



THE IHS PRIMARY CARE PROVIDER

A journal for health professionals working with American Indians and Alaska Natives



December 2010

Volume 35 Number 12

Economic Costs of Motor Vehicle Crashes and Economic Benefits of Prevention for the San Carlos Apache Tribe

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Introduction

American Indians and Alaska Natives (AI/AN) have a motor vehicle-related death rate more than one-and-a-half times greater than the rate for all other Americans (23.48/100,000 vs. 14.46/100,000).¹ To help address this disparity, the Centers for Disease Control and Prevention (CDC) awarded funds in 2004 to four tribes to tailor and implement evidence-based injury prevention programs to reduce motor vehicle-related injuries and deaths among members of their communities. Over the course of the five-year period of the CDC-funded cooperative agreements, each program implemented interventions selected from The Guide to Community Preventive Services, a systematic review of community-based interventions.² More information about The Guide and recommended interventions can be found at www.thecommunityguide.org.

The San Carlos Apache (SCA) Tribe, one of the four funded tribes, is located in southeast Arizona on 1.8 million acres of land with a population of more than 10,000 residents. In late 2004, the SCA Tribe established their CDC-funded Tribal Motor Vehicle Injury Prevention Program (TMVIPP) within the SCA Police Department. The goal of the SCA TMVIPP was to reduce motor vehicle-related injury and death by decreasing alcohol-impaired driving and increasing restraint use. To reach this goal, a network of partners was established with organizations both internal and external to the tribe, including the Indian Health Service (IHS), the Arizona

Department of Public Safety, Mothers Against Drunk Driving (MADD), and several tribal groups. Partners assisted with planning and carrying out program activities, under the lead of the program coordinator. The SCA TMVIPP activities included a comprehensive media campaign, sobriety checkpoints, enhanced police enforcement, and local community events. Data were collected on numbers of DUI arrests, sobriety checkpoints, and motor vehicle crashes, as well as on restraint use. Over the intervention period, the SCA TMVIPP was able to document important successes. Highlights include total DUI arrests increased 52%, motor vehicle crashes decreased 29%, nighttime motor vehicle crashes decreased 27%, and motor vehicle crashes involving injuries and/or fatalities decreased by 31%.³

This study builds on the detailed TMVIPP intervention data and evaluation work to examine the economic effects of the SCA TMVIPP. While detailed evaluation data have shown the successes of the program in terms of reductions in crashes and injuries, economic estimates provide valuable information about how such preventive programs affect the economies of tribes. These estimates reflect the amount of resources that may be saved from the TMVIPP and redirected to other

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services.

Approval to conduct and publish this study was obtained from the San Carlos Apache Police Department.

Methods

The SCA TMVIPP collected data on motor vehicle intervention activities (such as number of sobriety checkpoints and DUI arrests); and police-reported crashes, injuries, and fatalities. The police-reported crash and injury data allowed for comparison of motor vehicle crash and injury rates over a period of eight years: four years before the TMVIPP (2001 - 2004) and four years following the implementation of the program (2005 - 2008). Injury data from the local hospital were not used in our analysis because many seriously-injured motor vehicle crash victims were transported elsewhere for care.⁴

The crash and injury data from the SCA police department were not aggregated by age group, gender of victims, or severity of injury. These variables can greatly influence estimates of economic costs. Therefore, estimates of the distribution of motor vehicle-related injuries were made by adopting rates derived from Ari on a Crash Outcome Data Evaluation System (CODES) data.⁵ The availability of Ari on a-wide cost data from the Ari on a CODES Project, when coupled with the SCA-specific, police-reported injury data, provided the foundation for estimating motor vehicle injury costs for the SCA community.

In the Ari on a CODES project, crash data were collected by police at the scene of the crash; emergency medical systems (EMS) data were collected by emergency personnel at the scene of the crash; and emergency department and hospital data were collected by medical personnel providing treatment at the emergency department (ED), inpatient hospital, or outpatient department or other ambulatory facility. These data were linked further with rehabilitation and long-term care data.

