

# Evaluating Potential Spatial Access to Trauma Centres in Canada using Geographic Information Systems

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## Abstract

The purpose of this research is to evaluate the potential spatial access of severely injured patients to trauma centres in Canada. The availability of unique datasets allowed these biases and limitations to be overcome and provided insight into how well Canada's trauma care needs and resources are spatially aligned. Ultimately, this research will identify potential gaps in access where needs are high and resources few.

## Background and Relevance

The purpose of this research is to evaluate the potential spatial access of severely injured patients to trauma centres in Canada. Specifically, this study will determine what proportion of severe injuries occur within one hour transport time of the closest trauma centre. Designated trauma centres are acute care hospitals that have a trauma team immediately available to assess patients, and all resources required to provide definitive care to the severely injured (1,2). The proximity of the site of injury to the nearest trauma centre might significantly affect timely access to trauma centre care (3;4). Assuring that access needs are met through strategic distribution of trauma centres is important in reducing injury-related mortality (1). While need is typically estimated through an assessment of the number and distribution of severely injured patients admitted to hospital, this information provides a biased evaluation (2). Focusing on this cohort alone results in the exclusion of patients who die in the field or emergency department, whose location of death might reflect an unmet need for trauma centre care. Others have focused on the relationship between population distribution and the spatial location of trauma centres as a measure of "access", but this is a poor surrogate of need given that not all populations have a similar risk of severe injury (3). The availability of unique datasets allowed these biases and limitations to be overcome and provided insight into how well Canada's trauma care needs and resources are spatially aligned. Ultimately, this research will identify potential gaps in access where needs are high and resources few.

## Methods and Data

Various datasets and methods were utilized in this research. The spatial distribution of Level 1 and 2 trauma centres in Canada was provided by the Public Health Agency of Canada. Level 1 and 2 trauma centres are almost always the acute care hospitals which have the largest capacity to treat severely injured patients in every region of the country.

The spatial distribution of severely injured patients was derived from two sources. First, those surviving to hospital admission were identified through the Hospital Morbidity Database (HMDB) using ICD-10 diagnoses codes. Deaths occurring outside the hospital were identified through the Canadian Mortality Database (CMDB) using external cause of injury coding. The six-digit postal codes of the patients' residences, which were used as a proxy for the site of injury, were translated into geographic coordinates using Statistics Canada Postal Code Conversion File Plus software. Using postal code of residence, rather than the precise geographic coordinates of the site of injury, is appropriate since several lines of evidence suggest that nearly half of all individuals spend their time within 10km of their home (the remainder stay within 50km) and, consistent with these data, 85% of injuries occur within this distance of home (5; 6; 7). Trauma centre catchment areas were created using a well-established travel-time catchment method developed by Schuurman *et al.* (8). First, travel times were calculated for each road segment in Canada using travel impedance values (e.g., speed limits) and impactors (e.g., stop signs, traffic lights, etc.) provided as attributes in the road access data from DMTI (Desktop Mapping Technologies Inc.) Spatial Canada. This allowed catchments to be delineated within a GIS by selecting road segments within 1 hour road travel time of each trauma centre. One hour is widely recognized as the 'golden hour': the time within which patients should receive emergency care at a hospital in order to minimize the risk of serious health outcomes (9;10). The postal code conversion file was used to link the spatial distribution of severely injured patients with road segments, which allowed the proportion of severely injured patients living within one hour of a trauma centre to be calculated.

## **Results**

The catchment areas served to highlight the regions of Canada that are considered to be out of practical service range for trauma care based on a travel time of one hour. Numerous regional clusters were identified that had high numbers of severe injuries and very distant trauma centres. A clear urban/rural divide was also evident, which supports recent research in this area (11).

## **Conclusions**

Results of this research suggest serious inadequacies exist in the spatial distribution of trauma care services in Canada. Access to trauma care in rural and remote regions of the country is particularly sparse or in many cases so distant as to be non-existent. The creation of strategically located trauma centres based on the findings of this study could help to improve geographic inequities in service provision. The methods employed in this study could be easily translated to other health research in which resolving inequities in geographic access and improving resource allocation are the objectives.

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