The Effect of a Community-based Police Surveillance Program on Snowmobile Injuries and Deaths

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Snowmobile injuries are a leading cause of morbidity and mortality in Ontario and other northern regions. In 1993, 407 snowmobile injury admissions occurred in Ontario; during 1992, 41 snowmobile deaths were reported. Acute hospital admissions due to snowmobiling injury average 2,872 hospital days each year in Ontario. As the leading cause of winter drownings and a major cause of injury admissions, this recreational activity has an important impact on health care resource expenditure in northern regions.

Snowmobile-related trauma has been extensively examined, and studies have identified alcohol use, night-time driving, speed, and driver error as factors associated with snowmobile trauma. In one fatal snowmobile study, over 65% of snowmobile drivers killed in Ontario had blood alcohol levels above the legal limit for operating a motorized vehicle (> 17 mmol/L). Injured snowmobilers were more likely to be intoxicated in the evening and early morning than during daylight hours.

Northeastern and Northwestern Ontario have significantly higher snowmobile admission rates than the rest of the province. Within these regions, certain communities have demonstrated a commitment to snowmobile injury prevention. An extensive snowmobile trail system has been supported to promote safe travel on trails which are groomed, controlled, and have posted directions. In addition, speed on groomed trails is regulated at 50 km/hour and drinking while snowmobile driving is governed by the same restrictions as the Highway Traffic Act and Criminal Code of Canada. Local and provincial task forces on snowmobile safety have been organized and public education has been encouraged. Despite these activities, rates of injury continued to increase.

Prior to the 1993-94 season, and for the subsequent three snowmobile seasons, the Snowmobile Trail Officer Patrol (STOP) program was established in Sudbury, a Northern Ontario community with high rates of snowmobile trauma. The use of volunteer deputized provincial offenses officers increased patrolling on snowmobile trails throughout the region. Their deployment increased enforcement presence and created a heightened awareness of alcohol issues among snowmobilers.

This study examines the impact of the STOP program on the incidence of serious snowmobile injuries in a region where snowmobile trauma is an important health care problem. The overall comparison was designed to determine changes in the rates, severity, and details of injuries after the introduction of the program.

**METHODS**

**Background**

The study was conducted in the Regional Municipality of Sudbury (population: 161,000; 1991 census). The area

**ABSTRACT**

Serious snowmobile injuries are preventable and associated with late-night travel, alcohol use, and speed. We studied the effectiveness of a community-based policing (STOP) program in the prevention of serious injuries related to snowmobile trauma in Sudbury, Ontario. Volunteers were trained in police protocol and were appointed special constables to increase policing on snowmobile trails from 1993-95. Snowmobile admissions and deaths in Sudbury were examined; the pre- (1990-1992) and post- (1993-1995) STOP seasons were compared.

In the pre-STOP period, 102 injuries, 87 admissions, and 15 deaths occurred compared to 57 injuries (p=0.0004), 53 admissions (p=0.00001) and 4 deaths (p=0.13) in the post-STOP period. All other event and demographic features of the crashes remained similar. Significant economic savings were realized from this intervention: acute care costs savings exceeded $70,000/year and costs from death decreased by $5 million. An intervention involving enforcement on snowmobile trails can reduce the incidence of injuries from snowmobile-related trauma.
STOP EVALUATION

has an active snowmobile organization, 1,200 km of groomed trails, and a documented snowmobile injury problem.1,2,3 There are two emergency departments (ED) and three hospitals which admit trauma patients; medical records at each hospital were examined.

Using the International Classification of Diseases codes, hospitalized patients injured while snowmobiling were included. ED physicians completed assessment forms for trauma victims presenting to the lead trauma emergency department (Sudbury General Hospital) from 1992-96. Police reports were confirmed with the Chief Coroner’s office for death information.

Only snowmobile injuries sustained within the region were included. The study period mirrored the snowmobile seasons, from December to April (1990-1995). Data on all injured drivers and passengers were collected; non-trauma-related illness and fatality were excluded.

STOP program

The STOP program was initiated in 1993-94 and continued during each subsequent snowmobile season. The 1990/91 to 1992/93 seasons represent the period prior to the STOP program (“pre-STOP”). The 1993/94 to 1995/96 seasons represent the period after the program (“post-STOP”). Volunteers were carefully selected, and trained by police and snowmobile organizers using a designated curriculum. They passed comprehensive proficiency testing, and were appointed as Provincial Offenses Officers by the Province of Ontario. These volunteers patrolled local snowmobile trails promoting safety, enforcing snowmobile regulations and assisting police with sobriety spot checks and alcohol interdiction efforts. For example, during the 1995/96 season, Sudbury had a special constable complement of 11 officers.

Outcome measurements

Demographic (age, gender), event (riding status, day, time, location, mechanism, alcohol involvement, etc.), and outcome (survival, injury severity scoring, length of stay (LOS) for ICU and hospital, operative procedures) data were collected. To assure reliability, a second reviewer examined a subset of 25 consecutive charts; disagreement was resolved by consensus.

