



Postoperative Outcomes for Nunavut Inuit at a Canadian Tertiary Care Centre: A Retrospective Cohort Study

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More Detailed Keywords:	
Keywords:	Aboriginal health, Anesthesia and analgesia, Health services research, Oncology, Surgery, Health policy
Abstract:	<p>Background: Structural aspects of the healthcare system, specifically limited access to specialized surgical and perioperative care can negatively impact the outcomes and resource use for patients undergoing elective and emergency surgical procedures. The aim of this study was to compare postoperative outcomes between Nunavut Inuit and non-Inuit at a Canadian tertiary care center.</p> <p>Methods: We conducted a retrospective cohort study of adult inpatient surgery patients (2011-2018) at The Ottawa Hospital, the tertiary referral hospital for the Qikiqtaaluk Region of Nunavut. The primary outcome was a composite of in-hospital mortality or complications. Secondary outcomes included postoperative hospital length of stay (LoS), adverse</p>

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	<p>discharge, readmissions within 30 days and total hospitalization costs.</p> <p>Results: There were 98,701 episodes of inpatient surgical care; 928 (0.9%) involved Nunavut Inuit. Death or post-operative complication occurred more among Nunavut Inuit than non-Inuit (159 (17.2%) vs. 15,691 (16.1%)), which was significantly different after adjustment (OR 1.25, 95%CI 1.03-1.51; P=0.025). This association was most pronounced in cancer and elective surgery cases (OR 1.63, 95%CI 1.03-2.58; OR 1.58, 95%CI 1.20-2.10). Adjusted rates of readmission, adverse discharge, length of stay and total costs were significantly higher for Nunavut Inuit.</p> <p>Interpretation: Nunavut Inuit experienced a 25% relative increase in their odds of morbidity and mortality after surgery at a major tertiary care hospital in Canada compared to non-Inuit, while also experiencing higher rates of other adverse outcomes and resource use. An examination of perioperative systems involving patients, Inuit leadership, healthcare providers and governments is required to address this inequity.</p>



Strobe Checklist

		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study’s design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	#4	Present key elements of study design early in the paper	4
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up.	5
Eligibility criteria	#6b	For matched studies, give matching criteria and number of exposed and unexposed	6
Variables	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
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. Give information separately for for exposed and unexposed groups if applicable.	6, App 1 & 2
Bias	#9	Describe any efforts to address potential sources of bias	NA
Study size	#10	Explain how the study size was arrived at	5
Quantitative	#11	Explain how quantitative variables were handled in the analyses. If	7

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1	variables	applicable, describe which groupings were chosen, and why	
2			
3	Statistical methods	#12a Describe all statistical methods, including those used to control for	8
4		confounding	
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9	Statistical methods	#12b Describe any methods used to examine subgroups and interactions	8
10			
11	Statistical methods	#12c Explain how missing data were addressed	9
12			
13	Statistical methods	#12d If applicable, explain how loss to follow-up was addressed	9
14			
15			
16	Statistical methods	#12e Describe any sensitivity analyses	9
17			
18			
19			
20			
21	Results		
22			
23	Participants	#13a Report numbers of individuals at each stage of study—eg numbers	9
24		potentially eligible, examined for eligibility, confirmed eligible,	
25		included in the study, completing follow-up, and analysed. Give	
26		information separately for for exposed and unexposed groups if	
27		applicable.	
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31	Participants	#13b Give reasons for non-participation at each stage	NA
32			
33	Participants	#13c Consider use of a flow diagram	NA Table
34			1
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39			
40	Descriptive data	#14a Give characteristics of study participants (eg demographic, clinical,	Table 1
41		social) and information on exposures and potential confounders. Give	
42		information separately for exposed and unexposed groups if applicable.	
43			
44			
45	Descriptive data	#14b Indicate number of participants with missing data for each variable of	9
46		interest	
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51	Descriptive data	#14c Summarise follow-up time (eg, average and total amount)	NA
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56	Outcome data	#15 Report numbers of outcome events or summary measures over time.	9
57		Give information separately for exposed and unexposed groups if	
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1		applicable.	
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5	Main results	#16a Give unadjusted estimates and, if applicable, confounder-adjusted	10
6		estimates and their precision (eg, 95% confidence interval). Make clear	
7		which confounders were adjusted for and why they were included	
8			
9			
10	Main results	#16b Report category boundaries when continuous variables were categorized	10
11			
12	Main results	#16c If relevant, consider translating estimates of relative risk into absolute	9
13		risk for a meaningful time period	
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19	Other analyses	#17 Report other analyses done—eg analyses of subgroups and interactions,	10
20		and sensitivity analyses	
21			
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23	Discussion		
24			
25	Key results	#18 Summarise key results with reference to study objectives	10
26			
27	Limitations	#19 Discuss limitations of the study, taking into account sources of potential	11
28		bias or imprecision. Discuss both direction and magnitude of any	
29		potential bias.	
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33	Interpretation	#20 Give a cautious overall interpretation considering objectives,	10
34		limitations, multiplicity of analyses, results from similar studies, and	
35		other relevant evidence.	
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38	Generalisability	#21 Discuss the generalisability (external validity) of the study results	12
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41	Other		
42	Information		
43			
44	Funding	#22 Give the source of funding and the role of the funders for the present	1
45		study and, if applicable, for the original study on which the present	
46		article is based	
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Title: Postoperative Outcomes for Nunavut Inuit at a Canadian Tertiary Care Centre: A Retrospective Cohort Study

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Contributors: Nadine Caron, Dylan Bould, Jason Nickerson, Dan McIsaac and Jason McVicar conceived of and designed the study and provided ongoing monitoring. Jenny Hoang-Nguyen, Justine O'Shea, Jason McVicar and Dan McIsaac interpreted the data and drafted the article. All of the authors revised the draft critically for important intellectual content and approved the final version.

