


Association between COVID-19 public health interventions and major trauma presentation in the northern region of New Zealand

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Abstract

Background: The New Zealand government implemented restrictive public health interventions to eradicate Covid-19. Early reports suggest that one downstream ramification is a change in trauma presentations. The aim of this study is to evaluate the effect these public health measures had on major trauma admissions in the Northern Region, New Zealand.

Methods: A retrospective comparative cohort study was performed. Two cohorts were identified: 16 March to 8 June 2020 and the same period in 2019. Data was extracted from the New Zealand Major Trauma Registry which prospectively collects data on all major trauma in New Zealand. All patients who presented to a hospital in the Northern Region with major trauma and met the Registry inclusion criteria were included.

Results: There were 163 major trauma admissions in 2019 and 123 in 2020, a reduction of 25% (rate ratio 0.75, 95% confidence interval 0.6–0.95; $P = 0.018$). There was no significant difference in mechanism of injury ($P = 0.442$), type of injury ($P = 0.062$) or intent of injury ($P = 0.971$). There was a significant difference in place of injury ($P = 0.004$) with 20% of injuries happening at home in 2019 compared with 35% in 2020.

Conclusion: This study has shown that public health interventions to prevent the spread of COVID-19 reduced major trauma admissions in the Northern Region of New Zealand. There was a variation in effect a between institutions within the region and a change in pattern of injury.

Introduction

New Zealand (NZ) joined the global fight against COVID-19 on February 28 following the countries first verified case. Confirmed community transmission and a rapidly escalating epidemic curve led the NZ Government to swiftly respond with restrictive public health interventions and a strategy aimed at COVID-19 eradication. A four-level alert system was announced allowing for a graded response to the national burden of COVID-19. The highest alert level, level 4, required the NZ population to isolate at home with interactions limited to essential services only. NZ entered alert level 4 on 25 March with the nation remaining 'locked down' for just over one month. This intense period of public health intervention successfully eradicated COVID-19 from NZ. It had wide-ranging downstream ramifications which are only now starting to be understood. The pandemic changed the lives and daily routines of many New Zealanders. It is therefore unsurprising that initial reports suggested a change in the number of

presentations in patients suffering trauma. An early report from the Midland region of NZ, including a small number of major trauma patients, suggested a 50% decrease in major trauma admissions during lockdown.¹

Injury is common in NZ and is the fifth leading cause of health loss across all age groups and the third for children and young people.² Approximately, 27 000 people with a physical injury are admitted to a public hospital each year with an associated mortality rate of 1%.³ The annual 2018/2019 New Zealand Major Trauma Registry (NZ-MTR) report found a national incidence of major trauma of 48/100 000 (2355 patients) in NZ. The mortality of patients sustaining major trauma is 8.4%.⁴

Understanding the change in major trauma admissions at different levels of public health restriction will help hospitals with future planning as further restrictive periods seem inevitable in the current pandemic climate. This will facilitate prioritization of resources in a time when they may already be stretched while maintaining adequate acute trauma services.

The aim of this study is to evaluate the effects the government-directed public health measures had on major trauma presentations in New Zealand.

Methods

Design

Data were retrospectively extracted from the NZ-MTR which is collected by the National Trauma Network. Two cohorts of patients were identified: 16 March to 8 June 2020 and the same period but in 2019. NZ-MTR is a single web-based system collecting data for all patients admitted with major trauma to an acute hospital in NZ. Data is prospectively collected with inclusion criteria being an Injury Severity Score > 12 or death following injury including in the Emergency Department. Exclusion criteria can be found on the National Trauma Network website.⁴ After data was retrieved, all patients transferred from a hospital outside of the Northern Region back to the Northern Region for further management or convalescence were excluded.

Outcomes of interest

The primary outcome of interest was comparison of the number of major trauma admissions in the Northern Region during population interventions for COVID-19 with the previous year. Secondary outcomes of interest were mechanism, intent, type and place of injury.

