F24, F25, F28, F29, F531 DSM-V: 29381, 29382, 295, 297, 298 OHIP dx: 295, 297, 298 OHIP fee code: Q021

Variable	Data Source	Definition Description
Mood disorders related mental health care from Dec 14, 2019 to Dec 14, 2020	DAD NACRS OMHRS OHIP CHC	1 hospitalization, ED visit or physician/CHC claim within 1 year of the index date with any of the following eligible codes: ICD-10: F063, F064, F30, F31, F32, F33, F34, F38, F39, F40, F41, F530, F930, F931, F932, F94 DSM-V: 296, 300, 301, 3002, 3004, 6254, 29383, 29384, 30113, 30921, 31323 OHIP dx: 296, 300, 311
Substance use related mental health care from Dec 14, 2019 to Dec 14, 2020	DAD NACRS OMHRS OHIP CHC	1 hospitalization, ED visit or physician/CHC claim within 1 year of the index date with any of the following eligible codes: ICD-10: F1, F55 DSM-V: 291, 292, 303, 304, 305, 31251 OHIP dx: 291, 292, 303, 304 OHIP fee code: A680, C680, K680, K682, K683, K684
Other mental health related care from Dec 14, 2019 to Dec 14, 2020	DAD NACRS OMHRS OHIP CHC	1 hospitalization, ED visit or physician/CHC claim within 1 year of the index date with any of the following eligible codes: ICD-10: F065, F066, F067, F068, F069, F07, F08, F09, F21, F42, F43, F44, F45, F48, F49, F50, F51, F52, F538, F539, F54, F59, F6, F7, F8, F90, F91, F92, F933, F934, F938, F939, F95, F98, F99 or X6, X7, X80, X81, X82, X83, X84, Y1, Y28 if dx10code1 not in F codes above OHIP dx: 299, 301, 302, 306, 307, 309, 313, 314, 315
Vaccine product during observation period (Dec 14, 2020 to Sept 30, 2021)	COVAXON	Type of vaccine received: a) Pfizer, b) Moderna, c) AstraZeneca/COVISHIELD d) Janssen

Variable	Data Source	Definition Description
Status for which vaccine was received during observation period (Dec 14, 2020 to Sept 30, 2021)	COVAXON PHO[14]	Priority status rationale for receipt of vaccine (recorded at first dose only): a) Age-based eligibility b) Congregate setting (includes "Congregate setting (not LTCH/RH) staff/resident", "LTCH resident", "RH resident") c) Priority populations (includes "High-risk condition adults and caregivers", "Adult recipients of chronic home care" and "Other priority population") d) Health-care Essential Workers (includes "HCW" "LTCH HCW" "RH HCW" "LTCH/RH employee/essential caregiver") e) Other Essential Workers (includes "Essential worker who cannot work from home" "Education and childcare worker" "Agricultural/farm/food manufacturing worker") f) Other (includes "Not reported" "Youth 12+" "Community at greater risk" – which Is a geographic criterion for areas with high COVID-19 risk) This variable only records status at the time of the first dose. Individuals may be eligible through more than one status at the timing of vaccination.
Vaccine administration location during observation period (Dec 14, 2020 to Sept 30, 2021)	COVAXON	Where the vaccine was administered: a) Congregate living/care b) Hospital c) Other d) PHU delivered clinic e) Pharmacy f) Physician's office

Appendix 6: COVID-19 vaccine coverage overall and in predefined subgroups as of Sept 30, 2021