The CODES data were comprised of both direct and indirect costs and include the following cost categories: medical costs (professional, hospital, emergency departments, drugs, rehabilitation, and long-term care); and other costs (police, ambulance, fire, insurance administration, loss of wages, loss of household work, legal and court costs, and property damage.⁵ The distribution of fatalities and level of severity of injuries in the 2005 Ari on a CODES data were used in the calculation of the overall economic burden of injuries. These data were adjusted (by CODES) to 2006 dollars. The data collection and code-linking methodologies adopted for the 29 CODES-participating states are detailed in several publications.⁶⁻⁸

This study used a Human Capital approach to estimate direct and indirect costs and productive life years foregone. This approach was an incidence-based model used to estimate the societal cost of motor vehicle-related injuries and derive lifetime costs. Total annual costs were estimated by motor

vehicle injury incidence multiplied by per capita injury costs derived from the CODES cost and injury severity distribution data.

A cost-benefit analysis approach was also used for the estimation and valuation of the effects of the SCA TMVIPP. This approach allowed the comparison of all program costs and ensuing benefits to be valued and reported in dollar terms. To calculate cost-benefit ratios for the CDC-funded TMVIPP, we used total grant expenditures as a proxy for total intervention costs. This is a very reasonable assumption because effective interventions require substantial infrastructure (overhead) and continued scientific evaluation and professional input (consulting, evaluation, program direction, and administration). All of these costs are critical to effective implementation and on-going application of the interventions. Generally, if a program's cost is less than the benefit it produces (in monetary terms) it produces a net social benefit and adoption or continuation should be considered. The marginal (incremental) cost against the marginal benefits a program produces was also estimated in the same monetary units. This provided critical information on the value of expanding, abandoning, or continuing a given program or intervention within a program.⁹ Since benefits, like costs, accrue over time, the net benefit in these calculations was estimated with the 3% discount rate used in the CODES project. A net benefit greater than zero indicates a positive economic benefit for the program.

Results

Table 1 displays the SCA alcohol-impaired driving activities and crash and injury statistics for the years 2000 - 2008. From 2000 to 2004, there was a generally increasing trend in motor vehicle crashes and crashes with injuries. This trend was interrupted in 2005, the first full year of interventions implemented through the TMVIPP. The trend from 2005 through 2008 was generally reversed except for 2007, which had an increase in crashes over years 2005 and 2006. However the number of crashes was below those for years 2002 through 2004 and declined again in 2008. These trends were also evident for crashes with injuries and/or fatalities.

Table 2 presents the estimates derived for fatalities per crash and persons injured per crash from the Ari on a CODES project for 2005. These estimates were derived from data for the total Ari on a population and were not specific for the American Indian population of the state. In the Ari on a CODES Project data, fatalities and disabling injuries made up of 1.7% and 9.9%, respectively, of the total number of injuries and fatalities. Non-disabling injuries constituted 35.6% of the total injuries and fatalities, and possible injuries were 54.3% of the total.⁶

Table 3 displays the estimated SCA motor vehicle injuries and associated medical and "other" costs (based on CODES

Table 1. Motor Vehicle Crashes and DUI Data, San Carlos Apache Tribe, 2000 - 2008

Item	2000	2001	2002	2003	2004	2005	2006	2007	2008
Crashes									
Total # of police-report crashes	237	247	343	341	338	276	247	297	240
Total # of fatal crashes	7	4	4	9	6	6	5	4	7
Total # of crashes with injuries and/or fatalities	84	83	88	99	104	87	83	101	72
DUI									
# of DUI arrests	266	245	261	307	308	385	411	391	468
# of sobriety checkpoints on SCA land						9	12	11	7
# vehicles stopped at checkpoints						3,644	3,892	7,002	3,621
# of saturation patrols								6	15

data) from 2001 - 2008. This period represents four years before the TMVIPP began and four years during which interventions and activities of the TMVIPP were carried out. There were increasing numbers of crashes and injuries from 2001 through 2004 and generally declining numbers over the intervention period of 2005 through 2008. It is notable that the first full year of implementation of the TMVIPP was followed by a large reduction of both crashes and injuries. The year 2007 was an exception that saw an increase that nearly equaled 2004, the year prior to the implementation of the prevention program. However, the next year, 2008, showed a dramatic decline in both crashes and injuries to levels previously unattained.

Over the eight-year period, we estimate that more than \$7.4 million were spent on medical care for motor vehicle-related injuries. Lifetime costs flowing from motor vehicle-related injuries amounted to over \$57 million. Taking as an example 2008 (the year with the lowest number of both motor vehicle crashes and persons with an injury), motor vehicle-related injuries accounted for approximately \$7,674 per injury in medical costs and \$57,428 per injury in total lifetime costs.

