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Title	Medical emergencies in northern Ontario remote First Nations: a cross-sectional descriptive study using air ambulance transport data to understand epidemiology
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Reviewer 1	Dr. Aaron Johnston
Institution	New Westminster, BC
General comments (author response in bold)	<p>Overall: This is an important study which advances knowledge for an important and understudied demographic group (rural First Nations). I think that the data used showed some data limitations and the authors should make recommendations on how data capture can be improved in the conclusions (specifically accounting for the fact that ultimate diagnosis is unknown at the time of transport and that mental health is not well captured).</p> <p>Thank you for this question. We agree that there are some major limitations to this data set. Overall, we feel this is important data to share in a region where so little publicly-accessible data exists.</p> <p>We agree it would be nice to be more specific about the reasons for transfer. Due to privacy and confidentiality concerns, the database we accessed details the general reason for transfer, but not further specific details. Ornge paramedics assign patients a primary reason for transportation, and we grouped these into clinical subheadings according to their clinical domain. Because these patients are transferred from nursing stations where minimal or no testing is available, patients do not yet have diagnoses, yet rather chief complaints. Connecting this dataset with ICES hospital-linked data would be helpful in terms of gaining further information about specific reasons for transfer - at the time of data analysis, this was not yet possible.</p> <p>Another big challenge in this study has been balancing the data versus privacy. The Research Ethics Board approvals outline that we can only report on collated data. Because we pulled data from 26 communities, when we tried to access population data from Government of Canada, Indigenous and Northern Affairs Canada (INAC), we experience data suppression for these smaller age brackets in the older age demographics. From INAC: "Data suppressions have been implemented to ensure that no individual can be identified as required by the Privacy Act. First Nations and General Lists with a total population of less than 40 have been suppressed and are indicated by a (*) in every cell." For many of the smaller communities, there is population data suppression in these tighter, older age brackets.</p> <p>We have added further explanation in the Limitations section.</p> <p>A reference to how data is collected in a parallel system (eg. rural Australia) may be useful if available</p> <p>Thanks. When examining papers published using data from the Royal Flying Doctor Service (RFDS), it appears that the RFDS database consists of information including aircraft information and ICD-9 codes. This is different from Ornge; the aircraft information is stored in a different dataset at Ornge.</p> <p>"All retrieval data was extracted from the electronic de-identified database of the RFDS, (QId), which covered the period 1 March 1994 to 28 February 2006. This medical, demographic, logistic, and aircraft dataset was compiled entirely from the handwritten records completed at the time of the aero-medical episode by the doctor or nurse as well as the pilot and crew of the aero-medical flight. Each retrieval record included up to three clinical diagnostic categories and up to one</p>

external cause of injury.”

(<https://doi.org/10.1093/alcalc/agm152>)

“This consisted of all patients with a diagnosis coded within the Injury and Poisoning chapter of International Classification of Diseases 9.”

(DOI: 10.1097/TA.0b013e318238bd4c)

Did the study have ethics approval and approval from NAN? If so I think it is important to mention, or if not to mention why not (eg. study using only publicly accessible data).

Good question. NAN does not have a Research Ethics Board. The objectives and methods were developed in consultation and collaboration with Nishnawbe Aski Nation (NAN), Sioux Lookout First Nations Health Authority (SLFNHA) and Weeneebayko Area Health Authority (WAHA). There has been a member from NAN on the research team throughout, and they are a co-author. Members of SLFNHA are co-authors. WAHA has been involved throughout the process. This project does have REB approval from both Sioux Lookout Meno Ya Win Health Centre REB and the WAHA REB - the REBs that have closest jurisdiction to the 26 communities - and the REBs of record and recommended by NAN. Further, this project also has REB approval at Lakehead, Laurentian, and Sinai Health System - five REBs in total.

A further sentence of clarification has been added at the beginning of the Methods section.

Page 4 Line 53. I've read the reference material and it looks like this actually says that approx. 25,000 people (The population mentioned x the 1% quoted with access >60 min drive) living in Ontario communities of <30,000 are >60 minutes drive from the nearest Emergency Department. The maps in this reference show that some of these communities are road accessible, so I doubt that all of these people are fully dependant on air transport. If possible provide a population figure for the 26 NAN communities being assessed. The full Ontario context is interesting, but I would like to understand the actual denominator for the population you are studying. If possible also provide demographic information about the communities in the areas of interest. Do they have population patterns or patterns of disease or illness that are different than most of Ontario (eg. if there is a higher than average percentage of children or elderly that would be important to mention).

