Does direct transport to provincial burn centres improve outcomes? A spatial epidemiology of severe burn injury in British Columbia, 2001–2006

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Background: In Canada and the United States, research has shown that injured patients initially treated at smaller emergency departments before transfer to larger regional facilities are more likely to require longer stays in hospital or suffer greater mortality. It remains unknown whether transport status is an independent predictor of adverse health events among persons requiring care from provincial burn centres.

Methods: We obtained case records from the British Columbia Trauma Registry for adult patients (age ≥ 18 yr) referred or transported directly to the Vancouver General Hospital and Royal Jubilee Hospital burn centres between Jan. 1, 2001, and Mar. 31, 2006. Prehospital and in-transit deaths and deaths in other facilities were identified using the provincial Coroner Service database. Place of injury was identified through data linkage with census records. We performed bivariate analysis for continuous and discrete variables. Relative risk (RR) of prehospital and in-hospital mortality and hospital stay by transport status were analyzed using a Poisson regression model.

Results: After controlling for patient and injury characteristics, indirect referral did not influence RR of in-facility death (RR 1.32, 95% confidence interval [CI] 0.54–3.22) or hospital stay (RR 0.96, 95% CI 0.65–1.42). Rural populations experienced an increased risk of total mortality (RR 1.22, 95% CI 1.00–1.48).

Conclusion: Transfer status is not a significant indicator of RR of death or hospital stay among patients who received care at primary care facilities before transport to regional burn centres. However, significant differences in prehospital mortality show that improvements in rural mortality can still be made.

Contexte : Au Canada et aux États-Unis, la recherche a montré que les patients traumatisés qui sont initialement traités dans de petits services d'urgence avant leur transfert vers un centre régional risquent davantage de nécessiter une hospitalisation plus longue ou de présenter une mortalité plus élevée. Il reste à déterminer si le transfert constitue, à lui seul, un prédicteur indépendant de complications chez les personnes qui ont besoin des soins dispensés par les centres des grands brûlés provinciaux.

Méthodes : Nous avons obtenus les dossiers du British Columbia Trauma Registry pour tous les patients adultes (âgés de 18 ans et plus) référés ou transférés directement aux centres des grands brûlés de l'Hôpital Vancouver General et de l'Hôpital Royal Jubilee entre le 1 janvier 2001 et le 31 mars 2006. Les décès survenus avant l'hospitalisation, pendant le transfert ou dans d'autres établissements ont été recensés à partir de la base de données du bureau du coroner de la province. Le lieu où le traumatisme s'est produit a été identifié grâce à des recoupements avec les dossiers de recensement. Nous avons procédé à une analyse bivariée pour les variables continues et discontinues. Le risque relatif (RR) de mortalité préhospitalière et perhospitalière et la durée du séjour hospitalier selon le transfert ont été analysés à l'aide du modèle de régression de Poisson.

Résultats : Après contrôle pour tenir compte des caractéristiques des patients et des traumatismes, la référence indirecte vers un centre n'a exercé aucune influence sur le RR de mortalité perhospitalière (RR 1,32; intervalle de confiance [IC] à 95 %, 0,54–3,22) ou d'hospitalisation (RR 0,96; IC à 95 %, 0,65–1,42). Les populations rurales ont présenté un risque accru de mortalité totale (RR 1,22; IC à 95 %, 1,00–1,48).

Conclusion : Le transfert n'est pas un indicateur significatif du RR de mortalité ou de la durée de l'hospitalisation chez les patients qui ont reçu des soins dans des établissements de soins primaires avant d'être transférés à un centre régional de grands brûlés. Les différences significatives observées au plan de la mortalité préhospitalière confirment toutefois qu'il y a lieu d'améliorer les taux de mortalité dans les centres ruraux.

The model of trauma care as we know it today is an organized system of care that encompasses injury prevention, prehospital emergency medical care and triage, acute care hospital admission and subsequent rehabilitation.[1] Although it is well established that persons who sustain a serious life-threatening injury benefit from the triage, referral and resuscitation services of regional trauma care networks,[2–6] evidence has shown that in many instances direct transport to level 1 or level 2 trauma centres reduces mortality and improves outcomes.[7–9] A recurring speculation is that adverse events among indirectly transported patients are caused by the quality of care or capacity to provide care within rural hospitals.[10–15]

Burn centres typically cover a considerably larger population base than trauma centres and therefore require coordinated communication links among emergency medical services (EMS), transportation networks and referral hospitals across tremendous distances.[1] In 2010, the ratio of designated adult level 1 and level 2 trauma centres to burn centres in Canada was about 3:1.[16] In British Columbia (BC), about 60% of the province's 4 million residents live in the same census metropolitan area (CMA) as the province's 2 designated adult burn centres in Vancouver and Victoria.[17] Nearly 40% of the population will require transport over hundreds or thousands of kilometers before arrival to either centre, potentially leading to delay in the resuscitation of patients with severe burn injuries.