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Data Sharing: All study data are available through contact with the corresponding author

Competing interests: None Declared

1
2
3 Abstract

4
5 **Background:**

6
7 Structural aspects of the healthcare system, specifically limited
8 access to specialized surgical and perioperative care can
9 negatively impact the outcomes and resource use for patients
10 undergoing elective and emergency surgical procedures. The aim of
11 this study was to compare postoperative outcomes between Nunavut
12 Inuit and non-Inuit at a Canadian tertiary care center.
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23 **Methods:**

24
25 We conducted a retrospective cohort study of adult inpatient
26 surgery patients (2011-2018) at The Ottawa Hospital,
27 the tertiary referral hospital for the Qikiqtaaluk Region of
28 Nunavut. The primary outcome was a composite of in-hospital
29 mortality or complications. Secondary outcomes included
30 postoperative hospital length of stay (LoS), adverse discharge,
31 readmissions within 30 days and total hospitalization costs.
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44 **Results:**

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46 There were 98,701 episodes of inpatient surgical care; 928 (0.9%)
47 involved Nunavut Inuit. Death or post-operative complication occurred more among
48 Nunavut Inuit than non-Inuit (159 (17.2%) vs. 15,691 (16.1%)), which was
49 significantly different after adjustment (OR 1.25, 95%CI 1.03-
50 1.51; P=0.025). This association was most pronounced in cancer and
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5 1.20-2.10). Adjusted rates of readmission, adverse discharge,
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7 length of stay and total costs were significantly higher for
8
9 Nunavut Inuit.

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12 **Interpretation:**

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14 Nunavut Inuit experienced a 25% relative increase in their odds of
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16 morbidity and mortality after surgery at a major tertiary care
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18 hospital in Canada compared to non-Inuit, while also experiencing
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20 higher rates of other adverse outcomes and resource use. An
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22 examination of perioperative systems involving patients, Inuit
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24 leadership, healthcare providers and governments is required to
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26 address this inequity.
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Introduction

Differences in health outcomes for First Nations, Inuit and Metis Peoples in Canada persist despite repeated commissions and calls to action(1-3). Racist and colonial policies such as the Indian Act, land dispossession, forced relocation and residential school systems have contributed to ongoing social inequities for Indigenous Peoples in the form of inadequate housing, lack of access to clean water, food and income insecurity, and inequitable experiences in the healthcare system(4-6).

There is increasing evidence of health disparities for Indigenous Peoples, such as higher rates of communicable and non-communicable diseases and unintentional injury(7-9). Similar trends are also seen in the surgical population. A recent systematic review of postoperative outcomes for Indigenous Peoples in Canada demonstrated higher rates of adverse events after surgery, including death (adjusted 30% relative decrease in survival), postoperative complications and hospital readmission(10). First Nations, Inuit and Metis Peoples in Canada are a highly heterogeneous populations, comprising of over 684 communities (630 First Nations and 54 Inuit) and 70 distinct languages(11). There are no available studies describe outcomes specifically for Inuit which represents a significant gap in our understanding of the pattern of surgical disease and outcomes in Canada.

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5 Inuit reside primarily in Inuit Nunangat (homeland), which includes
6 the Inuvialuit Settlement Region (Northwest Territories), Nunavut,
7 Nunavik (Québec), and Nunatsiavut (Labrador), with population
8 growth in cities such as Yellowknife, Edmonton, Winnipeg, Ottawa
9 and Montreal (4,12). Inuit experience extreme health disparities
10 and, on average, report worse overall scores on key social
11 determinants of health, including access to healthcare(12,13). It
12 is postulated that structural aspects of the healthcare system,
13 specifically limited surgical specialists, high provider turnover
14 in Nunavut, and perioperative processes can influence the health
15 of Inuit undergoing surgery(14). This is further exacerbated by
16 geographical remoteness, which can introduce significant logistic,
17 social and financial strains on individuals accessing care in urban
18 centers.
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39 The Ottawa Hospital (TOH) in Ontario is the quaternary referral
40 centre for adult patients from the Qikiqtaaluk Region of Nunavut,
41 population 18,985 (53% of the total territorial population, 80%
42 Inuit), providing specialized healthcare including elective and
43 emergency surgery for trauma, neurosurgery, thoracic surgery,
44 vascular surgery, oncology and complex orthopedics (Figure
45 1)(12,15). Our objective was to examine postoperative outcomes
46 between Nunavut Inuit and non-Inuit undergoing surgery at this
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3 referral center. We hypothesized that Inuit from Nunavut would
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5 experience higher rates of adverse outcomes compared to the non-
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7 Inuit population.
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11 12 **Methods**

13 14 *Design and setting*

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16 We performed a retrospective cohort study of all adult inpatient
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18 surgery at The Ottawa Hospital. The Ottawa Hospital Research
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20 Institute Research Ethics Board approval was received (20180324).
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22 This manuscript is reported in keeping with recommended guidelines
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24 for observational studies using routinely collected data (16) (17).
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30 31 *Data sources*

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33 All data were collected from The Ottawa Hospital Data Warehouse
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35 (TOHDW), which stores prospective clinical, electronic and
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37 administrative data for The Ottawa Hospital. Specific data sources
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39 used within TOHDW included the Canadian Institute for Health
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41 Information Discharge Abstract Database (DAD); the National
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43 Ambulatory Care Reporting System; the Surgical Information
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45 Management System (SIMS, Optum, Eden Prairie, MN), which records
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47 all details of surgical procedures performed in our hospital
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49 operating rooms; and our electronic health record database, which
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51 captures records of clinical care and laboratory data. Data sources
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53 are further described in Appendix 1.
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Cohort

We identified all adults (age ≥ 18 years) undergoing non-cardiac, non-obstetric surgery during an inpatient admission between April 1st 2011 to March 31st, 2018. First, we identified surgical procedures from the SIMS database. Next, we linked the corresponding inpatient admission from the DAD and created an episode-level analytic data set.

Exposure

The exposure was Nunavut Inuit identity, determined via the Nunavut health card number, which identifies Inuit Land Claim Beneficiaries through the presence of a '5' in the 9th position of the number, an approach used previously(18). Based on the presence, or absence, of this alphanumeric indicator individuals were categorized as Nunavut Inuit and were compared to all adult non-Nunavut residents receiving surgical care at TOH.