Thank you for your comment and careful reading. Good point re: the reference material. By our read, the reference states that 99.5% of the entire Ontario population lives within 30 min of an Emergency Department (Exhibit 1, page 4). This change has been made in the paper. In the reference, it also states, “ The population of remote communities (defined as communities that were not on the road network) was 25,605, which comprised 0.22% of the total Ontario population and 0.99% of communities with 30,000 or fewer people.” (page 3). This is where this reference in our paper comes from.

The population figure for the 26 NAN communities being assessed changed each of the 5 years of data. As outlined in the Results section, between 2012-2016, the total on-reserve population of the 26 included communities increased from 21,488 to 23,257.

The demographic data for the included communities is now available in the new, added Table 1 and is available Figure 2a - On-Reserve Population.

In terms of whether these populations have patterns of disease or illness that are different than most of Ontario, this is an important question. From our review of the literature, only a handful of published papers describing medical emergencies in these remote communities over the last 35 years, and there is not good, publicly

accessible data on the epidemiology in these 26 remote communities, and how it compares to the rest of Ontario. We hope that this paper is a step toward understanding this epidemiology better.

Page 6 line 13. Reference 8 is simply a link to the AFN homepage. A homepage is very dynamic to include as a reference, I would suggest replacing with a link to a comprehensive list of the 600+ FN communities if possible.

Thanks for the feedback. The link has been replaced to <https://www.afn.ca/about-afn/>. This links to an interactive map of each AFN-associated First Nation in Canada, and states that there are 634 First Nations in Canada.

Page 6 line 50: This is a good paragraph and tightly defines what you are doing in the study. It reinforces the need to use the introduction to provide the overall context , but also to provide as much specific information about the study region as possible and to understand the true denominator (population and demographics of these communities).

Thank you. We have added information in the Background section to provide the denominator, as well as further regional context such as distances.

Page 7 line 20. "Transfers due to primary mental health concerns were not clearly defined in this data set; patients who were transferred by Ornge due to a mental health crisis were captured under another chief complaint." I don't understand what this line means or what it means for how you treated possible mental health data?

We agree that this is a bit confusing. We have tried to clarify the language and update it in the paper:

"Transfers due to primary mental health concerns were not clearly identified or labeled as "Mental Health" in this data set. Patients who were transferred by Ornge due to a mental health crisis were captured under another chief complaint such as Neurological, Toxicology or Trauma. This issue is discussed further in the Limitations section of the study."

Page 10 Line 49: As 25% of the transfers are for 'Other' I think that some meaningful breakdown of this segment would be worthwhile, particularly as this article may be used for reference in future research looking at care of specific chief complaints in remote medical settings.

This table has been expanded to add several more rows.

Page 10 line 53. Please do not use abbreviations on this line, these terms vary by geographic region and will be confusing particularly to international readers. (I have no idea what 'End' refers to for example.

Good feedback. This has been changed.

Page 11 line 6. It would be interesting to know if there was a pattern of transfer destination based on the reason for transport.

We agree, this would be interesting. This is something we discussed in part of the planning stages. At the moment, we believe that this question is beyond the scope of this paper. One reason for this is that there are missing variables that we do not have access to. For most of these remote reserves, the main referral centres are Sioux Lookout Meno Ya Win Health Centre or Moose Factory (totaling about 72% of all transfers). In theory, when a patient is transferred from reserve directly to another site such as Thunder Bay or Winnipeg, they are meant to have been seen and assessed by a physician. In some circumstances, a physician will have been on-reserve, and seen and assessed the patient. In other circumstances, a

physician may have only heard about a patient on the phone, but calls a larger centre with more services to advocate for a direct transfer in cases such as polytrauma, critical care or post-operative issues. Unfortunately, we have no way to track in the database whether a patient has been seen and assessed by a physician. Further, we currently have no way to track patients who go from reserve to Sioux Lookout or Moose Factory and then get sent on to a larger centre. These are important questions, but we think currently bigger than this paper.