Studies from the United States have reported, albeit with some exceptions,[18] that the prognosis among burn patients initially transported to preliminary care hospitals before transfer to regional burn centres was poorer than that among patients transported directly to definitive care.[19] There is little evidence within Canadian trauma literature to suggest whether burn patients initially cared for at preliminary care facilities experienced poorer outcomes as a result of their delayed arrival to specialized care. Analysis of patient outcomes along their journey to regional burn centres is needed to evaluate the performance of our trauma networks. The objectives of our study were to compare outcomes among patients directly transported to regional burn centres in British Columbia versus outcomes among those who were transferred from a referral hospital.

Methods

Study area and setting

Both the Vancouver General Hospital (VGH) and Royal Jubilee Hospital (RJH) in Victoria operate designated burn centres equipped with specialized teams of surgeons, nurses, occupational therapists, physiotherapists, equipment and other resources needed to provide acute and reconstructive care for adult patients with severe burns and wounds. Current transport protocol to designated trauma centres in BC is based on a tiered response whereby patients are assured access to optimal levels of care required to manage their injuries.[20] As in the United States, in many instances injured persons are rapidly transferred by ground or air ambulance to the closest available medical facility before transfer to a regional burn centre.[21] In this event, referring physicians coordinate directly with the burn surgeons to confirm whether the patient should be managed locally or whether they require transport to the burn centre. Information on the severity of the injury and the patient's condition, including infectious precautions or whether the patient is intubated, is passed on to the receiving facility.

In BC, all transports of severely injured patients are organized through the BC Ambulance Service and the critical care transport team. Patients are typically transported via ground ambulance over short distances or within urban areas. Helicopters are primarily used to transfer patients over distances of less than 300 km, and fixed-wing aircraft are used for transport over greater distances, but these transport modes are also contingent on time of day and weather.

Patient data

This study used records from the British Columbia Trauma Registry (BCTR) hospital discharge database to retrospectively identify all adult patients (age ≥ 18 yr) who were transported directly or transferred from a referring facility to either VGH or RJH between Jan. 1, 2001, and Mar. 31, 2006. The BCTR records injury data for all persons treated at the VGH and RJH burn centres, excluding those who were treated and discharged on the same day or those who were outpatients treated for burns within the emergency department or the burn clinic at either facility. Included in the trauma registry is information about patient age, sex, place of residence, place of injury, mode of transport to referral hospital, mode of transport to burn centre, diagnosis codes (classified using the *International Statistical Classification of Diseases [ICD] and Related Health Problems*, 10th revision; ICD-10]), hospital separation destinations, injury classification (ICD-10) definitions on the most severe nature of injury, as well as clinical data on patient status on arrival to definitive care (e.g., intubation, blood pressure). Cases were selected from the registry if the primary mechanism of the most severe injury was "thermal," which included all injuries sustained from the transfer of energy from heat, chemicals, radioactive agents, cold or electricity (e.g., burn, cold exposure, electrical accident). All work was approved by the research ethics committees at Simon Fraser University and the University of British Columbia.

Information about patients who died in transport, at a medical facility other than VGH or RJH or at the scene of injury were obtained from the British Columbia Coroner Service (BCCS). The BCCS uses its own inclusion criteria when defining the mechanism and medical cause of death. We used the "means of death" field from the registry to identify all burn/fire-related case records for this study. Also recorded in the BCCS is the cause of injury, age, sex, city of residence, city where the injury occurred, city where death occurred, the place where death occurred (e.g., medical facility, transport, residence) and whether the death was intentional or unintentional. All case records were extracted by 1 author (N.B.) familiar with the coding scheme used by both the BCTR and BCCS. Excluded from both the BCTR and BCCS registries were all hospital admissions and deaths owing to hypothermia and intentional self-harm.

