Livestock-related injuries in the Midland region of New Zealand

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ABSTRACT

AIM: To assess the incidence and patterns of injury resulting from force transferred from large livestock in the Midland Region of New Zealand, and to identify foci for prevention.

METHOD: Data was sourced from the Midland Trauma System Registry. Patients admitted to Midland hospitals from 2012 to 2015 were evaluated. Data included patient demography, location, mechanism, and time of the injury, type of animals involved, injuries sustained, interventions, outcomes and hospital costs. The final sample included 168 injury events.

RESULTS: 75.6% were due to interactions with cattle. The remainder were from sheep, pigs and deer. Most of the injuries were either 'hit', 'crush' or 'kick' injuries. Moving and loading stock resulted in 38% of the injuries, and 29% occurred near fences, gates or poles. Cattle-related injuries peaked during September and October. Sheep-related injuries peaked in December. These months correspond to calving season in cows and shearing season in sheep. Injury peaks were observed in the 20–29 and 50–59 age groups.

CONCLUSION: This study has identified high-risk animals, activities, age intervals and times during which large livestock-related injuries may occur, and revealed the significant impact on hospitals and communities that these injuries result in.

Despite the societal and economic importance of agriculture, the industry remains one of the most dangerous worldwide.[1–3] Within the industry, livestock is consistently ranked as the second or third most common cause of injuries.[4–7] The burden to any health system of animal-related injury and economy from lost productivity is therefore a serious concern. This concern is particularly true for New Zealand. Compared to other developed nations, New Zealand has a higher rate of fatal work-related injury by 10–15%, when adjusted for differences in industry distribution.[8–10] Within the agriculture sector, New Zealand also has the highest rate of work-related injury of these countries.[11–14] With regard to economic burden, data from the New Zealand Accident Compensation Corporation (ACC) shows that injuries from contact with livestock are consistently of a high cost.[15] Several authors have noted the rates of injury are only a portion of a total due to significant under-reporting.[4,11,13,16,17] The Australian Bureau of Statistics reported that between July 2013 and June 2014, 69% of injuries in the agriculture, forestry and fishing industry did not receive workers' compensation.[18] Furthermore, hospital-based studies severely under-report the incidence of total injuries, as many victims would not attend the emergency department. Two studies found that 80% of agricultural injuries are treated by general practitioners.[17,19] Other documented reasons for under-reporting of agricultural injury include the lack of compensation, fear for losing employment and lack of inclusion of smaller farms in surveys.[2–4,16]

Almost all New Zealand livestock are pasture-raised and grass-fed. This has implications in terms of the nature of the work and the hazards involved, and may explain our higher rate of injury. Approximately 44.5% of the nation's dairy farms are in the Midland region. Our study aims to evaluate the incidence and nature of injuries related to large livestock in this region, when they occur, and which demographic groups are at higher risk to support focused interventions to reduce the impact of large animal-related injury on the community.

Methods

The Midland Trauma Registry collects detailed information on patients admitted to hospitals across five district health boards (DHBs): Waikato, Tairawhiti, Lakes, Bay of Plenty and Taranaki. For an event to be included in the registry the patient must be admitted to a Midland hospital within seven days of injury, or die in hospital following injury, including deaths in the emergency department (ED). Excluded were: patients seen and discharged from the ED, injuries attributable to a pathological process, isolated peri-prosthetic fractures, exertional injuries, hanging or drowning without evidence of anatomical injury, poisoning, foreign bodies that do not cause anatomical injury and patients admitted primarily for pre-existing medical conditions. All injuries with the ICD-10 codes W55.2 and W55.3 (Bitten or struck by cattle and sheep, respectively) were extracted.[16] Secondly, a free-text search was done using the search terms: 'alpaca', 'beast', 'bull', 'calf', 'cattle', 'cow', 'deer', 'foal', 'goat', 'horse', 'pig', 'ram', 'sheep' and 'steer.' From this dataset, incidents occurring from 2012–2015 (inclusive) that occurred because of direct or transferred force from large livestock (dairy and beef cattle, sheep, pigs, goat and deer) were included.

Equine injuries, injuries occurring during sport, recreation or hunting injuries, on-road injuries, and those injuries that were not able to be conclusively determined as being a result of direct or transferred force from an animal were excluded from the study. Information to determine inclusion was yielded from both the free-text description of the injury, the occupation of the victim and the location of the injury. This yielded a total of 168 incidents over the four-year period.