Outcomes

The primary outcome was a composite of in-hospital mortality or complication; death was identified from the DAD and complications were identified using type 2 (i.e., arising in hospital) diagnostic codes based on Southern and colleagues clusters of Patient Safety Indicators (PSIs) (Appendix 2) (19). Validation of the PSIs in

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3 surgical patients at TOH compared to National Surgical Quality
4 Improvement Program (NSQIP) prospectively collected complications
5 demonstrates good concurrent validity (i.e., similar rates of
6 complications identified with each system), as well as a positive
7 likelihood ratio of 6.4 and negative likelihood ratio of 0.4 using
8 NSQIP data as the reference standard(20). Secondary outcomes
9 included postoperative hospital length of stay (LoS) (from the
10 DAD), readmissions within 30 days of discharge (from creation of
11 a new DAD record within 30 days of the index episode discharge
12 among those discharged alive), adverse discharge (discharge to a
13 long-term or continuing care bed, or death in hospital as death is
14 a competing risk for discharge outcomes from the DAD) and total
15 hospitalization costs, using standardized methods that included
16 both direct and indirect costs standardized to 2018 Canadian
17 dollars.(21) This method accounts for an individual patient's
18 resource intensity weight, their case mix group, as well as fixed
19 and indirect costs to the hospital based on patient location of
20 care and LoS.
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46 *Covariates*

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48 From the DAD we identified patient age, sex and the specific
49 Canadian Classification of Interventions code for the index
50 surgery, and all Elixhauser comorbidities present on
51 admission(22). From SIMS we identified the primary surgical
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3 service (orthopedic, general, gynecologic oncology, benign
4 gynecology, neuro, plastics, dental, thoracic, urology, or
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6 vascular), urgency (elective or urgent priority 1, 2 or 3) and the
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8 American Society of Anesthesiologists' (ASA) Physical Status
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10 Score. From the health record we computed the Laboratory-based
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12 Acute Physiology Score (LAPS), an externally validated score that
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14 predicts physiology-associated mortality risk based on laboratory
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16 values, and identified whether the individual received cancer
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18 treatment at the TOH Cancer Center in the year prior to
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20 surgery(23).

21 22 23 24 25 26 27 28 *Analysis*

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30 All analyses were performed using SAS version 9.4 (SAS Institute,
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32 Cary, NC). Baseline characteristics were compared between those
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34 with and without Nunavut Inuit identity using absolute
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36 standardized differences (where values >0.1 suggest a substantial
37
38 difference) (24). A 5% level of significance based on two-tailed
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40 tests was used for the primary outcome, which was prespecified.
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42 With Bonferroni multiplicity adjustment for four secondary
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44 outcomes, a 1.25% level of significance was applied to secondary
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46 analyses. Sensitivity analyses were considered exploratory.
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52 We performed unadjusted and multivariable adjusted analyses for
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54 each outcome. For binary outcomes (death or complication,
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3 readmission, adverse discharge), we used logistic regression
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5 models; for skewed continuous outcomes (LoS, costs) we used
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7 generalized linear models with a log link and gamma response
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9 distribution, as recommended for surgical data(25). All adjusted
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11 models accounted for instances where an individual had more than
12
13 one episode of surgical care using generalized estimating
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15 equations, and included pre-specified terms for surgical service
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17 (categorical, with orthopedics as reference), age (categorical
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19 with 18-64 as reference, 65-74 and 75+), sex (binary), urgency
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21 (categorical with elective as reference) and procedural risk
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23 (using the Procedural Index for Mortality Risk (PIMR) score, an
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25 internally validated score (linear, as in its validation)(26,27).
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27 Adjustment for comorbidity and physiologic status were not
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29 performed in the primary analysis as they were thought to be
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31 intermediates on the causal pathway from having Nunavut Inuit
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33 identity to outcome and would therefore introduce over-adjustment
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35 bias.
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44 We performed several pre-specified sensitivity analyses. First,
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46 both components of the primary outcome were analyzed individually.
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48 Next, to evaluate whether comorbidity and physiologic status may
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50 mediate some adverse outcome burden we re-ran the primary adjusted
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52 model with additional terms for LAPS (linear), Elixhauser score
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54 (linear, a validated score predicting in-hospital mortality), and
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3 ASA score (binary 1-2 vs ≥ 3) (28). Prespecified subgroup analyses
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5 were also completed within patients with cancer and based on
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7 urgency (elective vs urgent).
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10 11 12 *Missing data*

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14 All analyses were performed as complete case analyses as no
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16 exposure or outcome data were missing and all covariate data was
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18 complete other than missing PIMR and LAPS scores for 91 and 90
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20 participants (<0.1%), respectively.
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26 **Results**

27
28 We identified 98,701 episodes of inpatient surgical care at TOH
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30 during the study period; 928 involved Nunavut Inuit (0.9%). Those
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32 with Nunavut Inuit identity were more likely to have urgent
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34 surgery, were younger and had a differential distribution of
35
36 surgical procedures. (Table 1).
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42 *Postoperative complications or in-hospital mortality*

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44 Among Nunavut Inuit, 159 died or experienced a complication in
45
46 hospital after surgery (17.2%; 155 with complications and 15
47
48 deaths), compared to 15,691 (16.1%; 15223 complications and 1446
49
50 deaths) for those without Nunavut Inuit identity (unadjusted odds
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52 ratio (OR) 1.06, 95%CI 0.89 to 1.27; P=0.500). After adjustment,
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54 Nunavut Inuit were significantly more likely to experience the
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3 primary outcome (OR 1.25, 95%CI 1.03 to 1.51; P=0.025). Sensitivity
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5 analysis including additional adjustment for chronic and acute
6
7 illness found no significant association (OR 1.15, 95%CI 0.94 to
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9 1.41; P=0.170). Heterogeneity in effect estimates were identified
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11 between subgroups, with larger and significant associations
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13 between Nunavut Inuit identity and outcome being identified in
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15 elective surgery and for cancer surgery, but not after urgent
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17 surgery. (Figure 2).
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23 *Secondary outcomes*

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25 Table 2 describes secondary outcomes by exposure, as well as
26
27 adjusted and unadjusted effect estimates. Prior to adjustment,
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29 those with Nunavut Inuit identity were significantly more likely
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31 to have an adverse discharge location, and higher LoS and costs.
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33 Following adjustment, these significant associations persisted,
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35 along with a significant association with readmission.
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42 **Interpretation**