Page 13 Line 21. Use the reference format suggested in the material you reference, particularly because the link provided does not work: Glazier RH, Gozdyra P, Yeritsyan N. Geographic Access to Primary Care and Hospital Services for Rural and Northern Communities: Report to the Ontario Ministry of Health and Long-Term Care. Toronto: Institute for Clinical Evaluative Sciences; 2011

Thank you. We have updated the reference to Vancouver Style as suggested and believe the hyperlink should work.

Glazier RH, Gozdyra P, Yeritsyan N. Geographic Access to Primary Care and Hospital Services for Rural and Northern Communities: Report to the Ontario Ministry of Health and Long-Term Care. Toronto: Institute for Clinical Evaluative Sciences; 2011 [cited 2019 Feb 26]. Available from <http://www.ices.on.ca/flip-publication/geographic-access-to-primary-care-and-hospital-services-for-rural-northern/index.html>.

Page 12. Given that the study has used this data set and identified areas that it did not perform well (eg. mental health) you should include specific discussion of improving how data is captured in the discussion.

Agreed. Further language has been added in the Limitations section.

Page 13. line 46. Suggest replacing reference 8 for the reasons specified above.

The link has been replaced to <https://www.afn.ca/about-afn/>. This links to an interactive map of each AFN-associated First Nation in Canada, and clearly states that there are 634 First Nations in Canada.

Pages 15-19. It would be unusual for a CMAJ published article to include such extensive tabular appendices at publication. Where possible appendix data should be synthesized and presented in the body of the article. The decision to include or exclude appendices (or to include in an online only format) is a decision for the editors. The data is interesting, from my point of view this is an editorial and space decision.

We will leave this decision to the editorial team. We too believe that this is interesting, foundational information not easily accessed in other venues. As such, we have included this information in appendices.

'Page 19 of 18': The philosophical possibility of the existence of such a page is better suited for a journal of philosophy than a journal of medicine. Suggest simple renumbering to a running total of 19 as an easier work-around.

Ha! The reviewer makes an important observation, and we particularly appreciate the opportunity to push our analyses further into the metaphysical realm — an approach often overlooked in conventional epidemiology.

Reviewer 2	Mr. Dylan Gabriel Clark
Institution	Geography, McGill University, Montréal, Que.
General comments	While the dataset appears to offer deep and comprehensive information that could be analyzed, the article falls short in its current form and does not add substantively to the

(author response in bold)

scholarship, offers minimal information that could inform policy or improved patient care, and does not develop any new methodologies. Given the importance of the topic, the seemingly rich dataset, and the standard that CMAJ has for publication, I am suggesting major revisions to the article, as outlined below.

The authors state that they "aim to describe who is transported from remote NAN communities in Northern Ontario to access emergency hospital-based care and why they are transported." The authors should consider what the outcome of this new information may lead to. Are the authors trying to improve patient care? Demonstrate medical gaps? Show public policy needs?

While the research shouldn't be prescriptive, high level descriptive statistics hold less use and would be better suited to a commentary or research article in a different journal.

Thank you for your feedback. We agree that this is an important topic. We have revised this version substantially.

While we believe that more work can, should and will be done on this topic, we do believe that this study adds substantively to literature. Specifically, this study adds accessible, foundational information in a geographic region where health data is not available for those trying to improve policy or patient care. The characteristics of patients requiring air medical transport in this region has not been thoroughly described, with only a handful of published papers describing medical emergencies in these remote communities over the last 35 years.

We agree that epidemiological analyses should be purposeful, with the goal of responding to a clearly defined problem. When data is readily accessible, we agree that analyses should be driven by clear clinical or policy prerogatives. But when there is a data vacuum requiring complex approaches just to describe the situation, merely completing a descriptive analysis and bringing issues out of the epidemiological darkness is a goal unto itself. The public policy need is the absence of descriptive data. This is the case for remote Indigenous communities (where on-reserve health services are not captured by any publicly accessible provincial or federal database, such as ICES, NACRS, or CIHI), the complete absence of descriptive statistics is itself a health systems problem. The absence of data creates a compound marginalization: not only do communities face elevated health risks and disparities, they also lack the essential epidemiological infrastructure to describe and address these issues. Our study aims to aid in the closing of that gap.