These injuries were then categorised by mechanism. The main mechanisms were 'bitten', 'crushed', 'trampled', 'hit', 'crash from avoidance of animal', 'vehicular collision with animal', 'impaled' and 'kicked'. 'Crushed' meant being trapped between two animals or the animal and another object (excluding being stood on), or two objects if the force was transferred from an animal. Being trampled meant that the victim was stood on by the animal. Injuries were classed as 'hit' if they were a result of non-sustained contact. Being impaled included those injuries both by horns or tusks, and those by metal hooks because of animal contact.

Where more than one mechanism of injury could be identified, the primary mechanism of injury was used. For incidents where the injury was a result of transferred force, the mechanism applicable to the object directly causing the injury was used. The data was then stratified demographically; by age, sex and ethnicity, temporally; by month, year and time of day, and by severity; using the Injury Severity Score (ISS).[17] These variables were assessed in groups based on the type of animal causing the injury, and the mechanism of injury.

Results

Burden of livestock injuries

Over the four years in the study, there were 168 events, a mean of 42 per year. Most of the injuries were minor, those with an ISS of less than nine accounting for 90% of the injuries. The highest ISS recorded was 22, and the average for all injuries was 3.6.

Demographics

Peaks occurred in the 19–29 (20.2%) and 50–59 age groups (18.5%). These peaks were a result of cattle-related injuries. Sheep-related injuries were most common in the 40–49 age group. Of all injuries, 77.5% were to males and 14.3% were to Māori (Table 1).

Mechanism

Of the 168 incidents, 75.6% were cattle-related and 14.3% were sheep-related (Table 2). The most common mechanism of injury was being 'hit' (47 injuries), and being 'crushed' was the next (39 injuries). Cattle contributed to 90% of this subset and 92% of the 'kick' injuries. Sheep caused 59% of the cut/pricked injuries (Table 2), 80% of which occurred during shearing, the rest occurring during slaughtering. Pigs were solely responsible for a small number of biting injuries.

Activities

Of the total 168 events, 100 were the result of an identifiable activity being carried out at the time of injury. At least 29% of the cattle-related injuries occurred near gates, poles or fences. Patients were often moving

Table 1: Demographics of livestock-related trauma in the Midland region (excludes Tairāwhiti DHB) 2012–2015; total events (%), by animal involved.

	Livestock					
	Cattle	**Sheep**	**Pig**	**Goat**	**Deer**	**Total**
Total	127 (75.6%)	24 (14.3%)	12 (7.1%)	3 (1.8%)	2 (1.2%)	168 (100%)
Major/non-major						
Major (ISS>12)	8 (100%)	-	-	-	-	8 (100%)
Non-major (ISS<13)	119 (74.4%)	24 (15.0%)	12 (7.5%)	3 (1.9%)	2 (1.3%)	160 (100%)
Type						
Blunt	124 (76.5%)	24 (14.8%)	10 (6.2%)	2 (1.2%)	2 (1.2%)	162 (100%)
Penetrating	3 (50.0%)	-	2 (33.3%)	1 (16.7%)	-	6 (100%)
Burn	-	-	-	-	-	-
Gender						
Female	32 (84.1%)	5 (13.2%)	1 (2.6%)	-	-	38 (100%)
Male	95 (73.1%)	19 (14.6%)	11 (8.5%)	3 (2.3%)	2 (1.5%)	130 (100%)
Ethnicity						
Māori	14 (58.3%)	5 (20.8%)	3 (12.5%)	1 (4.2%)	1 (4.2%)	24 (100%)
Other	113 (78.5%)	19 (13.2%)	9 (6.3%)	2 (1.4%)	1 (0.7%)	144 (100%)
Age (yrs)						
00–09	2 (100%)	-	-	-	-	2 (100%)
10–19	4 (66.7%)	2 (33.3%)	-	-	-	6 (100%)
20–29	30 (88.2%)	2 (5.9%)	1 (2.9%)	1 (2.9%)	-	34 (100%)
30–39	22 (75.9%)	2 (6.9%)	5 (17.2%)	-	-	29 (100%)
40–49	17 (56.7%)	8 (26.7%)	3 (10.0%)	1 (3.3%)	1 (3.3%)	30 (100%)
50–59	27 (87.1%)	4 (12.9%)	-	-	-	31 (100%)
60–69	16 (66.7%)	4 (16.7%)	2 (8.3%)	1 (4.2%)	1 (4.2%)	24 (100%)
70–79	6 (75.0%)	1 (12.5%)	1 (12.5%)	-	-	8 (100%)
80–89	3 (75.0%)	1 (25.0%)	-	-	-	4 (100%)
90+	-	-	-	-	-	-