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44 In a single center retrospective cohort study, we found that those
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46 with Nunavut Inuit identity had increased odds of postoperative
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48 morbidity and mortality, especially after elective and cancer
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50 surgeries. Rates of healthcare resource utilization were also
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52 higher. These findings help to address an important knowledge gap
53
54 around surgical and perioperative outcomes for Inuit and highlight
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3 the urgent need to improve systems of care in partnership with
4 Nunavut Inuit representative organizations to help ameliorate
5 outcomes for Nunavut Inuit requiring surgery.
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12 At least two systematic reviews describe associations between
13 Indigenous status and perioperative outcomes. One, focused on
14 Indigenous people from the United States, Australia and New Zealand
15 found higher rates of mortality after cardiac surgery(29). A
16 second, which synthesized available Canadian studies similarly
17 found an adjusted 30% relative decrease in survival across surgery
18 types and narratively described increased rates of complications
19 compared to the general population(10). However, both studies
20 identified important knowledge gaps and limitations that the
21 current study helps to address. First, defining Indigenous
22 exposure is often a source of bias. In our study, we were able to
23 identify Nunavut Inuit identity directly from government issued
24 health cards. Second, no Inuit-specific data were identified in
25 either review, meaning that a core Indigenous population in Canada
26 had been excluded from evaluation of perioperative outcomes, a gap
27 that the current study directly addresses.
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51 Our finding that Nunavut Inuit have a 1.25-fold increase in the
52 odds of morbidity and mortality is consistent with existing
53 perioperative risk estimates for Indigenous Canadians. However,
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3 the causal pathway underlying this effect is likely
4 multidimensional and complex (Figure 3), reflecting upstream
5 social determinants and related chronic health conditions, process
6 factors related to access, as well as challenges in receiving care
7 thousands of kilometers from one's home and community. It is not surprising
8 that resource utilization was higher, but these data provide crucial context that despite spending
9 nearly 20% more on care, outcomes were over 20% less favorable.
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21 Inuit experience poor social determinants of health including
22 inadequate access to health services, which can ultimately lead
23 to worse acute health outcomes(4,13). This was supported by our
24 findings. In patients undergoing emergency surgery, there was no
25 significant difference in postoperative morbidity or mortality
26 between Nunavut Inuit and the non-Inuit population. Instead, the
27 differences in perioperative health outcomes were more prominently
28 observed in patients undergoing elective and cancer surgery. This
29 may be due to systemic barriers in accessing timely and culturally
30 appropriate surgical care faced by Nunavut Inuit, leading to
31 presentations with more advanced disease and thereby increasing
32 risk of postoperative adverse events. This is in keeping with the
33 cancer care literature, where barriers to accessing care is well
34 documented with some evidence that Indigenous patients may present
35 at a later stage in cancer progression(30,31).
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3 This study has several strengths including a reliable identifier
4 for Inuit identity, which remains a recurring challenge in
5 Indigenous health outcome literature in Canada. The study has valid
6 exposure and outcomes, strong control for confounders and
7 effective exploration of effect modification. The study also
8 accounts for both clinical and economic outcomes.
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19 The study also has some limitations. The focus is centred around
20 the acute hospitalization of a primary surgical procedure without
21 describing the entire perioperative journey for Nunavut Inuit.
22 There is the potential for misclassification of complications for
23 emergency surgery and there is no information on the cancer stage
24 at presentation. We recognize that Nunavut patients who receive
25 care at TOH have unique referral patterns due to systemic factors
26 related to low population density and decreased access to
27 physicians for both primary and speciality care. Large distances
28 for follow up care may also influence discharge patterns in the
29 recovery phase which can impact hospitalization times and costs.
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46 Further elucidation of the complicated journeys for surgical
47 patients from Inuit Nunangat to the network of tertiary care
48 hospitals across Canada is needed to reduce barriers in the
49 transitions of care as patients move across health systems. There
50 is a need for data linkage and integration between Territorial and
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3 Provincial health systems to better understand longitudinal
4 trajectories. Future research in accordance with the principles
5 outlined in the National Inuit Strategy on Research (32) is required
6 to inform policy change, eliminate the outcome disparities
7 described and integrate Inuit Qauijimajatuqangit (traditional
8 knowledge) into current health practices. There is a need to
9 examine the upstream and downstream factors that influence
10 surgical outcomes for Inuit such as the impacts of the social
11 determinates of health, access to healthcare, cancer screening
12 programs and systemic racism. This approach needs to be done in
13 collaboration with Inuit leaders, patients, family members,
14 clinicians and territorial and provincial healthcare
15 administrators to address issues along the entire surgical care
16 pathway.
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References

1. Truth and Reconciliation Commission of Canada. Truth and Reconciliation Commission of Canada: Calls to Action. Truth and Reconciliation Commission of Canada. 2015;20.
2. Kirby M, LeBreton M. The health of Canadians—the federal role. Final report of the Standing Senate Committee on Social Affairs, Science and Technology. Ottawa; 2002.
3. Royal Commission on Aboriginal Peoples. Report of the Royal Commission on Aboriginal Peoples: Volume 3 Gathering Strength. Rep R Comm Aborig Peoples. 1996;3.
4. ITK. Social determinants of Inuit health in Canada. ITK. 2014;(0).
5. Allan B, Smylie J. First Peoples, Second Class Treatment. First Peoples, Second Cl Treat Role Racism Heal Well-being Indig Peoples Canada. 2015;1-65.
6. King M, Smith A, Gracey M. Indigenous health part 2: the underlying causes of the health gap. Vol. 374, The Lancet. Elsevier; 2009. p. 76-85.
7. First Nations Information Governance Centre. First Nations Health Regional Health Survey (RHS) 2008/10: National Report on Adults , Youth and Children living in First Nations Communities. 2008.
8. Dyck R, Osgood N, Lin TH, Gao A, Stang MR. Epidemiology of