Furthermore, Indigenous and Northern Affairs Canada has identified these data gaps, and emphasized the need for innovative partnerships and robust data governance systems to address these gaps. See:

https://crdcn.org/sites/default/files/workshop_pm_tim_leonard_indigenous_data_lan_dscape_an_overview.pdf

Developing these kinds of partnerships and data governance systems is no easy task. Our study provides not only the descriptive statistics, but also a strong example of community partnerships and data governance systems to achieve this goal. This kind of epidemiological partnership is particularly rare outside of large centralized institutions, such as the IC/ES collaboration with the Chiefs of Ontario. Finally, CMAJOpen has published descriptive studies under similar circumstances where data is essentially absent. See: Orkin AM, Lay M, McLaughlin J, Schwandt M, Cole D. Medical repatriation of migrant farm workers in Ontario: a descriptive analysis. CMAJOpen. 2014 Jul;2(3):E192.

Further information has been added to the conclusion section.

Based on the authors described aim of the study, I would expect the analysis to include at least a multi-variate regression analysis to determine correlating trends between chief

complaint, demographics, and geography. I would expect the researchers to also answer their question "why they are transported" with a review of the medical care and outcomes. This could include an analysis of GCS, trauma scores, whether there was surgical interventions at the destination, airway interventions en-route, etc. These data would interrogate 'why they are transported' more comprehensively than the chief complaint.

Thanks for the feedback. See our response to the item above. We agree that the analyses proposed by the reviewer would be interesting and would take the study further, but we do not agree that a multi-variable regression establishes the base requirement for the importance of this study, nor does our question necessitate correlative statistics. Without a comparator group that was not transported, we also did not feel that there was a clinically or epidemiologically important dependent variable that would lend itself to analysis in a multivariate regression. We feel that the descriptive analyses provided address a substantial data vacuum, which is an important finding unto itself.

To clarify, we have changed the term "why they are transported" to "describe the primary clinical reason for their transport as stated in the patient record".

In terms of addressing patient outcomes, yes we would love to be able to answer this question. However, because these patients are transferred from nursing stations where minimal or no testing is available, patients do not yet have diagnoses, yet rather chief complaints. Currently, it is not possible to tie these patients to hospital databases. Connecting this dataset with ICES hospital-linked data will be helpful in terms of gaining further information about specific reasons for transfer, interventions at hospital, discharge diagnoses.

During the process of this analysis, Ornge and ICES have entered into a Data Sharing Agreement to link Ornge data with ICES and hospital-based data.

However, the linkage and data mapping exercise is still in process and have not been completed yet.

As an article that explores the epidemiology of aeromedical evaluations published in CMAJ, I would expect this research to include an analysis of the broader environmental factors around incidents - including a timeseries analysis of transportations. Are these mostly daytime? Are these nighttime? Are there seasonality changes? Are there temporal spatial interactions? Are there changes in the chief complaint seasonally?

Thanks for the feedback. Your suggestion is one that was considered during the development of the paper. However, given the study's focus on describing the baseline characteristics of patients requiring air medical transportation for medical emergencies in these remote NAN communities, the time series was felt to distract from the overall objective. A proper time series analysis would include the factors that you mention plus may also incorporate a predictive modelling element to improve resource allocation by Ornge. Given that this analysis is beyond the scope of the current study, it may fit well with future work.

The elephant in the room throughout this paper is the cost and implementation of the current emergency medical system structure for Northern Ontario. The research should at a minimum provide a cost estimate for the flights. Describe the cost ratio differences to Southern Ontario. And, discuss options/areas where more research is needed to better address the epidemiological conditions outlined in the research.

A fair comment. We agree this would be an interesting and important analysis. We believe that a cost analysis of health-care delivery on remote reserve in Northern Ontario would warrant its own study. Our indigenous partners have suggested that inclusion of flight costs would distract from the intention of the paper which is to