(27%) or loading (11%) livestock when these injuries occurred. The patient cohort involved in these incidents consisted almost exclusively of farmers and truck drivers. Other activities included milking cows, shearing sheep (10% each), treating animals, and catching or wrestling livestock (each 8%), slaughtering animals (5%) and hoof cleaning (5%).

Body region of injury

The regions of injury are either listed as upper/lower extremity or bony pelvis, face, head or neck, or external. Of the 168 events there were a total of 224 individual injury diagnoses. Table 3 contains a detailed breakdown of body region of injury by animal. The most common region was 'upper/lower extremity' (40%), closely

Table 2: Livestock-related trauma in the Midland region (excludes Tairāwhiti DHB) 2012–2015; total events (%) by mechanism and animal involved.

Mechanism of injury	Livestock				
	Cattle	Sheep	Pig	Goat	Total
Hit	34 (72.3%)	8 (17.0%)	2 (4.3%)	3 (6.4%)	47 (100%)
Crushed	35 (89.7%)	2 (5.1%)	2 (5.1%)	-	39 (100%)
Kicked	34 (91.9%)	2 (5.4%)	-	-	37 (100%)
Cut/pricked	5 (29.4%)	10 (58.8%)	2 (11.8%)	-	17 (100%)
Impaled	4 (57.1%)	-	3 (42.9%)	-	7 (100%)
Vehicular collision	5 (83.3%)	-	-	-	6 (100%)
Trampled	5 (100%)	-	-	-	5 (100%)
Wrestling/handling	3 (60.0%)	2 (40.0%)	-	-	5 (100%)
Bitten	-	-	3 (100%)	-	3 (100%)
Crash from avoidance	2 (100%)	-	-	-	2 (100%)

followed by 'external' (34%), which was a broad category largely consisting of injuries limited to skin. Cattle were the primary animal involved in multi-region injuries.

Temporal trends

Figure 1 shows the pattern of injury by month for cattle and sheep. Cattle-related injuries begin to increase in June, peaking in spring. Sheep-related injuries peak in December. Cattle-related injuries had two peaks throughout the day. The first was between 9am and 10am (18%), then between 3pm and 5pm, (21% of injuries). Sheep-related injuries were much more evenly spread throughout the day.