Setting

The National Trauma Network is formed by four regional networks: Northern, Midland, Central and South Island. The Northern Region comprises Northland District Health Board (DHB), Auckland DHB, Waitemata DHB and Counties Manukau DHB; four of 22 NZ DHBs. The Northern Region has a population of over 1.9 million and includes Auckland, NZ's largest city which is home to approximately 35% of the NZ population.⁵

Classification of four time periods

Patients were divided into four time periods based on the NZ government's public health interventions. The first period, 'early interventions', was from 16 March to 24 March 2020. During this period, there was escalating interventions. On 16 March, the government introduced border restrictions, compulsory self-isolation for all arriving passengers except from Pacific islands, prohibited cruise ships and banned non-essential outdoor gatherings >500 people. On 19 March, NZ borders closed to all but NZ citizens and residents, indoor events with more than 100 people were banned with exemptions for workplaces, schools, supermarkets, and public transport. On 21 March, NZ moved to level 2 and on 23 March level 3. The second period, 'level 4 lockdown', was from 25 March to 26 April. The third period, 'level 3', from 27 April to 12 May marked the de-escalation from level 4 lockdown. Significant restrictions were still in place during level 3 with the most significant changes from level 4 being people could expand their contacts to close family, businesses can open their premises without customer interaction and schools and early childhood centres can open with

limited numbers. 'Level 2', the fourth period, was from 13 May until 8 June when NZ transitioned to level 1. Level 2 allows people to socialize in groups of up to 100, domestic travel restrictions are lifted, business can open to the public and sport and recreation activities can resume.

Data analysis

Data were analysed in the categories provided by NZ-MTR for dominant injury, injury intent and place of injury classified by ICD10 code. Due to small numbers, the places of injury beach/forest/countryside, farm, industrial/construction were grouped with other for analysis. Mechanism of injury was categorized from the injury description into road traffic crash (RTC), fall from standing, fall from height, assault, cyclist, pedestrian, quad/dirt bike injury and others.

Data was entered into IBM SPSS (Armonk, New York, USA) for analysis. Scale data was described as median, mean, standard deviation (SD) and minimum and maximum (min-max). Non-parametric data was tested with a Mann-Whitney *U* test. Parametrically distributed data was tested with a student's *t*-test. Nominal data was tested using a chi-squared test. The number of trauma admissions per day between years and groups was analysed using a Poisson regression model and a pairwise rate ratio (RR) and 95% confidence intervals (CI) calculated. Statistical significance was accepted if $P < 0.05$.

Study approval and ethics

This study was performed on behalf of the Northern Region Trauma Network to help guide future resourcing for major trauma during the COVID-19 pandemic. Study approval from the Northern Region Trauma Network was obtained. The study was reviewed by the Health and Disability Ethics Committee and was deemed out-of-scope.

Results

Basic demographics and admission characteristics

A total of 303 patients were identified in the NZ-MTR; 17 were excluded due to initially presenting outside of the Northern Region; 286 presented to hospitals in the Northern Region; 163 in 2019 and 123 in 2020.

There was no significant difference between 2019 and 2020 in age or gender in major trauma patients. Mean age was 41 (SD 22) in 2019 and 49 (SD 23) in 2020 ($P = 0.610$). An overall 3:1 ratio for males to females was seen; this was preserved between years ($P = 0.575$). There was no significant difference between periods of public health intervention for 2019 and 2020 in age ($P = 0.800, 0.944$) or gender ($P = 0.853, 0.957$).

Primary outcome of interest

Figure 1 graphs major trauma admissions as a 7 day moving average and number of new COVID-19 case per day in NZ across each period with raw data outlined in Table 1. There was a significant reduction in the number of major trauma admissions per day between 2019 and