In addition, we assessed whether there was a substantial difference in outcomes among persons injured in rural and urban areas. Geographic disparities in burn injury survival or length of stay in hospital (LOS) could potentially point to the effect of discovery bias in rural and remote areas of the province.[10] We defined geographic isolation by assigning all case records as an urban or rural injury. Urban and rural locations were identified by linking the BCTR and BCCS registries with the census subdivision (CSD) place name field from the 2001 census administrative records. All data linkages were conducted using a geographic information system (GIS).

Census subdivisions exist for all areas in Canada and are roughly equivalent in size to a municipality or large urban city. We defined each CSD as urban or rural area using the statistical area classification (SAC) codes uniquely assigned to each CSD. Statistical area classification codes group CSDs according to whether they are a component of a CMA, a tracted census agglomeration, a nontracted census agglomeration (NTCA) or 4 varying levels of census agglomeration influence zones (strong, moderate, weak or no influence). Dummy variables were constructed from SAC codes, with all CMA and TCA areas defined as "urban" and all other CSD classes defined as "rural." This classification scheme resulted in 86% of the CSDs in BC classified as "urban" and 14% classified as "rural." This was within 1% of Statistics Canada provincial urban:rural population estimates of 85%:15% for 2001.[22]

Statistical analysis

Our analysis included patient characteristics that have been previously been reported to be important confounding factors of survival among patients transported from referral hospitals to burn centres.[18,23,24] Covariates included the site where definitive care was delivered, age, sex, injury severity score (ISS), inhalation injury, intubation, mode of transport, transport time and total body surface area (TBSA) of the burn. We also measured differences in rural and urban injury location and injury mechanism (e.g., vehicular collision) among both cohorts. Differences between means of continuous variables were examined using a 2-tailed Student t test, and differences in proportions of categorical variables were examined using a χ^2 test. We examined all categorical variables where expected values were less than 5 using the Fisher exact test. All in-facility deaths were excluded from the hospital LOS and discharge location comparisons.

Relative risk (RR) of in-facility death and increased hospital LOS were analyzed using a Poisson generalized linear model and adjusted for covariates. Variables identified from the bivariate analysis with $p < 0.25$ were included as potential factors that would affect the association between transport status on LOS or risk of death. The robust standard errors corrected for significance estimates of the RRs. All statistical analyses were performed using SAS version 9.2.

Results

Between Jan. 1, 2001, and Mar. 31, 2006, a total of 164 patients were resuscitated at VGH (n = 128) and RJH (n = 36) for a burn or inhalation injury that required at least a 2-day stay in hospital. A total of 138 case records were identified from BCCS reporting that a death related to burn or inhalation occurred at the scene (n = 89), during transport (n = 33) or at a hospital other than VGH or RJH (n = 16). Overall hospital mortality after 72 hours was 18.3% among patients transported directly to VGH or RJH and 8.6% among those transferred from another hospital. Table 1 shows the distribution of major subtypes of burn injury, as classified by the BCTR and BCCS.

Table 2 shows the distribution of selected covariates among the direct transport and transfer patient groups. Compared with patients who were directly transported to either VGH or RJH, transferred patients tended to be younger, male and intubated, and they tended to arrive at VGH or RJH via air ambulance. They were also more likely than patients in the direct transport cohort to originate from a rural area and require more than 4 hours to arrive at either centre. Patients who were directly transported to a burn centre were more likely than those in the transfer cohort to arrive in less than 1 hour and have injuries with a TBSA greater than 30%.

Outcomes among both patient cohorts are shown in Table 3. Mortality was greater among the direct transport than the transfer cohort (25% v. 17%); however, bivariate analysis of LOS, injury severity and in-facility mortality was not associated with whether a patient was or was not transported directly to a burn centre. Most patients from both cohorts were discharged home. Patients who were discharged to another acute care facility tended to be from the transfer cohort (11.6% v. 2.2%).

Results from the multivariate Poisson regression model against in-facility mortality and LOS are shown in Table 4. After controlling for patient injury characteristics and burn centre site, transfer status did not influence RR (RR) of in-facility death (RR 1.32, 95% confidence interval [CI]

0.54–3.22) or LOS (RR 0.96, 95% CI 0.65–1.42). Male sex was independently associated with a decrease in the RR of increased LOS (RR 0.62, 95% CI 0.47–0.84). Age was associated with a greater RR of in-facility death (RR 1.04, 95% CI 1.02–1.06). Adjusted impact of in-facility mortality among patients who required airway management during transport was significantly higher than that of patients who did not require intubation (RR 5.15, 95% CI 2.24–11.83).