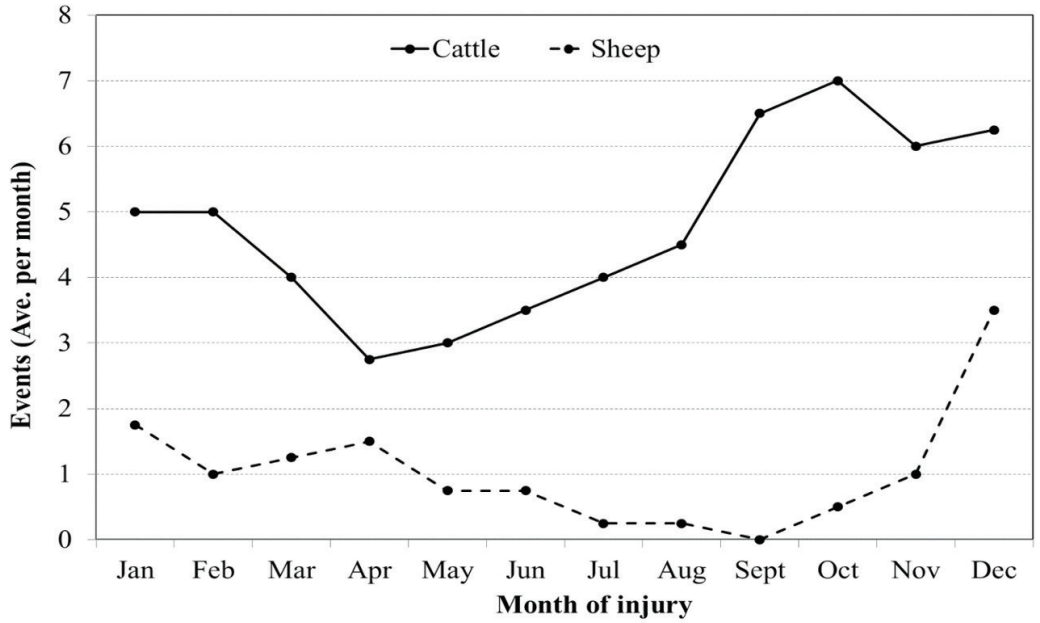
Cost

Direct costs to Waikato Hospital were available for 97 patients (95% ie, 97/102 Waikato Hospital admissions). The total inpatient cost of these incidents was $478,200 between 2012 and 2015. The injury with the highest cost was $48,700 and the average was $4,688. The average cost for a severe injury (ISS>12) was $17,633. This did not include any costs incurred after discharge.

Table 3: Individual injury volumes (%) by body region (AIS) and livestock animal involved (Midland region excluding Tairāwhiti DHB, 2012–2015), n=224 individual injury diagnoses.

	Livestock					
Body region (AIS)	**Cattle**	**Sheep**	**Pig**	**Deer**	**Goat**	**Total**
Head/neck	16 (100%)	-	-	-	-	16 (100%)
Face	9 (90.0%)	1 (10.0%)	-	-	-	10 (100%)
Chest	19	-	-	-	-	19 (100%)
Abdomen + pelvic contents	12 (100%)	-	-	-	-	12 (100%)
Upper/lower extremity	64 (71.7%)	18 (20.0%)	4 (4.4%)	1 (1.1%)	3 (3.3%)	90 (100%)
External	61 (79.2%)	6 (7.8%)	9 (11.7%)	1 (1.3%)	-	77 (100%)
Total	**181 (80.8%)**	**25 (11.2%)**	**13 (5.8%)**	**2 (0.9%)**	**3 (1.3%)**	**224 (100%)**

Figure 1: Average trauma events per month (Midland region, excluding Tairāwhiti DHB, 2012–2015) month of injury and caused by contact with sheep (n=24) or cattle (n=127).



Length of stay

The mean length of stay for all injuries was 2.3 days. 61% of all incidents were discharged after one day, with only 5.3% of injuries resulting in the patient staying for 10 or more days. The longest length of stay was 27 days.

Discussion

Burden of livestock-related trauma

This study has shown that livestock-related injuries result in a significant economic cost to the New Zealand health system. These figures only pertain to injured patients requiring hospitalisation, however ACC data on both hospitalised and non-hospitalised patients shows injuries from cows, sheep, deer and other animals (excluding dogs and horses), resulted in 7,465 claims ($11 million) from farms in the Midland region during the study period. Less than 1,000 of these incidents were treated in a hospital. This information, combined with the severity of injuries in this study, implies that most livestock-related injuries are minor, but significant enough for the patient to take time off work, incurring significant economic costs and hardship.

Injuries

The finding that cattle were the primary source of livestock-related injury is consistent with the literature.[2,11] Cattle, being the largest of the animals, would be more likely to cause injury when hitting someone, which is reflected in the finding of cattle accounting for 72% of these injuries. Furthermore, the heavy representation of cattle in 'crushed', as well as them accounting for all the incidents of trampling, and 92% of the kicking-related injuries, is in keeping with their size and unpredictability. Additionally, this is consistent with them causing the most severe injuries. However, our finding of being hit and crushed as the most common causes of injury contrasts with previous findings of kicking being the most common mechanism.[11,14] This may be in part explained by different methods of categorisation. Also, the inclusion of other animals, particularly sheep, would relatively reduce the frequency of kicking injuries. However, our results are consistent with those of Farmsafe Australia. Waller (1992) grouped 'hit' and 'kicked' together, with 'crushed' as a separate category, resulting in findings more comparable to that of this study. They found 'hit' or 'kicked' was

the most common mechanism, followed by being crushed.[19] Casey et al found that, if being pushed, knocked down and head-butted are combined, these injuries exceed the number of kick injuries.[20]

The identification of proximity to gates and fences, moving stock and milking is consistent with previous findings, confirming the hazardous nature of working in these environments.[20] General handling such as shearing and wrestling are less frequently reported in the literature, likely because of the lack of studies including injuries relating to sheep.