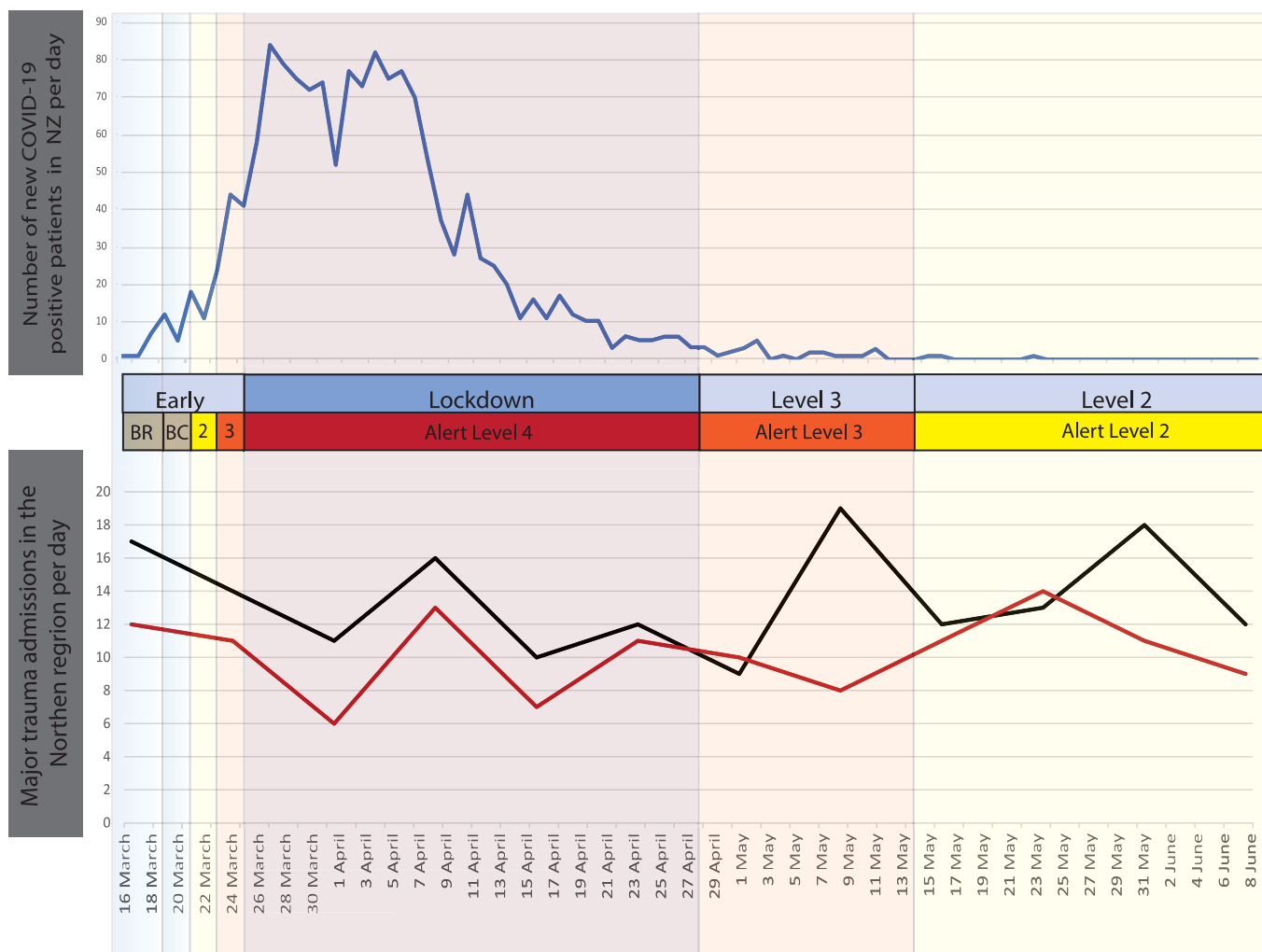


Fig 1. Comparison of 2019 and 2020 major trauma admissions by level of public health intervention and incidence of new COVID-19 cases. (—), 2019; (—), 2020.

2020 (RR 0.75, 95% CI 0.6–0.95; $P = 0.018$). Although each period of public health intervention had a decrease in admissions in 2020 when compared to 2019, a statistically significant difference was not

reached due to relatively small numbers in each group. Admissions for patients under 65 fell 29% from 129 to 92 and admissions for patient 65 and over fell 9% from 34 to 31 comparing 2019 with 2020.