Table 4 compares the number crashes and injuries reported in 2001 - 2004 with 2005 - 2008 and their associated economic costs. The number of crashes decreased by 16.5%, fatal crashes by 4.3%, total fatalities by 3.8%, total crashes with injuries by 8.5%, and total number of persons injured by 8.6%. The economic costs are reported in deflated real (2006) rather than nominal dollars. They show generated reductions of \$357,700 in direct medical costs and \$2,354,850 in other costs, for a total savings of \$2,709,550 for the intervention period.

From 2005 - 2008, total TMVIPP costs were estimated to be \$274,696, or about \$69,000 per year. The four-year TMVIPP intervention savings in Direct Medical Costs alone (over

\$357,000) more than financed the cost of the interventions. For every dollar spent on interventions, over \$1.30 was returned in avoided Direct Medical Costs from reduced numbers of motor vehicle crashes, fewer injuries per crash, and reduced injury severity. Total cost-benefit for the interventions shows a lifetime ratio of about 1:9.86. This means that every dollar spent on interventions yielded a lifetime savings of \$9.86.

Discussion

This study estimated the economic cost and burden of injuries resulting from motor vehicle crashes on the San Carlos Apache Reservation in Arizona. These estimates build on the detailed epidemiological and program evaluation work performed during a five year CDC-funded motor vehicle injury prevention program grant awarded to the SCA Tribe.³ These grants were in response to exceptionally high rates of motor vehicle-related injury and death among AI/AN. For example, for the state of Arizona in 2000 the mortality rate for all races was 19.9 per 100,000 population; 76.8 for American Indians (AI); and 117 per 100,000 for AI living on the SCA Reservation.^{1,3} These high rates of motor-vehicle injury substantially impair the ability of tribes to provide adequate health care for their population and to maintain a population structure that promotes productivity and economic development.¹⁰

The SCA TMVIPP is designed to reduce the number of motor vehicle crashes and the number and severity of injuries per accident. These factors drive the short and long-term medical cost and economic burden on the community. The initial costs of transportation and treatment are frequently compounded by recurring medical costs for continuing care, specialty care, rehabilitation, and long-term care. This is a

Table 2. Estimates of Motor Vehicle Injury and Fatality Incidence, State of Arizona, All Races (CODES Project, 2005)

Total Crashes	139,265
Fatal Crashes	1,038 (0.75%)
Fatalities	1,179
Fatalities per crash	1.136
Injury Crashes	45,361 (32.57%)
Number of Injuries	70,293
Number of Persons Injured per Crash	1.548

burden on the health care resources available to the community. The community is also affected by the loss of income and productivity that injured individuals, their families, and other caregivers would have generated if the injuries had been avoided.

Over the eight-year period of this study, economic costs due to lost productivity and income from injury victims and those who care for them totaled nearly \$50 million (\$49,829,149). Prior to the TMVIP Program institution, the previous four years had seen increasing numbers of motor vehicle crashes and injuries each year from 2001 through 2004. During the years of TMVIP Program implementation, reductions were not only seen in terms of crashes and injuries but also costs. There were some fluctuations in the numbers of crashes, injuries, and costs during the program period. However, during the TMVIP Program (from 2005 to 2008) crashes were reduced by 16.5%, total crash fatalities by 3.8%,

and the total number of crash-related injuries by 8.6%. These decreases suggest that the interventions had a positive effect. Moreover, the program period showed a total reduction of \$2,709,550 in direct medical and other costs. These results have a large impact on the ability of the community to develop and grow, as the impact of crash-related injuries is recurring and continues to affect the economic potential of the community over a very long period.

The value of the TMVIP was also estimated using a cost-benefit approach: for every dollar spent on interventions, there was a lifetime benefit of \$9.86 saved. This ratio represents a substantial return on investment. It compares favorably to cost-benefit analyses of other preventive approaches, such as worksite wellness programs (\$1 to \$4.75 saved per \$1 spent), screening newborns for PKU and hypothyroidism (\$6.60 to \$13.80), drug courts (\$2.80 to \$6.32), and preconception care of women with diabetes (\$1.24 to \$5.19).¹¹⁻¹⁴

Table 3. Estimated Economic Cost of Motor Vehicle Injuries (includes fatalities), San Carlos Apache Tribe, 2001-2008