	Total population	One dose only			Two doses			One or more doses			
	N	**N**	**%**	**95 CI%**	**N**	**%**	**95 CI%**	**N**	%	**95 CI%**	**p-value***
Ontario population (aged ≥ 18)[14]	12,083,325	613,833	5.1		9,855,160	81.6		10,468,993	86.6		
IRHH overall (aged ≥ 18)	23,247	3,189	13.7	13.3 - 14.2	11,082	47.7	47.0 - 48.3	14,271	61.4	60.8 - 62.0	
Age groups (years)											<0.0001
18 to 29 years old	4,435	724	16.3	15.3 - 17.4	1,667	37.6	36.2 -39.0	2,391	53.9	52.4 - 55.4	
30 to 39 years old	7,086	1,173	16.6	15.7 - 17.4	2,578	36.4	35.3 -37.5	3,751	52.9	51.8 - 54.1	
40 to 49 years old	3,919	525	13.4	12.4 - 14.5	1,842	47.0	45.4 - 48.6	2,367	60.4	58.9 - 61.9	
50 to 59 years old	3,642	445	12.2	11.2 - 13.3	2,025	55.6	54.0 - 57.2	2,470	67.8	66.3 - 69.3	
60+ years old	4,165	322	7.7	7.0 - 8.6	2,970	71.3	69.9 - 72.7	3,292	79.0	77.8 - 80.3	
Method of identification of individuals with a recent history of homelessness											<0.0001
Hospital-based encounter only	16,377	2,407	14.7	14.2 - 15.3	6,970	42.6	41.8 - 43.3	9,377	57.3	56.5 - 58.0	
Outpatient CHC visit	6,870	782	11.4	10.7 - 12.2	4,112	59.9	58.7 - 61.0	4,894	71.2	70.2 - 72.3	
≥1 visits to an emergency department (Dec 14, 2020 to Sept 30, 2021)											<0.0001
Yes	15,327	2,369	15.5	14.9 - 16.0	6,899	45.0	44.2 – 45.8	9,268	60.5	59.7 – 61.2	
No	7,920	820	1.04	9.7 – 11.0	4,183	52.8	51.7 – 53.9	5,003	63.2	62.1 – 64.2	
≥1 outpatient visits to a general practitioner (Dec 14, 2020 to Sept 30, 2021)											<0.0001
No	3,468	467	13.5	12.4 - 14.6	1,124	32.4	30.9 - 34.0	1,591	45.9	44.2 - 47.5	
Yes	19,489	2,722	14.0	13.5 - 14.5	9,958	51.1	50.4 - 51.8	12,680	65.1	64.4 - 65.7	
Receipt of an Influenza vaccine in the 2019-20 or 2020-21 seasons											<0.0001
No	20,957	2,997	14.3	13.8 - 14.8	9,259	44.2	44.8 - 46.1	12,256	58.5	57.8 - 59.2	
Yes	2,290	192	8.4	7.3 - 9.6	1,823	79.6	77.9 - 81.2	2,015	88.0	86.6 - 89.3	
Number of chronic health conditions											<0.0001
0	12,023	1,825	15.2	14.6 - 15.8	4,737	39.4	38.5 - 40.3	6,562	54.6	53.7 - 55.5	
1	6,412	881	13.7	12.9 - 14.6	3,129	48.8	47.6 - 50.0	4,010	62.5	61.4 - 63.7	
2+	4,812	483	10.0	9.2 - 10.9	3,216	66.8	65.5 - 68.2	3,699	76.9	75.7 - 78.0	

Level of urbanicity											<0.0001
Rural regions (population <10 000)	1,503	214	14.2	12.6 - 16.1	695	46.2	43.7 - 48.8	909	60.5	58.0 - 62.9	
Small to medium metropolitan region (population 10 000-500 000)	9,034	1,386	15.3	14.6 - 16.1	3,833	42.4	41.4 - 43.5	5,219	57.8	56.8 - 58.8	
Large metropolitan region (population >500 000)	12,123	1,497	12.3	11.8 - 13.0	6,319	52.1	51.2 - 53.0	7,816	64.5	63.6 - 65.3	
Unknown/missing	587	92	15.7	13.0 - 18.8	235	40.0	36.2 - 44.1	327	55.7	51.7 - 59.7	
Mental health-care encounter in the previous year											<0.0001
Yes	15,448	2,264	14.7	14.1 - 15.2	7,440	48.2	47.4 - 49.0	9,704	62.8	62.1 - 63.6	
No	7,799	925	11.9	11.2 - 12.6	3,642	46.7	45.6 - 47.8	4,567	58.6	57.5 - 59.7	

*within group p-values for coverage of 1+ doses (X^2 test)

Appendix 7: Characteristics of participants by maximum number of doses received as of Sept 30, 2021

	Zero doses (n=8,976)	One dose only (n=3,189)	Two doses (n=11,082)	p-value
Demographics				
Age mean (SD)	39.35 (13.46)	39.50 (13.53)	47.37 (16.76)	<.0001
Age groups, N (%)				
18 to 29 years	2,044 (22.77%)	724 (22.70%)	1,667 (15.04%)	<.0001
30 to 39 years	3,335 (37.15%)	1,173 (36.78%)	2,578 (23.26%)	
40 to 49 years	1,552 (17.29%)	525 (16.46%)	1,842 (16.62%)	
50 to 59 years	1,172 (13.06%)	445 (13.95%)	2,025 (18.27%)	
60+ years	873 (9.73%)	322 (10.10%)	2,970 (26.80%)	
Female, N (%)	3,048 (33.96%)	1,102 (34.56%)	4,345 (39.21%)	<.0001
Level of urbanicity, N (%)				
Large metropolitan region (> 500 000 population)	4,307 (47.98%)	1,497 (46.94%)	6,319 (57.02%)	<.0001
Small to medium metropolitan region (10 000-500 000 population)	3,815 (42.50%)	1,386 (43.46%)	3,833 (34.59%)	
Rural regions (<10 000 population)	594 (6.62%)	214 (6.71%)	695 (6.27%)	
Unknown/missing	260 (2.90%)	92 (2.88%)	235 (2.12%)	
Evidence of homelessness between June 14, 2018 and June 14, 2020, N (%)	4,140 (46.12%)	1,520 (47.66%)	4,894 (44.16%)	0.0005
Identified as IRHH via a CHC encounter	1,976 (22.01%)	782 (24.52%)	4,112 (37.11%)	<.0001
Health status, N (%)				
Chronic health conditions				
Asthma	1,425 (15.88%)	549 (17.22%)	1,830 (16.51%)	0.1796
Chronic obstructive pulmonary disease	852 (9.49%)	376 (11.79%)	2,087 (18.83%)	<.0001
Congestive heart failure	169 (1.88%)	63 (1.98%)	543 (4.90%)	<.0001
Hypertension	1,088 (12.12%)	437 (13.70%)	3,148 (28.41%)	<.0001
Diabetes	849 (9.46%)	339 (10.63%)	2,387 (21.54%)	<.0001
Dementia	95 (1.06%)	49 (1.54%)	483 (4.36%)	<.0001
Autoimmune diseases (multiple sclerosis, psoriasis, rheumatoid arthritis, Crohn's disease, or ulcerative colitis)	253 (2.82%)	108 (3.39%)	666 (6.01%)	<.0001
Immunocompromised state (cancer, sickle cell, HIV, other)	392 (4.37%)	171 (5.36%)	593 (5.35%)	0.0034