- 1
2
3 diabetes mellitus among First Nations and non-First Nations
4 adults. *Cmaj*. 2010;182(3):249-56.
5
6
7
8 9. Ospina MB, Voaklander D, Senthilselvan A, Stickland MK, King
9 M, Harris AW, et al. Incidence and prevalence of chronic
10 obstructive pulmonary disease among aboriginal peoples in
11 Alberta, Canada. *PLoS One*. 2015;10(4):1-13.
12
13
14
15
16
17 10. McVicar J, Poon A, Caron N, Bould D, Nickerson J,
18 Kimmaliardjuk DM, et al. Postoperative Outcomes of
19 Indigenous Peoples in Canada: A Systematic Review. *C Can*
20 *Med Assoc J*. 2021;
21
22
23
24
25
26 11. Canada G of. About Indigenous peoples and communities
27 [Internet]. [cited 2021 Apr 9]. Available from:
28 [https://www.rcaanc-](https://www.rcaanc-cirnac.gc.ca/eng/1100100013785/1529102490303)
29 [cirnac.gc.ca/eng/1100100013785/1529102490303](https://www.rcaanc-cirnac.gc.ca/eng/1100100013785/1529102490303)
30
31
32
33
34
35 12. Statistics Canada. Aboriginal peoples in Canada: key results
36 from the 2016 Census. 2017;11. Available from:
37 [https://www150.statcan.gc.ca/n1/daily-](https://www150.statcan.gc.ca/n1/daily-quotidien/171025/dq171025a-eng.htm?indid=14430-1&indgeo=0)
38 [quotidien/171025/dq171025a-eng.htm?indid=14430-1&indgeo=0](https://www150.statcan.gc.ca/n1/daily-quotidien/171025/dq171025a-eng.htm?indid=14430-1&indgeo=0)
39
40
41
42
43
44 13. Smylie J, Firestone M, Spiller MW. Our health counts:
45 population-based measures of urban Inuit health
46 determinants, health status, and health care access. *Can J*
47 *Public Heal*. 2018;109(5-6):662-70.
48
49
50
51
52
53 14. Reading C, Wien F. National Collaborating Centre for
54 Aboriginal Health Centre De Collaboration Nationale De La
55
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- 1
2
3 Santé Autochtone. 2009;
4
5 15. Qikiqtani Inuit Association [Internet]. [cited 2021 Apr 6].
6 Available from: <https://www.qia.ca/about-qikiqtani/>
7
8
9
10 16. Benchimol EI, Smeeth L, Guttman A, Harron K, Moher D,
11 Peteresen I, et al. The REporting of studies Conducted using
12 Observational Routinely-collected health Data (RECORD)
13 Statement. PLoS Med. 2015;12(10):1-22.
14
15
16
17
18 17. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC,
19 Vandembroucke JP. The Strengthening the Reporting of
20 Observational Studies in Epidemiology (STROBE) statement:
21 guidelines for reporting observational studies. J Clin
22 Epidemiol. 2008;61(4):344-9.
23
24
25
26
27
28
29
30 18. Asmis TR, Febbraro M, Alvarez GG, Spaans JN, Ruta M, Lalany
31 A, et al. A retrospective review of cancer treatments and
32 outcomes among inuit referred from Nunavut, Canada. Curr
33 Oncol. 2015;22(4):246-51.
34
35
36
37
38
39 19. Southern DA, Burnand B, Driesler SE, Flemons W, Forster AJ,
40 Gurevich Y, et al. Deriving ICD-10 Codes for Patient Safety
41 Indicators for Large-scale Surveillance Using Administrative
42 Hospital Data. Med Care. 2017;55(3):252-60.
43
44
45
46
47
48 20. McIsaac DI, Hamilton GM, Abdulla K, Lavallée LT, Moloo H,
49 Pysyk C, et al. Validation of new ICD-10-based patient
50 safety indicators for identification of in-hospital
51 complications in surgical patients: A study of diagnostic
52
53
54
55
56
57
58
59
60

- 1
2
3 accuracy. *BMJ Qual Saf.* 2020;29(3):209-16.
4
- 5 21. Wodchis W, Bushmeneva K, Nikitovic M, McKillop I. Guidelines
6 on Person-Level Costing Using Administrative Databases in
7 Ontario. Toronto, ON; 2013.
8
9
- 10 22. Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi
11 J-C, et al. Coding Algorithms for Defining Comorbidities in
12 ICD-9-CM and ICD-10 Administrative Data. *Med Care.*
13
14 2005;43(11):1130-9.
15
16
- 17 23. Escobar GJ, Greene JD, Scheirer P, Gardner MN, Draper D,
18 Kipnis P. Risk-Adjusting Hospital Inpatient Mortality Using
19 Automated Inpatient, Outpatient, and Laboratory Databases.
20
21 *Med Care.* 2008;46(3):232-9.
22
23
- 24 24. Austin PC. Using the Standardized Difference to Compare the
25 Prevalence of a Binary Variable Between Two Groups in
26 Observational Research. *Commun Stat - Simul Comput*
27
28 [Internet]. 2009 May 14;38(6):1228-34. Available from:
29
30 <https://doi.org/10.1080/03610910902859574>
31
32
- 33 25. Austin PC, Ghali WA, Tu J V. A comparison of several
34 regression models for analysing cost of CABG surgery. *Stat*
35
36 *Med.* 2003;22(17):2799-815.
37
38
- 39 26. Bilimoria KY, Liu Y, Paruch JL, Zhou L, Kmieciak TE, Ko CY,
40
41 et al. Development and evaluation of the universal ACS NSQIP
42 surgical risk calculator: A decision aid and informed
43
44 consent tool for patients and surgeons. *J Am Coll Surg*
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
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2
3 [Internet]. 2013;217(5):833-842.e3. Available from:
4
5 <http://dx.doi.org/10.1016/j.jamcollsurg.2013.07.385>
6
7
8 27. van Walraven C, Wong J, Bennett C, Forster AJ. The
9
10 Procedural Index for Mortality Risk (PIMR): an index
11
12 calculated using administrative data to quantify the
13
14 independent influence of procedures on risk of hospital
15
16 death. *BMC Health Serv Res*. 2011 Jan;11(1):258.
17
18
19 28. van Walraven C, Austin PC, Jennings A, Quan H, Forster AJ. A
20
21 modification of the Elixhauser comorbidity measures into a
22
23 point system for hospital death using administrative data.
24
25 *Med Care*. 2009 Jun;47(6):626-33.
26
27
28 29. McLeod M, Signal V, Gurney J, Sarfati D. Postoperative
29
30 Mortality of Indigenous Populations Compared with
31
32 Nonindigenous Populations: A Systematic Review. *JAMA Surg*.
33
34 2020;
35
36
37 30. Condon JR, Barnes T, Armstrong BK, Selva-Nayagam S, Elwood
38
39 JM. Stage at diagnosis and cancer survival for indigenous
40
41 Australians in the Northern Territory. *Med J Aust*.
42
43 2005;182(6):277-80.
44
45
46 31. Horrill TC, Linton J, Lavoie JG, Martin D, Wiens A, Schultz
47
48 ASH. Access to cancer care among Indigenous peoples in
49
50 Canada: A scoping review. *Soc Sci Med*.
51
52 2019;238(August):112495.
53
54
55 32. Inuit Tapiriit Kanatami. National Inuit Strategy on Research
56
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[Internet]. 2018. 46 p. Available from: www.itk.ca