	<p>to access Ornge data as one of the only reliable datasets in the region to describe the epidemiology of emergencies in the remote, Northern Ontario. We have added sentences to the Limitations to address this issue.</p> <p>The authors should also speak to the relevance of the OAG audit on aviation in the North (2017) and highlight when medical evacuations were needed, but not available; how often flight crews timed out; when weather was a limiting factor; and morbidity en-route or before flight crew arrival.</p> <p>Thank you. This is an excellent reference. Information from this report has been added in the background section, and it has been added as a reference.</p>
Reviewer 3	Dr. Richard Fleet
Institution	Chaire de recherche en médecine d'urgence Université Laval - CISSS Chaudière-Appalaches, Lévis, Que.
General comments (author response in bold)	<p>First, the authors should attempt to provide a more thorough review of the literature on rural and remote emergency inter facility transfers in Canada. I think this is worth a full paragraph either in the introduction or discussion.</p> <p>We have read and appreciate this reviewer's work on rural emergency departments and issues related to inter-facility transfer. We have added several sentences in the discussion/interpretation section to try to compare rural Canadian inter-facility transfer to transfers from remote nursing stations.</p> <p>Second, can the authors provide more information on the reasons for the transfers? What was gastrointestinal? Neurological? Etc Can they provide more medical characteristics of the patients (vital signs, severity index scores, noted abnormalities upon arrival of flight crew etc)? Can the authors provide any information on the actual diagnoses upon arrival or eventual discharge from the hospital? How many patients required actual hospital admission, where (ICU? Surgery?) and for how long? How many patients died if any? How many required further transfers to a major regional center? What were the transfer time intervals (time from initial request to arrival of retrieval team and arrival to receiving hospital)? Can the authors estimate the average cost for each transport?</p> <p>If the authors cannot provide more information on the above interrogations, then I suggest this should be addressed in the limitations section.</p> <p>Thank you for the feedback. We agree it would be nice to be more specific about the reasons for transfer. Due to privacy and confidentiality concerns, the database we accessed details the general reason for transfer, but not further specific details. Ornge paramedics assign patients a primary reason for transportation, and we grouped these into clinical subheadings according to their clinical domain. Because these patients are transferred from nursing stations where minimal or no testing is available, patients do not yet have diagnoses, yet rather chief complaints, or clinical reason for their transport as stated in the patient record.</p> <p>Connecting this dataset with ICES hospital-linked data would be helpful in terms of gaining further information about specific reasons for transfer - at the time of data analysis, this was not yet possible. This has been further outlined in the limitations section.</p> <p>Finally, it would be very useful to other rural and remote communities to further elaborate on the underlying reasons for this elevated number of transfers and provide solutions based on local experience or review of the literature on how this issue will be addressed? Telemedicine? Improved access to resources (imaging, additional health care</p>

	<p>professionals)? Improve training of health care professionals? The authors did mention improvement of point of care testing. What do the authors think of the transfer timelines? Thanks. We have not addressed this further in the paper for two reasons. First, there has been so little data accessible in the region that it is hard to resource plan. Second, the issue is massive, complex, and compounded that any solution for a remote community in the region needs to be replicated across 26 communities. Yes, all of these things will help - telemedicine, more resources, more health care professional training, more imaging, more point-of-care. However, for many of these indigenous communities Health Care Transformation will mean more than resources, but also encompass issues related to self-determination of healthcare in their territory. We have added some recommendations to the conclusion section coupled with the reviewer's next comment.</p> <p>Finally, what future studies could be conducted? How can the database be improved (as it looks like it has some deficiencies (for ex. No information on mental health was provided). A prospective study better detailing the reasons for transfers and patient outcomes? A qualitative study interviewing major stakeholders involved in all aspects of patient-care in these communities? An intervention study examining inter-facility transfer rate change after the implementation locally desirable strategies ex. Point of care testing, telemedicine, tele ultrasound, portable CT scanner, Improving Pediatrics care (TREKK protocols) local mental health /addiction, obstetric care ...</p> <p>Agree. These are all good ideas. Further suggestions for future studies have been added to the conclusion section.</p>
Reviewer 4	Dr. Dominika Alina Jegen
Institution	Department of Family Medicine, Queen's University, Kingston, Ont.
General comments (author response in bold)	<p>This is an excellent article on a very important topic. I am very happy that you have chosen to do this research and share it as it's very relevant and needs dissemination in today's medical and fiscal landscape. I have reviewed it in detail and suggest revision of some typos (highlighted in the article) and pose some further questions that I recommend addressing in the final manuscript. I look forward to seeing it published and frankly feel it paints an objective quantifiable depiction of what we see as physicians working in NAN communities daily.</p> <p>Thank you for your feedback and support.</p>