The primary outcomes were rates of hospital admissions, deaths, and total injuries. Secondary outcomes included length of hospital stay and injury severity scoring. The Injury Severity Score (ISS) was revised in 199517 and is used to classify trauma severity (range 0 to 75). Studies examining reliability have been encouraging.18

Denominator estimations

Rates of injury were determined using two denominator estimations. First, yearly trail permit holders statistics were provided by the Sudbury Trail Plan (STP). Population figures were also used for these years.

Cost estimations

Acute care and in-patient costs were estimated, shown in 1996 Canadian dollars and based on the following assumptions from current Ontario Health Insurance Plan costs or other available literature:19

- Emergency department costs/visit: $65.00
- Emergency physician assessment: $26.35
- Admission physician assessment: $28.00
- Consultation: $105.00
- Costs per hospital day: $374.00
- Costs per ICU day: $798.00
- Surgical costs/Procedure: $500.00

Mortality costs were estimated using the human capital approach.20,21 Earning data were obtained from the 1991 Census data for Metropolitan Sudbury; we used the male and female Average Full-time Employment Income. This measure of earnings was considered an annuity for the remaining years of life up to the normal retirement age of 65 and discounted to the present value. Although there is agreement to discount the stream of earnings, there is no consensus on the method. We used the discount rate for the average yield of 10-year Treasury Bonds over the 1991-1995 period (calculated: 8.68%). This choice is based on the need to capture a variety of factors (i.e., expected inflation rate, productivity gains, uncertainty, etc.) that are likely to be important over the long term.22 Finally, years of productive life lost (YPLL) were calculated for fatal injuries (age 65 to age at death).

Statistical analysis

Descriptive statistics are presented to identify the important demographic features of trauma in this region. Continuous data were analyzed using two-tailed t-tests or Mann-Whitney U tests while categorical data were analyzed using odds ratios (OR) and chi-square tests. Confidence intervals (95%CI) were calculated for the odds ratios.23 For trends over time, Mantel-Haenzel Chi-square statistics were used. Since multiple statistical testing of the same data set inflates the overall alpha level, only the primary research questions were examined using bivariate techniques.

RESULTS

During the 1995/96 season (typical), 11 constables volunteered 1,230 hours of time and checked 2,252 vehicles; they issued 393 warnings, 61 Motorized Snowmobile Vehicle Act charges, 9 12-hour licence suspensions, 2 impaired driving charges, and 4 bylaw charges.

Overall, 201 charts were examined; 40 transfers and 2 misclassified cases were excluded. Records for each fatality (n=19) were recovered and reviewed at the Provincial Coroner’s office. A total of 159 records are included in the database. Agreement on data extraction of selected outcomes between two independent reviewers was high (kappa > 0.75).

The injured populations and circumstances were similar between the pre-STOP and post-STOP periods (Table I). Comparisons of patients revealed similar age, gender, and rider status at the time of injury. Alcohol was associated with approximately 30% of the crashes during both periods.

The injury details for the pre and post periods are shown in Table II. Timing of injuries (days of the week and during times of sub-optimal lighting) and other environmental conditions remained similar. Being thrown from the vehicle was the single most common reason for presentation (Table II), however, collisions with fixed objects or motor vehicles were common.

In the post-STOP period, a 39% reduction in snowmobile-related admissions (87 vs 53) and a 44% reduction in overall injuries and deaths (102 vs 57) (Table III).
were observed. The totals for the 1994-95 season were the lowest recorded in 10 years of surveillance. There was a significant decrease in injuries over time using the STP trail permit holder (p=0.00001) and population (p=0.0002) denominator figures.

Outcome

Injured snowmobilers requiring assessment and admission suffered a large number of injuries (Table III). The mean Injury Severity Score (ISS) was 17.5 before the intervention, compared to 11.9 after (p=0.12). There were 15 deaths in the pre-STP period compared to 4 in the post-STP period (73% reduction).

Admissions to the hospital were reduced by 45%. Therefore, the estimate of acute ED and hospital cost savings were $218,870 over the study period or $72,960/year (Table IV). Since follow-up assessment and costs from lost work time were not included in these calculations, the savings could be substantially greater.

In addition, the reductions in death mean 476 fewer years of productive life lost (Table IV). For the period prior to the STOP program, deaths were estimated to cost 6.7 million dollars; in the post-STP period, the 4 deaths represent 1.7 million dollars to society—a difference of approximately 5 million dollars.

DISCUSSION

The majority of snowmobile injuries and fatalities are associated with a number of modifiable risk factors. Although we are not aware of any previous evaluations on the effectiveness of strategies to reduce snowmobile injuries, successful interventions generally require a coordinated and multi-level approach. The results from this study demonstrate injuries and deaths can be significantly reduced through targeted surveillance and public education, centred on alcohol awareness and safety. In addition, a reduction in acute care costs associated with trauma can be realized.