Categorising upper and lower extremity together may be misleading, as other studies have reported distal regions such as fingers, hands, feet and toes as very common regions of injury, and upper limbs much more frequently injured than lower limbs.[10,17,21] However, Casey et al found that subdivisions of distal and proximal, as well as lower and upper, all had similar numbers of injuries.[20] Furthermore, upper and lower extremities being the most common region of injury is consistent with most of the literature.[9,17,21,22] Sprince et al found that the back and lumbar region was the most common region of injury.[12] However, their study included injuries not requiring admission, which may account for this.

Most of the cattle-related injuries occurred over spring and summer, which is consistent with the calving season in New Zealand. When milk production tails off, during late summer and autumn (February–May), so does the number of cattle-related injuries. However, there was an unexplained decrease in cattle-related injuries in November. The peaks of the sheep-related injuries coincided with mating and crutching, in May and June, and then with shearing, in summer.

Due to the significant peak of cattle-related injuries around 9am, it is likely farmers are performing high-risk activities around this time. The smaller sample size and more even distribution of sheep-related injuries makes it difficult to ascertain as to whether there is a particularly high-risk time of day for working with sheep, however the higher incidence during morning and evening suggests farmers should be wary during these times.

Demographics

Most of the injuries in the 19–59 age group is likely related to this demographic having the highest exposure to animals due to more hours spent working on the farm. There were 4,503 people in the 20–29 year age group working on livestock farms in the Midland region, comprising 16% of all livestock workers in this region. Targeting this age-group for safety training may result in a decrease in incidents of injuries within this age group, as well as throughout their lives, by developing safe practices. The next peak, in the 50–59 age group, could possibly be explained by an intersection of farmers having a large 'on-farm work' responsibility, in combination with their increased age, resulting in health problems and the taking of medications which put them at higher risk.[6,11,15,21] This age group contributes the highest number of livestock workers in the Midland region of any 10-year age bracket. Risk perception may also be a factor, with increased experience correlated to higher-risk behaviour.[15] The 40–49 age bracket contributed more than twice as many sheep-related injuries than any other age group, and 8 of the 12 pig-related injuries involved patients aged between 30 and 49. Due to the inability to derive an accurate denominator representative of the population in the study, it is not possible to assess relative risk of each age group from the data in this study. There is no conclusion in the literature of which specific age brackets are at the highest risk, and it is difficult to assess due to no standardised age grouping. A meta-analysis by Jadhav et al identified an increasing incidence of agricultural injury with age; however, this association was reversed when the studies were not weighted for size.[21]

Males accounted for 77.5% of the patients in our study, compared to 68.6% of the livestock workforce in the Midland region (including apiarists and poultry workers, excluded in our sample), so male gender may be a risk factor for livestock-related injuries. This is consistent with the literature reporting that being male is a risk factor for sustaining livestock-related injury.[6,11,15,20]

Limitations

The Midland Trauma Registry, like almost all trauma registries, only records infor-

mation on admitted patients, with injuries treated in the community not included. True incidence and prevalence were not calculated, as a representative population was not able to be discerned to calculate a denominator. Despite these limitations, a strength of the Midland trauma registry is that is contains detailed information on admitted patients at all levels of injury severity rather than major trauma only (ISS >12), giving the opportunity to interrogate the clinical journeys of the most injured and vulnerable exposure groups and calculate total hospital cost from livestock-related trauma.

Conclusion

This study has identified high risk animals, activities, age intervals and times of the year during which livestock-related injuries may occur and has revealed the resource implications on hospitals from large animal-related injuries in the Midland community. Key recommendations from the study are that care should be taken particularly with cattle during calving season, especially when moving stock near gates and fences. With sheep, farmers should exercise additional caution around times of shearing, crutching and mating. Organisations should work with at-risk groups to help maximise safety precautions during these activities. WorkSafe NZ has already published a guide for working safely with cattle[22] and sheep.[23] Additionally, healthcare professionals in rural areas, armed with this knowledge, should advocate for their patients to take extra care when working with livestock in these situations.

Competing interests:
Nil.

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