Our analysis also included a comparison of total mortality. After controlling for place of death, mode of injury, age, sex and inhalation injury, persons who were injured in rural areas throughout the province were more likely to die as a result of the injury than persons injured in urban areas (RR 1.22, 95% CI 1.00–1.48; Table 5). Injuries sustained as a result of a motor vehicle collision were associated with a greater RR of death among all causes (RR 2.05, 95% CI 1.70–2.47).

Discussion

It is widely known that delayed arrival to level 1 trauma centres is an independent predictor of an adverse health event among trauma patients.[7–15] Among burn patients, studies from the United States have shown that delayed transport to burn centres adversely affects patient outcomes owing in part to extensive transport times or poor medical intervention within the referring facilities.[19] We are aware of no study in Canada that has attempted to evaluate the geographic characteristics of burn injury and whether the added delay of transport to a preliminary care facility adversely affects patient outcomes. The purpose of our study was to identify whether transport status and place of injury were independent predictors of improved survival among persons who were able or unable to receive care from provincial burn centres.

During the study period, patients who were first treated

Table 1. Distribution of burn-related injury hospitalization and death by primary injury mechanism as defined by ICD-10 and coroner classification codes, BC, 2001–2006

Primary mechanism of injury	ICD-10 or coroner code	No. (%)
BCTR		
Transport accidents	V03, V43, V44, V47, V49, V53, V86, V93, V95	9 (5.5)
Exposure to inanimate mechanical forces	W35, W36, W40	32 (19.5)
Exposure to electric current	W85, W86, W87	9 (5.5)
Exposure to smoke, fire, flames	X00, X01, X03, X04, X05, X06, X08	89 (54.3)
Contact with heat and hot substances	X10, X11, X12, X13, X15, X16, X19	17 (10.4)
Intentional third party	X86, X97	7 (4.3)
Other	Y26	1 (0.1)
BCCS		
Exposure	Heat, air, explosion	18 (13.0)
Inhalation	Smoke inhalation, gas/vapour	54 (39.1)
Structural fire	Residential or commercial building	12 (8.7)
Transport accident	Vehicle driver, passenger or pedestrian	36 (26.1)
Electrical accident	Machinery, explosions, high voltage	12 (8.7)
Other	Unclassified or other	6 (4.3)

BCCS = British Columbia Coroner Service; BCTR = British Columbia Trauma Registry; ICD-10 = *International Statistical Classification of Diseases and Related Health Problems*, 10th revision.

Table 2. Patient and injury characteristics among direct and transfer patients to VGH and RJH

Characteristic	Transport; no. (%)* Direct, n = 60	Transfer, n = 104	p value
Treated at VGH	46 (76.7)	82 (78.8)	0.74
Age, mean (95% CI) yr	50.5 (45.5–55.5)	43.7 (40.3–47.0)	0.020
Male sex	41 (68.3)	82 (78.5)	0.13
Inhalation	27 (45.0)	42 (40.4)	0.56
Intubated then transported	21 (35.0)	63 (60.6)	0.002
Fixed-wing transport	2 (3.3)	48 (46.1)	< 0.001
Helicopter transport	5 (8.3)	15 (14.4)	0.25
Rural discovery†	5 (9.8)	51 (49.0)	< 0.001
Transport time‡			< 0.001
< 1 h	34 (63.0)	0 (0.0)	
1 to < 2 h	12 (22.2)	2 (2.2)	
2 to < 3 h	3 (5.5)	7 (7.6)	
3 to < 4 h	0 (0.0)	12 (13.0)	
> 4 h	5 (9.3)	71 (77.2)	
TBSA of injury			0.48
> 89%	1 (1.7)	2 (1.9)	
40%–89%	14 (23.3)	19 (18.3)	
30%–39%	13 (21.7)	12 (11.5)	
20%–29%	15 (25.0)	33 (31.7)	
10%–19%	6 (10.0)	15 (14.4)	
< 10%	11 (18.3)	23 (22.1)	

CI = confidence interval; RJH = Royal Jubilee Hospital; TBSA = total body surface area; VGH = Vancouver General Hospital.
*Unless otherwise indicated.
†Rural discovery could not be calculated for 9 patients.
‡A total of 18 records were missing transport time information.