While we suggest that these findings are the result of the STOP intervention, alternative explanations should be considered. First, weather affects snowmobile season length, and consequently injury statistics. However, comparisons of the two time periods suggest they were similar (Jim Robinson, personal communication). Moreover, research has shown that snowmobilers travel similar annual distances, irrespective of the winter weather and trail conditions. Thus, we believe it is valid to assume the two periods had comparable weather and trail conditions.

Second, while the STOP program was the major intervention of the study period, public education was provided in conjunction with the program. This may have changed behaviour, attitudes, and/or perceptions regarding alcohol consumption. However, public education has been used in this community and throughout the province over both the pre- and post-study period. Furthermore, this region is unique in demonstrating a decreased snowmobile death and injury pattern. We

TABLE I


<table>
<thead>
<tr>
<th>Characteristics</th>
<th>1990-1992 (n = 102)</th>
<th>1993-1995 (n = 57)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>27.3 (11.5)</td>
<td>29.2 (12.2)</td>
<td>0.33</td>
</tr>
<tr>
<td>Gender</td>
<td>Number (%)</td>
<td>Number (%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>81 (79)</td>
<td>48 (86)</td>
<td>0.45</td>
</tr>
<tr>
<td>Residence</td>
<td>Number (%)</td>
<td>Number (%)</td>
<td></td>
</tr>
<tr>
<td>Sudbury</td>
<td>83 (85)</td>
<td>42 (75)</td>
<td>0.29</td>
</tr>
<tr>
<td>NE Ontario</td>
<td>12 (12)</td>
<td>10 (18)</td>
<td>0.29</td>
</tr>
<tr>
<td>Ontario</td>
<td>3 (3)</td>
<td>4 (7)</td>
<td></td>
</tr>
<tr>
<td>Riding Status</td>
<td>Number (%)</td>
<td>Number (%)</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>70 (77)</td>
<td>41 (77)</td>
<td>0.52</td>
</tr>
<tr>
<td>Passenger</td>
<td>20 (22)</td>
<td>10 (19)</td>
<td></td>
</tr>
<tr>
<td>Bystander</td>
<td>1 (1)</td>
<td>2 (4)</td>
<td></td>
</tr>
<tr>
<td>Helmet Non-Use</td>
<td>Number (%)</td>
<td>Number (%)</td>
<td></td>
</tr>
<tr>
<td>Alcohol Use</td>
<td>4 (4)</td>
<td>3 (5)</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Notes: NE = Northeastern; Numbers do not total 159 due to missing data.

TABLE II


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of Day</td>
<td>Number (%)</td>
<td>Number (%)</td>
<td></td>
</tr>
<tr>
<td>08:01-16:00</td>
<td>17 (19)</td>
<td>8 (15)</td>
<td>0.09</td>
</tr>
<tr>
<td>16:00-24:00</td>
<td>51 (58)</td>
<td>25 (45)</td>
<td></td>
</tr>
<tr>
<td>00:01-08:00</td>
<td>20 (23)</td>
<td>22 (40)</td>
<td></td>
</tr>
<tr>
<td>Day of Week</td>
<td>Number (%)</td>
<td>Number (%)</td>
<td></td>
</tr>
<tr>
<td>Weekday</td>
<td>45 (51)</td>
<td>21 (39)</td>
<td>0.17</td>
</tr>
<tr>
<td>Weekend</td>
<td>44 (49)</td>
<td>33 (61)</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Number (%)</td>
<td>Number (%)</td>
<td></td>
</tr>
<tr>
<td>Frozen lake</td>
<td>22 (24)</td>
<td>23 (42)</td>
<td>0.42</td>
</tr>
<tr>
<td>Trail</td>
<td>21 (23)</td>
<td>12 (23)</td>
<td></td>
</tr>
<tr>
<td>Road</td>
<td>14 (15)</td>
<td>10 (18)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>34 (37)</td>
<td>10 (18)</td>
<td></td>
</tr>
<tr>
<td>Mechanism of Injury</td>
<td>Number (%)</td>
<td>Number (%)</td>
<td></td>
</tr>
<tr>
<td>Collision - fixed object</td>
<td>30 (32)</td>
<td>11 (20)</td>
<td>0.18</td>
</tr>
<tr>
<td>Collision - MV</td>
<td>20 (21)</td>
<td>18 (33)</td>
<td></td>
</tr>
<tr>
<td>Thrown from sled</td>
<td>2 (2)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Drowning</td>
<td>8 (8)</td>
<td>3 (5)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: MV=motorized vehicle; Numbers do not total 159 due to missing data.
The results of this study confirm that a volunteer police-assisted enforcement program on snowmobile trails reduces death and admission from snowmobile injuries in a community where these events burden health care delivery. Changing behaviours, attitudes, and beliefs surrounding alcohol and snowmobiling has been the main thrust of the campaign. Tempering these results is the realization that success may not be maintained over the long term. Since snowmobilers have the potential to “tune out” and new individuals enter the sport through maturation and immigration, prevention activities need to be continually monitored and improved. Clearly, further evaluation is required to determine if the rates and patterns of injury are maintained in the future. Nevertheless, based on these figures, cautious optimism appears justified.

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REFERENCES


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