	2001	2002	2003	2004	2005	2006	2007	2008	2001-2008
Individuals with motor vehicle injuries	130	136	153	161	135	128	156	111	1,110
Medical Cost	\$736,483	\$809,294	\$954,130	\$1,056,770	\$924,835	\$915,712	\$1,163,008	\$851,784	\$7,412,016
Other Cost	\$5,241,982	\$5,598,490	\$6,457,780	\$7,302,072	\$6,116,950	\$6,020,747	\$7,568,398	\$5,522,730	\$49,829,149
Total Cost	\$5,978,465	\$6,407,784	\$7,411,910	\$8,358,842	\$7,041,785	\$6,936,459	\$8,731,406	\$6,374,514	\$57,241,165

Limitations

These cost estimates are conservative for several important reasons. First, there is a high probability of incomplete reporting of serious motor vehicle injuries due to absence of information about victims transported to referral hospitals.⁴ Second, it is very difficult to obtain complete cost data. Even the CODES project has been only partially successful in generating cost data from all the myriad sources of payment, including Medicare, Medicaid (AHCCCS), IHS Direct and Contract care, FEHB, private health insurance from other payers, and other public sources (VA, TriCare, etc.). Furthermore, the injury and fatality incidence data are derived from CODES data for the total Arizona population and are not specific for American Indians. Therefore, these cost estimates are conservative because of the higher incidence of serious motor vehicle-related injuries in this population, the rural environment, shortage of specialized emergency facilities and personnel, and long distances and travel times required for transport of injured patients.

Motor vehicle crash and injury data are also incomplete. A recent study on crash reporting for the San Carlos Apache Reservation showed that for the year 2001, the actual number of motor vehicle crash injuries was 60% higher than the police reported injuries. Additionally, motor vehicle-related fatalities reflected deaths at the scene of the crash while many deaths occurred during transit to, or at, tertiary facilities. Total fatalities may be as much as 20% to 30% higher than reported.⁴ Finally, the cost estimates do not include the value of such intangibles as pain and suffering or stress and depression, which can be serious and long-term outcomes of these crashes.



Table 4. Changes in Motor Vehicle Crashes, Fatalities, Injuries, and Economic Costs, San Carlos Apache Tribe, 2001 - 2004 and 2005 - 2008

	2001-2004	2005-2008	Difference (% change)
Crashes and Injuries			
Total # of police-reported crashes	1,269	1,060	209 (-16.5%)
Total # of fatal crashes	23	22	1 (-4.3%)
Total # of fatalities	26	25	1 (-3.8%)
Total # of crashes with injuries (includes fatalities)	375	343	32 (-8.5%)
Total # of individuals with injuries (includes fatalities)	580	530	50 (-8.6%)
Estimated economic costs			
Medical Cost	\$4,149,320	\$3,791,620	- \$357,700
Other Cost	\$27,281,460	\$24,926,610	- \$2,354,850
Total Cost	\$31,430,780	\$28,721,230	- \$2,709,550 (-8.6%)

Conclusions

Motor vehicle-related injuries and deaths are preventable. Crashes place an economic and societal burden on tribal communities. Through the work of the SCA TMVIPP and the active participation of many members in the community in the design, implementation, and operation of motor vehicle injury prevention interventions, there were reductions in crashes and injuries.

Not only do crashes result in numerous injuries and deaths, but the economic estimates in this study quantify their economic burden. From 2001 through 2008, economic costs associated with medical care and productivity losses to the SCA Tribe totaled more than \$57 million. Cost reductions were seen during the period that TMVIPP was implemented. The cost-benefit for the TMVIPP showed a lifetime ratio of about 1:9.86. This means that for every dollar spent to implement the prevention program, there were almost \$10 in savings from reduced medical and other costs.

These estimates provide information for health service resource utilization and health policy decisions, as well as valuable information for the design of cost-effective interventions to prevent motor vehicle-related injuries. The large and continuing burden of motor vehicle injury and death demands that effective programs be implemented, sustained, continuously evaluated, and improved.

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Acknowledgements

The authors are grateful to Alejandro Benally, Kenny Hicks, Stephen Piontkowski, Christine Reede, Gordon Tsatoke, David Wallace, and many other individuals from the San Carlos Apache Nation for their contributions to the planning, implementation, and evaluation of the San Carlos Apache Motor Vehicle Injury Prevention Program.