Table 3. Outcome and discharge status among direct and transfer patients to VGH and RJH

Outcome/disposition	Transport; no. (%)* Direct, n = 60	Transfer, n = 104	p value
LOS, mean (95% CI)	39.5 (29.5–49.5)	36.5 (29.6–43.4)	0.62
ISS, mean (95% CI)	24.8 (21.3–28.3)	24.2 (22.3–26.2)	0.76
In-facility death	15 (25.0)	18 (17.3)	0.24
72-hour mortality	11 (18.3)	9 (8.6)	0.08
Discharge status			0.19
Acute care facility	1 (2.2)	10 (11.6)	
Home†	32 (71.1)	57 (66.3)	
Rehabilitation facility	8 (17.8)	16 (18.6)	
Other‡	4 (8.9)	3 (3.5)	

CI = confidence interval; ISS = Injury Severity Score; LOS = length of stay; RJH = Royal Jubilee Hospital; VGH = Vancouver General Hospital.
*Unless otherwise indicated.
†Includes with nursing, rehabilitation, or not further specified.
‡Includes extended care, discharge planning unit and psychiatric care.

at a preliminary care facility tended to be younger, male, require intubation and require on average more than 4 hours to arrive at either burn centre. Patients transported directly to VGH or RJH were more likely than transferred patients to reach the facility in less than 1 hour and have a percentage of TBSA greater than 30%. However, when adjusted for covariates transfer status was not associated with RR of in-facility mortality or LOS.

Nearly 36% of all trauma records and more than 55% of all coroner records identified that the burn injuries of patients in our study cohorts occurred in rural areas. However, only 10% of direct admissions to VGH or RJH involved persons who were injured in a rural area compared with nearly 50% of all patients who were transported through a referral hospital. Multivariate analysis of total mortality revealed disparities in burn-injury mortality, as persons injured in rural areas experienced a 1.22 increase in RR of death from their injuries compared with persons injured in urban areas.

Previous studies have shown that medical intervention may confound the relation between mode of transport to burn centre and outcomes.[18,25–27] During our study period, an estimated 60% of patients transferred to VGH or RJH required intubation for airway management compared with 35% of patients directly transported (RR 1.94, 95% CI 1.26–3.00) and experienced a 5.1 increase in RR of death (95% CI 2.24–11.83) after adjusting for covariates. However, it is commonly believed that risk of death associated with intubation is generally less than that associated with missing the diagnosis of inhalation injury or losing an airway during transport.[18] As many of these patients also experience an inhalation injury and/or greater TBSA, these findings likely point to delayed mortality as a result of securing rapid access to definitive health care services. Further research is required to identify whether risk of death among patients requiring airway management is attributable to factors other than TBSA or inhalation injury.

It is widely known that burn injury risk differs between rural and urban populations, with rural populations more likely to live in poorer housing and live farther away from emergency medical services.[28] A leading contributor to burn injury mortality in this study was motor vehicle collisions. They were responsible for 5.5% of all deaths among persons admitted to hospital and 26.1% of all prehospital deaths. Although motor vehicle collisions have been previously documented as a minor yet significant cause or secondary cause of death from burn-related injury,[29–31] they were a major contributing factor in prehospital mortality in the present study. Motorists involved in a vehicular collision are predisposed to increased risk of burn injury owing to ethanol ingestion, inhalation or severe burn from ignited gasoline in addition to other collision-related injuries. Although motor vehicle collisions remain an important cause of burn-related injury in BC, the relation between burn-injury mortality and place of injury is likely to be confounded by factors relating to the driver behaviour or road conditions at the time of injury.

Limitations

No study that uses administrative health records to measure health events is without error. First, this study only reports on severe burn-related injury in BC. Severe burn injury represents about 10% of all burn-related injury.[1] Each year in Canada there are an estimated 200 persons affected by a severe burn or fire-related injury who require resuscitation at a definitive care hospital or specialized burn trauma centre.[32,33] Results from our analysis should be interpreted as relevant to the patient and injury characteristics of severe burn-related injury only.

Second, the RR estimates were adjusted using a dichotomized TBSA estimation above and below 30%. The BCTR currently aggregates TBSA estimates into noncontiguous blocks of 10% intervals for grades less than or equal to TBSA 39%, but groups TBSA of 40%–89% into a single category. This limits our comparison of burn injury mortality and LOS by stepwise increase in TBSA, which has previously been shown to be a significant indicator of patient

Table 4. Adjusted impact of transfer status on in-facility mortality and length of stay in hospital, BC, 2001–2006