Table 1 Comparison of number of trauma admissions between 2019 and 2020 overall and by period of public health intervention

	2019	2020	% decrease (%)	P-value (RR, 95% CI)
Total	163	123	25	0.018 (0.75, 0.6–0.95)
Mean per day (SD)	1.9 (1.6)	1.45 (1.2)		
Median per day (min–max)	2 (0–8)	1 (0–6)		
Early intervention	23	14	39	0.143 (0.61, 0.31–1.2)
Mean per day (SD)	2.56 (2.3)	1.6 (1.3)		
Median per day (min–max)	2 (0–8)	1 (0–4)		
Level 4	57	46	19	0.279 (0.81, 0.55–1.2)
Mean per day (SD)	1.7 (3)	1.4 (1.3)		
Median per day (min–max)	1 (0–7)	1 (0–6)		
Level 3	33	21	36	0.105 (0.64, 0.368–1.1)
Mean per day (SD)	2 (1.3)	1.3 (0.9)		
Median per day (min–max)	2 (0–4)	1 (0–3)		
Level 2	50	42	16	0.405 (0.84, 0.56–1.37)
Mean per day (SD)	1.9 (1.3)	1.6 (1.2)		
Median per day (min–max)	2 0–5)	1 (0–4)		

CI, confidence interval; RR, rate ratio; SD, standard deviation.

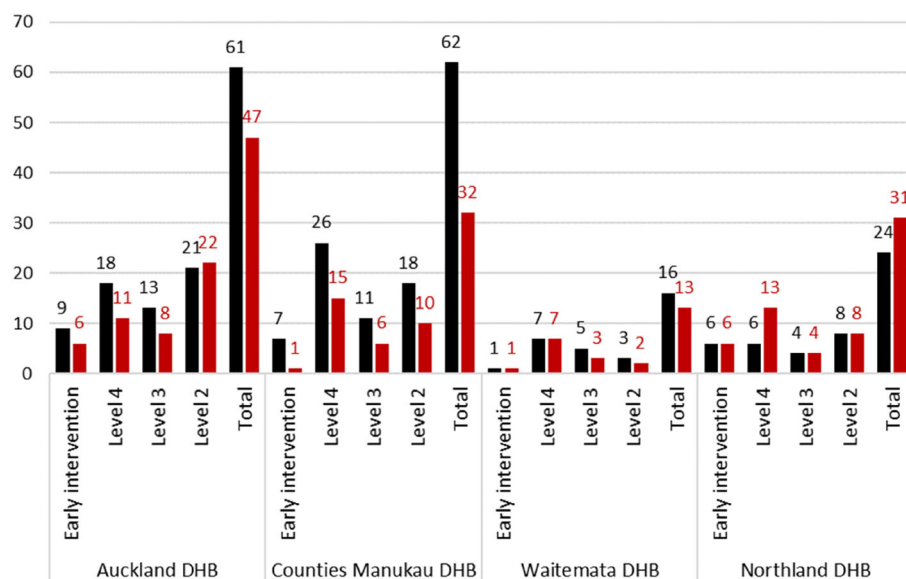


Fig 2. Comparison of major trauma admission between 2019 and 2020 by District Health Board. (■), 2019; (■), 2020.

Figure 2 outlines major trauma admission by DHB. Major trauma admissions decreased at Auckland DHB by 23% (RR 0.77, 95% CI 0.53–1.3; $P = 0.179$), Counties Manukau DHB by 48% (RR 0.52, 95% CI 0.34–0.79; $P = 0.002$) and Waitemata DHB by 19% (RR 0.81, 95% CI 0.39–1.7; $P = 0.578$); however, they increased in Northland DHB by 29% (RR 1.29, 95% CI 0.76–2.2; $P = 0.347$).

Injury characteristics

Table 2 outlines injury characteristics. Overall, there was no significant difference in mechanism of injury ($P = 0.442$), type of injury ($P = 0.062$) or intent of injury ($P = 0.971$) between 2019 and 2020.

Table 2 Injury characteristics

	2019, n (%)	2020, n (%)	<i>P</i> -value
Mechanism			0.442
Assault	15 (9)	8 (7)	
Bicycle	12 (7)	4 (3)	
Fall from height	25 (15)	19 (15)	
Fall from standing	16 (10)	19 (15)	
RTC	59 (36)	37 (30)	
Other	23 (14)	24 (20)	
Pedestrian	8 (5)	7 (6)	
Quad/dirt bike	5 (3)	5 (4)	
Injury type			0.062
Blunt	148 (91)	119 (97)	
Burn	2 (1)	1 (1)	
Penetrating	13 (8)	3 (2)	
Injury intent			0.971
Self-inflicted	6 (4)	4 (3)	
Unintentional	139 (85)	106 (86)	
Other	18 (11)	13 (11)	
Place of injury			0.016
Street and highway	85 (52)	56 (46)	
Beach/forest/countryside	4 (2)	2 (2)	
Home	33 (20)	43 (35)	
Farm	4 (2)	6 (5)	
Industrial/construction	4 (2)	5 (4)	
Other	33 (20)	11 (9)	