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Table 1: Baseline characteristics of study participants

Table 2: Secondary outcomes by exposure

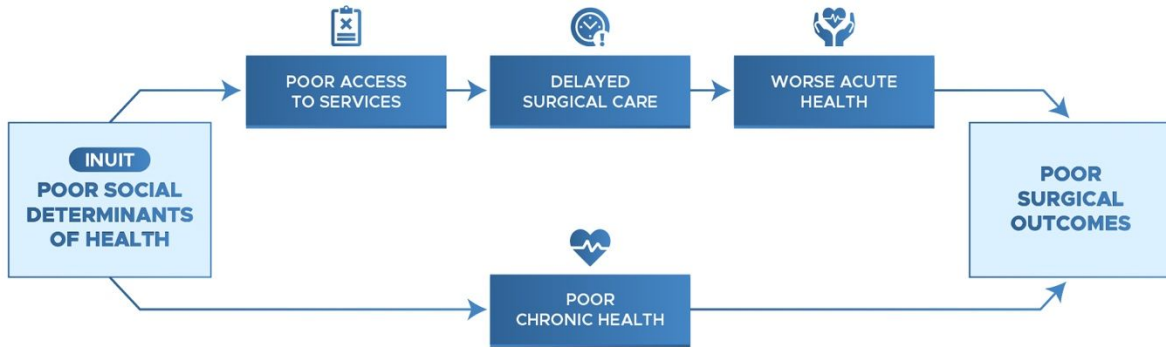
See Exel File for all tables.

Figure 1: Referral pathway for patients from the Qikiqtaaluk Region of Nunavut



Figure 2: Adjusted Odds Ratios for Nunavut Inuit

Figure 3: Proposed association between poor social determinants of health poor surgical outcomes for Inuit



Appendix 1: Description of Further Data

Appendix 2: Patient Safety Indicator International Classification of Diseases Codes by Cluster

Table 1: Baseline characteristics of study participants

	Nunavut Inuit n=928 (%)	Non-Inuit n=97,773 (%)	Absolute Standardized Difference*
Demographics			
Female	52.3	58.9	0.13
Age at surgery (Mean (SD))	51 (17)	59 (18)	0.43
<i>Surgery type</i>			
Orthopaedic Surgery	40.0	30.4	0.20
General Surgery	20.3	21.5	0.03
Urology	6.6	12.5	0.20
Neurosurgery	6.8	9.1	0.09
Benign Gynecology	5.7	7.8	0.08
Vascular Surgery	1.6	6.8	0.26
ENT Otolaryngology	2.8	4.5	0.09
Thoracic Surgery	6.4	3.6	0.13
Gynecology Oncology	1.0	3.1	0.15
Plastic Surgery	4.0	1.3	0.17
Dental Surgery	3.9	1.2	0.17
<i>Procedural urgency</i>			
Elective	41.9	57.5	0.32
Urgent	58.1	42.5	0.32
<i>Comorbidities</i>			
Alcohol abuse	2.4	0.5	0.16
Anemia	*	0.2	0.01
Arrhythmia	1.7	2.5	0.51
Blood loss anemia	*	0.1	0.05
Heart failure	1.5	0.9	0.06
Obstructive pulmonary disease	4.9	1.6	0.19
Connective Tissue Disease	*	0.5	0.01
Cancer with Metastasis	7.0	5.7	0.06
Cancer without Metastasis	14.9	18.2	0.09
Coagulopathy	*	0.7	0.02
Depression	*	0.5	0.02
Diabetes with Complications	3.3	7.3	0.18
Diabetes without Complications	4.2	6.4	0.10
Drug abuse	*	0.3	0.03
Fluid or electrolyte abnormality	2.2	1.0	0.09
Hypertension with Complications	*	0.1	0.03
Hypertension without Complications	7.3	8.4	0.04
Hypothyroid	*	0.5	0.08
Liver Disease	*	0.5	0.01
Lymphoma	*	0.6	0.06
Neurological	1.3	1.0	0.02
Obesity	*	4.2	0.23
Peptic Ulcer Disease	*	0.1	0.04
Peripheral vascular disease	0.9	4.6	0.23
Paralysis	1.1	0.7	0.04
Psychoses	*	0.2	0.03
Pulmonary	*	0.1	0.01
Renal	*	1.6	0.12
Cardiac valve disease	0.8	0.3	0.06
Weight loss	*	0.2	0.06
<i>Validated risk scores</i>			
Elixhauser score (Mean (SD))	2.0 (4.7)	1.7 (4.2)	0.07

Laboratory Acute Physiology Score (Mean (SD))	12.0 (18.8)	9.8 (17.5)	0.12
<i>American Society of Anesthesiologists' Score</i>			
1 to 2	85.9	84.1	0.05
3 to 5	14.1	15.9	0.05
Procdeural Index for Mortality Risk (Mean (SD))	0.6 (2.0)	0.4 (1.4)	0.11

All values represent % with characteristics unless otherwise indicated; *cell sizes <6 cannot be reported per healthcare privacy legislation

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Table 2. Secondary Outcomes

	Inuit	Non-Inuit	Unadjusted Effect Estimate‡ 95% CI	Adjusted Effect Estimate‡ 95% CI
Readmission (n)*	76	6,582	1.27	1.4
%	8.4	6.9	0.99-1.62	1.09-1.77
Adverse discharge (n)*	202	12,065	2.47	2.18
%	21.8	12.9	2.33-2.62	1.78-2.68
LoS (mean)	8.9	6.6	1.35	1.28
<i>Standard Deviation</i>	14.4	12.0	1.21-1.50	1.17-1.40
Total Cost (mean)†	18,017	14,703	1.23	1.17
<i>Standard Deviation</i>	30,832	25,884	1.09-1.38	1.07-1.23

LoS: length of stay; *readmission analyses limited to people discharged alive from hospital. † 2018 Canadian dollars; ‡ Cost analyses expressed as ratios of means, institutional discharge and readmissions as odds ratios

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Figure 1: The patient referral pathway from Qikiqtaaluk to Ottawa