Number of chronic conditions[1]				
0	5,461 (60.84%)	1,825 (57.23%)	4,737 (42.74%)	<.0001
1	2,402 (26.76%)	881 (27.63%)	3,129 (28.23%)	
2+	1,113 (12.40%)	483 (15.15%)	3,216 (29.02%)	
Historical use of health services				
Visits to an ED (2-year lookback), mean (SD)	6.99 (14.13)	8.34 (17.05)	7.23 (16.66)	0.0002
Outpatient visits to a general practitioner[2] (2-year lookback), median (IQR)	3.00 (1.00-10.00)	6.00 (2.00-16.00)	7.00 (3.00-16.00)	<.0001
Receipt of an Influenza vaccine in 2019-20 or 2020-21 seasons, N (%)	275 (3.06%)	192 (6.02%)	1,823 (16.45%)	<.0001
Mental healthcare encounter (1 year lookback), N (%)	5,744 (63.99%)	2,264 (70.99%)	7,440 (67.14%)	<.0001
Specific mental health conditions				
Psychotic disorder	997 (11.11%)	405 (12.70%)	1,415 (12.77%)	0.0009
Mood disorder	2,628 (29.28%)	1,111 (34.84%)	4,279 (38.61%)	<.0001
Substance use related disorder	3,889 (43.33%)	1,614 (50.61%)	4,183 (37.75%)	<.0001
Other mental health related care	1,626 (18.11%)	656 (20.57%)	2,812 (25.37%)	<.0001
Recent use of health services				
≥ 1 SARS-CoV-2 test (Mar 1, 2020 to Sept 30, 2021), N (%)	6,311 (70.31%)	2,577 (80.81%)	8,760 (79.05%)	<.0001
Infection or hospitalization for COVID-19 (Mar 1, 2020 to Sept 30, 2021), N (%)	715 (7.97%)	337 (10.57%)	1,015 (9.16%)	<.0001
Outpatient visits to a general practitioner[2], any (Dec 14, 2020 to Sept 30, 2021), mean (IQR)	2.00 (0.00-7.00)	4.00 (1.00-10.00)	5.00 (1.00-11.00)	<.0001
≥1 in-person outpatient visits to a general practitioner (Dec 14, 2020 to Sept 30, 2021), N (%)	6,311 (70.31%)	2,567 (80.50%)	9,348 (84.35%)	<.0001
Visits to an emergency department (Dec 14, 2020 to Sept 30, 021), mean (SD)	1.00 (0.00-3.00)	2.00 (0.00-4.00)	1.00 (0.00-3.00)	<.0001
≥1 visit to an emergency department (Dec 14, 2020 to Sept 30, 2021), N (%)	6,059 (67.50%)	2,369 (74.29%)	6,899 (62.25%)	<.0001

Month dose received, N (%)				
January or February 2021		22 (0.69%)	149 (1.34%)	NA
March 2021		258 (8.09%)	214 (1.93%)	
April 2021		398 (12.48%)	290 (2.62%)	
May 2021		323 (10.13%)	461 (4.16%)	
June 2021		388 (12.17%)	3,492 (31.51%)	
July 2021		473 (14.83%)	3,783 (34.14%)	
August 2021		466 (14.61%)	1,575 (14.21%)	
September 2021		861 (27.00%)	1,118 (10.09%)	

[1]Sum of the specific chronic health conditions

[2]General practitioner visits include outpatient visits to a physician with the OHIP designation of "FAMILY PRACTICE AND GENERAL PRACTICE" or any visit to a Community Health Centre.

SD = standard deviation, ED = emergency department, NA = not applicable; test not performed

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