Variable	RR of death, mean (95% CI)	*p* value	RR of increased LOS, mean (95% CI)	*p* value
Transfer	1.32 (0.54–3.22)	0.54	0.96 (0.65–1.42)	0.85
Injury occurred in rural area	0.82 (0.44–1.54)	0.54	1.04 (0.72–1.49)	0.83
Age	1.04 (1.02–1.06)	< 0.001	1.01 (1.00–1.02)	0.19
Male sex	1.04 (0.54–2.01)	0.91	0.62 (0.47–0.84)	0.001
Intubated then transported	5.15 (2.24–11.83)	< 0.001	1.12 (0.84–1.49)	0.43
Fixed-wing transport	1.11 (0.45–2.74)	0.82	1.04 (0.69–1.58)	0.83
Total time to burn centre, h	0.90 (0.78–1.04)	0.16	0.99 (0.98–1.00)	0.06
TBSA of injury > 30%	0.94 (0.52–1.69)	0.83	1.01 (0.75–1.36)	0.94

CI = confidence interval; LOS = length of stay in hospital; RR = relative risk; TBSA = total body surface area.

Table 5. Adjusted impact of place of injury on risk of burn injury mortality, BCTR and BCCS* case records

Variable	RR of death, mean (95% CI)	*p* value
Injury occurred in rural area	1.22 (1.00–1.48)	0.05
Injured in motor vehicular collision	2.05 (1.70–2.47)	< 0.001
Age	1.01 (1.00–1.02)	< 0.001
Male sex	0.88 (0.71–1.10)	0.27
Inhalation injury	1.01 (0.83–1.24)	0.90

BCCS = British Columbia Coroner Service; BCTR = British Columbia Trauma Registry; CI = confidence interval; RR = relative risk.
*All BCCS deaths exclude Vancouver General Hospital and Royal Jubilee Hospital in-facility mortality records.

outcomes after severe injury.[18,19,27] Our attempt to assess TBSA above and below 30% as a comparison between survival and death is supported in the literature.[34–36] In addition, it is likely that TBSA was not a significant indicator of burn injury mortality owing to the study sample, which was quite small once stratified by transfer status.

A third limitation was our inability to measure reliability among referral hospital diagnosis records. The BCTR is biased toward information collected from the definitive care facilities and has limited information from referring hospitals. Previous studies have shown that TBSA estimation is not congruent between referral hospitals and the burn centres in as many as 60% of patients, which may confound the relation between mode of transport to burn centre and outcomes.[18,27,37] This is an important limitation, as excessive fluid administration increases risk for injury complications and death. In this study, in-hospital mortality in the transfer cohort was 17.3% compared with 25.0% in the direct transport cohort. The TBSA was not associated with mortality or LOS in either patient cohort after adjusting for other covariates. Whereas education and training in burn size calculation in referring hospitals is a valuable component to improving trauma care, this study was unable to identify whether error in TBSA estimates existed among transfer patients.

To our knowledge, the effect of transport protocols on patient outcomes following severe burn injury has not been fully explored within a Canadian context. Given the level of resource-intensive dedication needed to maintain and operate a comprehensive burn unit, most hospitals in BC do not receive sufficient patient volumes to qualify to operate as a dedicated burn centre. Instead, these hospitals resuscitate burn patients and expedite the initial triage and transfer of the appropriate patients to higher-level trauma care. This necessitates that hospitals communicate with the regional burn centres and assess, stabilize and arrange for safe and rapid transport for patients who first receive care at preliminary facilities. As many of these facilities are located in rural areas, physicians and emergency medical personnel with potentially little burn care experience may be responsible for important aspects of early postinjury care.[23] The present study has shown that current transport practices to provincial burn centres do not adversely affect survival or hospital stay among populations who require transport over long distances or require extended time to reach provincial burn centres. However, areas of future study should include a review of intubation practices within referring hospitals and recognition of disparities in access to health care resources within rural areas.

Conclusion

Our study has shown that outcomes of patients who receive care at other facilities before transfer to provincial burn centres are similar to patients who are directly transported to burn centres. Furthermore, burn injury morbidity and mortality were greater in rural areas, but geographic location did not influence the likelihood of in-facility mortality or increased LOS regardless of direct transport or transfer to a burn centre. However, there was a significant relation between rural injury and total mortality, highlighting the importance of including prehospital mortality in the analysis of patient outcomes following direct transport or transfer to regional burn centres. Further study is needed to determine whether there are significant differences in TBSA estimation between referral hospitals and provincial burn centres. Because, to our knowledge, this is the first Canadian study to identify disparities in patient outcomes as a result of place of injury or mode of transport to definitive care, additional work is required on a provincial and national scale to inform and guide the evaluation Canadian trauma system performance for the provision of burn care.

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