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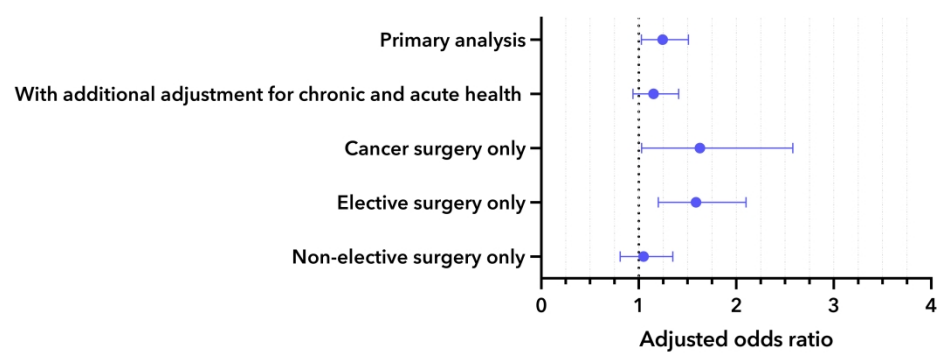
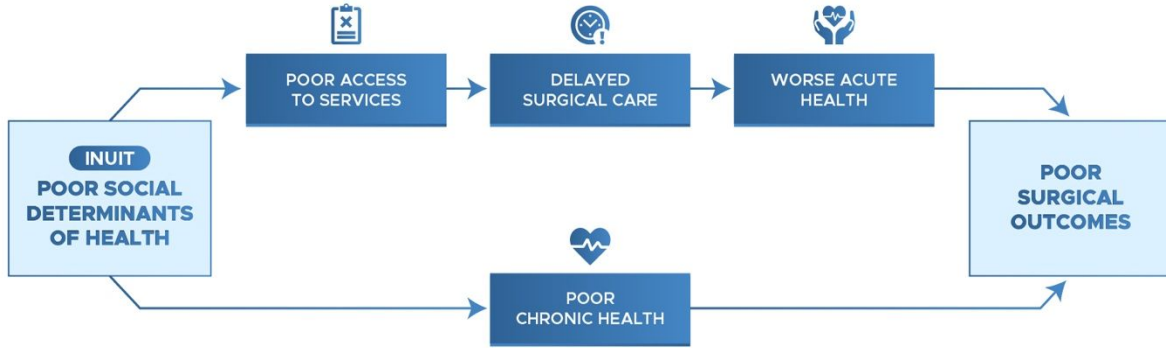


Figure 2: Adjusted Odd Ratios
195x75mm (600 x 600 DPI)

Figure 3: Proposed association between social determinants of health poor surgical outcomes for Nunavut Inuit



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3 **Appendix 1 – Description of data sources**
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5 Data was linked using different data sources in the Ottawa Hospital Data Warehouse, which stores
6 clinical and administrative data.
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8 For this study we used:

9
10 -the Canadian Institute for Health Information Discharge Abstract Database, which records all
11 admissions, patient demographics, surgical procedures, pre-existing patient comorbidities, length of stay
12 and in-hospital deaths.

13
14 -the National Ambulatory Care Reporting System (NACRS), which records details of emergency room
15 visits, including dates and diagnoses.

16
17 -the Surgical Information Management System (SIMS) which is a system used for supporting OR
18 operations at The Ottawa Hospital, and which records all details of surgical procedures including relevant
19 dates and times, urgency (elective vs. emergent), American Society of Anesthesiology Physical Status
20 Score (ASA score), priority (based on a standard hospital-wide 5-level prioritization system), and reasons
21 for delay. The SIMS system provides the information of record on these details and is considered
22 reference standard for surgical data and records at TOH.

23
24 -The Ottawa Hospital’s electronic health record (EHR) database to obtain all laboratory and pharmacy
25 data, as well as patient’s location in the hospital prior to surgery.
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Appendix 2 – Patient Safety Indicators Clusters

Hospital-acquired infections

A02.0, A02.1, A04.4, A04.5, A04.7, A04.8, A04.9, A08.0, A08.1, A41.0, A41.1, A41.2, A41.4, A41.50, A41.51, A41.52, A41.58, A41.80, A41.88, A41.9, A49.0, B30.9, B37.3, B37.4, B37.7, B37.80, B37.81, B95.6, B95.7, B95.8, B96.1, B96.2, B96.4, B96.5, B96.81, B96.88, B97.4, G00.3, J15.0, J15.1, J15.2, J15.5, J15.6, J15.9, J18.1, J21.0, J85.3, J86.0, J86.9, J95.01, K65.0, N39.0, N99.51, O75.30, O85.00, O86.00, O86.10, O86.20, O86.30, O86.80, P36.0, P36.1, P36.2, P36.3, P36.4, P36.8, P36.9, P38, R57.2, T81.4, T82.6, T82.7, T83.5, T83.6, T84.53, T84.54, T84.60, T84.61, T84.63, T84.64, T84.65, T84.68, T84.7, T85.7, T87.42, T87.46, T87.47, T87.48

Decubitus ulcer

L89.0, L89.1, L89.2, L89.3, L89.8, L89.9

Endocrine and metabolic complications (electrolyte abnormalities, diabetes, etc.)

E10.10, E10.63, E10.64, E11.0, E11.10, E11.11, E11.63, E11.64, E13.63, E14.63, E15, E16.0, E27.2, E89.1, E89.2, E89.3, G37.2, T50.3

Venous thromboembolic events

I26.0, I26.9, I80.1, I80.2, I82.2, O87.102

Cardiac complications

I20.0, I20.1, I20.88, I20.9, I21.0, I21.1, I21.2, I21.3, I21.4, I21.9, I22.0, I22.1, I22.8, I22.9, I46.1, I46.9, I47.2, I48.1, I49.00, I49.01, I50.0, I50.1, I50.9, J81, O74.20, S26.811, T82.0, T82.1, T82.2, T82.5, T82.6, T82.7, T82.8, T82.9

Respiratory complications

J15.0, J15.1, J15.2, J15.5, J15.6, J15.9, J18.1, J21.0, J38.01, J38.02, J38.09, J69.0, J69.8, J85.3, J86.0, J86.9, J94.2, J95.00, J95.01, J95.02, J95.03, J95.08, J95.1, J95.2, J95.5, J95.80, J95.81, J95.88, J95.9, J96.0, S20.2, S22.200, S22.300, S22.400, S22.410, S22.490, S27.000, S27.001, S27.100, S27.200, S27.300, S27.310, T17.3, T17.4, T17.5, T17.8, T17.9, T71, T79.7, T81.81