There was a significant difference in place of injury ($P = 0.016$) with 35% of injuries happening at home in 2020 compared with 20% in 2019. Analysis of mechanism of injury for patients injured at home did not demonstrate an increase in one particular mechanism instead showing a small increase in injuries across all mechanisms. The decrease in ‘other’ place of injury was in part due the restrictions on activities in 2020. This includes a decrease in admission for injuries related to sports (6 versus 2), boating and water activities (3 versus 0) and injuries at shops (5 versus 0). There were also more injuries in unknown locations (8 versus 1) when comparing 2019 with 2020.

Additional data is available in Table S1 and outlines injury characteristics overall and by group. Table S2 outlines the difference in injury characteristics by DHB. Northland DHB saw an increase in injuries occurring on a street or highway, 11 in 2019 versus 14 in 2020. All other DHBs saw a decrease; Auckland DHB 39 versus 23, Counties Manukau DHB 29 versus 16 and Waitemata DHB 6 versus 3, in 2019 and 2020, respectively.

Injury severity

Table 3 outlines factors associated with injury severity overall and by group. There was no significant difference overall in Injury Severity Score ($P = 0.262$), inpatient mortality ($P = 0.585$), length of stay ($P = 0.387$) or intensive care unit admissions ($P = 0.819$) between 2019 and 2020.

Discussion

This study has shown that over the period of national public health interventions for COVID-19 in the Northern region of NZ there was a significant reduction in major trauma admissions compared to the previous year. There was variation in effect between institutions within the region and a change in pattern of injury.

These findings are important for hospitals caring for patients suffering major trauma and will help guide resource allocation if

Table 3 Injury severity overall and by group

	Overall		Early intervention		Lockdown		Level 3		Level 2	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
ISS										
Mean (SD)	20 (8.5)	20 (8.6)	21 (8.7)	22 (6.6)	20 (5.9)	18 (6.4)	21 (8)	21 (7.4)	22 (11)	21 (11.5)
(min-max)	9–75	10–75	13–43	13–34	9–34	10–38	13–41	13–35	13–75	13–75
Mortality										
Yes, <i>n</i> (%)	19 (12)	17 (14)	1 (4)	1 (7)	8 (14)	6 (13)	3 (9)	1 (5)	7 (14)	9 (21)
No, <i>n</i> (%)	144 (88)	106 (86)	22 (96)	13 (93)	49 (86)	40 (87)	30 (91)	20 (95)	43 (86)	33 (79)
Length of stay (days)										
Mean (SD)	12 (16.7)	9 (8.5)	12 (12.4)	10 (9.4)	15(24.4)	9 (8.4)	9 (8.1)	10 (8.2)	10 (10.4)	10 (8.7)
(min-max)	0.03–160	0.03–42	0.8–48	0.85–32	0.2–160	0.2–41.7	0.04–39	0.84–35	0.03–50	0.18–35
ICU admission										
Yes, <i>n</i> (%)	47 (29)	37 (30)	7 (30)	4 (29)	20 (35)	10 (22)	5 (15)	5 (24)	15 (30)	18 (43)
No, <i>n</i> (%)	116 (71)	86 (70)	16 (70)	10 (71)	37 (65)	36 (78)	28 (85)	16 (76)	35 (70)	24 (57)

ICU, intensive care unit; ISS, Injury Severity Score; SD, standard deviation.

further public health interventions are needed in NZ. The data sheds light on the effect varying levels of public health intervention has on major trauma admissions with the largest decrease in the early intervention period. This was likely the time of greatest uncertainty and fear with limited information on NZ pandemic trajectory.⁶ The largest differences in secondary outcomes were seen in the period of greatest public health restriction with the lowest number of RTCs and highest number of injuries at home across the study period in level 4 lockdown. This data on the difference in injury pattern may help guide the government's public health advice. An emphasis should be placed on mitigating injuries at home with public health messaging targeted accordingly. The three Auckland DHBs saw a decrease in major trauma admissions while Northland DHB saw a 29% increase. A possible explanation for this is increased northward migration from the three metropolitan DHBs. Northland DHBs catchment area includes many holiday homes and beaches popular for vacation. With the inability to travel abroad and many people forced to take time off work it is conceivable the resident population of Northland increased during the study period. Regional travel restrictions were only implemented at the start of the level 4 lockdown.

Since the onset of public health interventions to control the COVID-19 pandemic there have been many reports outlining the effect of these interventions on general surgical trauma admissions from around the world.^{1,6–21} Various methodologies have been employed with commonly short periods of time used and a time period before the interventions used as a comparator. Many studies considered all trauma patients and did not specifically report on major trauma. There was also variation in the restrictiveness of contemporaneous public health intervention, with data most commonly reported from time periods of 'lockdown'. Several common themes emerge on examination of the published data. Firstly, a general reduction in trauma and major trauma admissions can be assumed during periods of public health interventions. This effect is likely to be most marked during the most restrictive, or 'lockdown' period. In studies from around the world, a 35–70% reduction in admissions of trauma patients was seen. Secondly, the main reduction, as may be expected, was seen in RTCs. Thirdly, a change in the pattern of injury occurs with an increase in injuries occurring at home.

A similar pattern has been seen in orthopaedic trauma with a large review of 57 papers from across the world finding a 20 to 85% reduction in admissions, an increase in interpersonal violence and a decrease in road traffic collisions and sport injuries.²²

Three studies have specifically examined outcomes of adult trauma patients in Australasia, one from NZ and two from Australia. Data from a major trauma centre in the Midland Region of NZ, including 33 patients suffering major trauma, revealed a 50% reduction when comparing a 2-week period before the level 4 lockdown and a 2-week period after it commenced.¹ There was a change in injury location with more injuries occurring at home. These findings are in keeping with this data although a lower overall reduction in admissions was seen at 25%. It is likely that this difference is due to a longer period of public health interventions being considered, comparison with a time period from the previous year and examination of a larger cohort, allowing a more accurate estimate of effect. Two Australian studies have demonstrated varying results. Jacob *et al.* found no reduction in major trauma admissions when comparing a 2-month period of societal restriction, including a lockdown period, with the four previous years.²⁰ In contrast Harris *et al.* reported a 33% reduction in major trauma presentations compared to 7-week period prior to lockdown.²¹ The differences in part may be explained by the fact these two studies are from different Australian states with varying public health restrictions and different endemic levels of COVID-19. In all the Australasian studies the decrease in trauma admissions is at the lower level compared to reported international reductions. It is possible that this is due to the relatively well-coordinated COVID-19 response, lower COVID-19 numbers and the prevention of health system overburden.

The authors acknowledge the limitations of this study including the small sample size increasing the risk of error. Although the data were collected prospectively this was a retrospective analysis. The data during public intervention periods was compared with the previous year which may have been an outlier. Despite this, the number of major trauma patients is high compared to previous studies and this data is from a large geographical area and population within New Zealand. A prospective nationally collated database that is effectively resourced was used to obtain data and a large dataset was analysed. The data is therefore likely to be accurate and relevant.

Although more information on the effect of COVID-19 on major trauma and its outcomes is needed, this study reinforces the notion that trauma is a societal disease.²³ The significant reduction in the number of major trauma admissions highlights the preventable burden of disease trauma places on the healthcare system.

This study has demonstrated that public health interventions to prevent the spread of COVID-19 reduced the number of major trauma admissions in the Northern Region of NZ by approximately 25%. There was variation in effect amongst different institutions within the region and a change in pattern of injury.

Author contributions

Matthew McGuinness: Formal analysis; methodology; writing-original draft; writing-review and editing. **Christopher Harmston:** Conceptualization; methodology; supervision; writing-original draft; writing-review and editing.

The Northern Region Trauma Network:

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Conflicts of interest

None declared.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1. Injury characteristics overall and by group.

Table S2. Injury characteristics overall and by District Health Board.