Hemorrhagic events

D62, D68.3, J94.2, J95.00, O71.701, O71.704, O71.801, O72.00, O72.10, O72.20, O90.20, P12.0, S06.4, S06.5, S06.6, S27.100, S27.200, S27.300, S36.090, S36.091, S36.150, S36.151, S36.800, S36.810, S37.000, S37.300, T79.2, T81.0

Drug-related adverse events

D68.3, E16.0, E88.3, H91.0, I95.2, O74.50, T36.0, T36.1, T36.5, T36.8, T36.9, T37.8, T38.0, T38.3, T39.0, T39.1, T39.3, T39.8, T40.2, T40.3, T40.4, T40.6, T41.2, T41.3, T42.0, T42.1, T42.4, T42.6, T42.7, T43.0, T43.2, T43.4, T43.5, T43.8, T44.5, T44.7, T45.0, T45.1, T45.5, T45.7, T45.8, T46.0, T46.1, T46.2, T46.4, T46.5, T47.4, T48.0, T48.6, T49.0, T50.1, T50.2, T50.9, T80.8, T80.9, T81.80, T88.2, T88.3, T88.6

Adverse events related to fluid management

E86.0, E86.8, E87.7, G37.2, T50.3, T80.8, T80.9

Complications directly related to surgery

H59.80, M96.6, O75.401, O75.40, O86.00, O90.00, S26.811, S27.001, S36.091, S36.151, S36.411, S36.461, S37.111, S37.211, S37.311, T81.0, T81.1, T81.2, T81.3, T81.52, T81.58, T81.59, T81.6, T81.81, T81.88, T81.9

Traumatic injuries (nonprocedural) arising in hospital

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3 S01.00, S01.01, S01.10, S01.20, S01.30, S01.40, S01.50, S01.70, S01.80, S01.90, S02.000, S02.100, S02.200,
4 S02.300, S02.480, S02.490, S02.5, S02.890, S03.0, S05.0, S05.1, S05.8, S05.9, S06.0, S06.1, S06.25, S06.35, S06.4,
5 S06.5, S06.6, S06.85, S06.9, S09.0, S09.8, S09.9, S10.1, S10.9, S13.48, S14.38, S20.2, S20.4, S20.8, S22.200,
6 S22.300, S22.400, S22.410, S22.490, S27.000, S27.100, S27.200, S27.300, S27.310, S27.810, S27.860, S30.0, S30.1,
7 S30.80, S30.81, S30.88, S30.9, S31.200, S31.400, S32.100, S32.400, S32.500, S32.700, S32.800, S33.5, S35.1,
8 S35.2, S35.5, S36.090, S36.150, S36.460, S36.610, S36.810, S37.000, S37.090, S37.110, S37.190, S37.210, S37.290,
9 S37.300, S37.310, S37.390, S37.610, S39.08, S39.8, S39.9, S40.0, S40.8, S40.9, S41.10, S41.11, S42.010, S42.020,
10 S42.090, S42.190, S42.200, S42.210, S42.220, S42.280, S42.290, S42.300, S42.390, S42.400, S42.480, S43.000,
11 S43.090, S43.100, S46.00, S46.08, S49.7, S49.8, S49.9, S50.0, S50.1, S50.7, S50.8, S50.9, S51.00, S51.01, S51.70,
12 S51.80, S51.90, S52.000, S52.100, S52.300, S52.500, S52.580, S52.590, S52.600, S52.800, S59.8, S59.9, S60.0,
13 S60.2, S60.7, S60.8, S60.9, S61.00, S61.70, S61.80, S61.90, S62.000, S62.500, S62.690, S62.800, S63.100, S63.59,
14 S69.8, S69.9,

15 S70.0, S70.1, S70.8, S70.9, S71.10, S71.11, S72.000, S72.010, S72.080, S72.090, S72.100, S72.190, S72.200,
16 S72.300, S72.410, S72.420, S72.490, S72.800, S72.900, S73.000, S73.090, S74.18, S75.0, S79.9, S80.0, S80.1,
17 S80.7, S80.8, S80.9, S81.00, S81.01, S81.80, S81.81, S81.90, S81.91, S82.000, S82.100, S82.200, S82.300, S82.400,
18 S82.500, S82.600, S82.800, S82.890, S83.6, S89.8, S89.9, S90.0, S90.1, S90.3, S90.7, S90.8, S90.9, S91.00, S91.10,
19 S91.20, S91.30, S92.000, S92.300, S92.400, S92.500, S93.49, S99.8, S99.9, T00.1, T00.8, T00.9, T09.0, T11.0,
20 T11.1, T13.0, T13.1, T14.0, T14.9, T20.0, T20.2, T21.0, T21.1, T21.2, T21.3, T22.0, T22.4, T23.0, T23.2, T24.0,
21 T24.2, T25.0, T25.2, T71, T79.2, T79.6, T79.7

Anesthesia-related complications

22
23 O29.50, O74.20, O74.30, O74.50, O74.60, O74.80, O89.40, O89.50, O89.80, T41.2, T41.3, T88.2, T88.3, T88.4,
24 T88.5

Delirium

25
26 F05.0, F05.1, F05.8, F05.9

Central nervous system complications

27
28
29 E11.0, E15, F05.0, F05.1, F05.8, F05.9, G00.3, G37.2, G97.2, O74.30, O89.40, S06.0, S06.1, S06.25, S06.35, S06.4,
30 S06.5, S06.6, S06.85, S06.9

Gastrointestinal

31
32 A02.0, A04.4, A04.5, A04.7, A04.8, A04.9, A08.0, A08.1, B37.80, B37.81, K22.3, K65.0, K91.0, K91.3, S27.810,
33 S27.860, S36.150, S36.151, S36.411, S36.460, S36.461, S36.610, T18.1, T18.2, T18.3, T18.9, T28.2, T85.5

Severe events proximally threatening to life or to major vital organs

34
35 G37.2, I21.0, I21.1, I21.2, I21.3, I21.4, I21.9, I22.0, I22.1, I22.8, I22.9, I26.0, I46.1, I46.9, I47.2,
36 I49.00, I49.01, J96.0, K22.3, K65.0, O74.20, O74.30,
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