Snow Machine / ATV / Non-Motorized Related Injury in Alaska Children Aged 1-14 Years

- Stephen S. Tower, M.D.
- Orthopedic Surgery
- *Anchorage Fracture and Orthopedic Clinic*

Snowmachine related mortality and morbidity in Alaska: a comparison with non-motorized winter sport.

Tower SS, Simonsen BL, Propst MT.

Alaska Med. 2000 Oct-Dec;42(4):94-5, 100.

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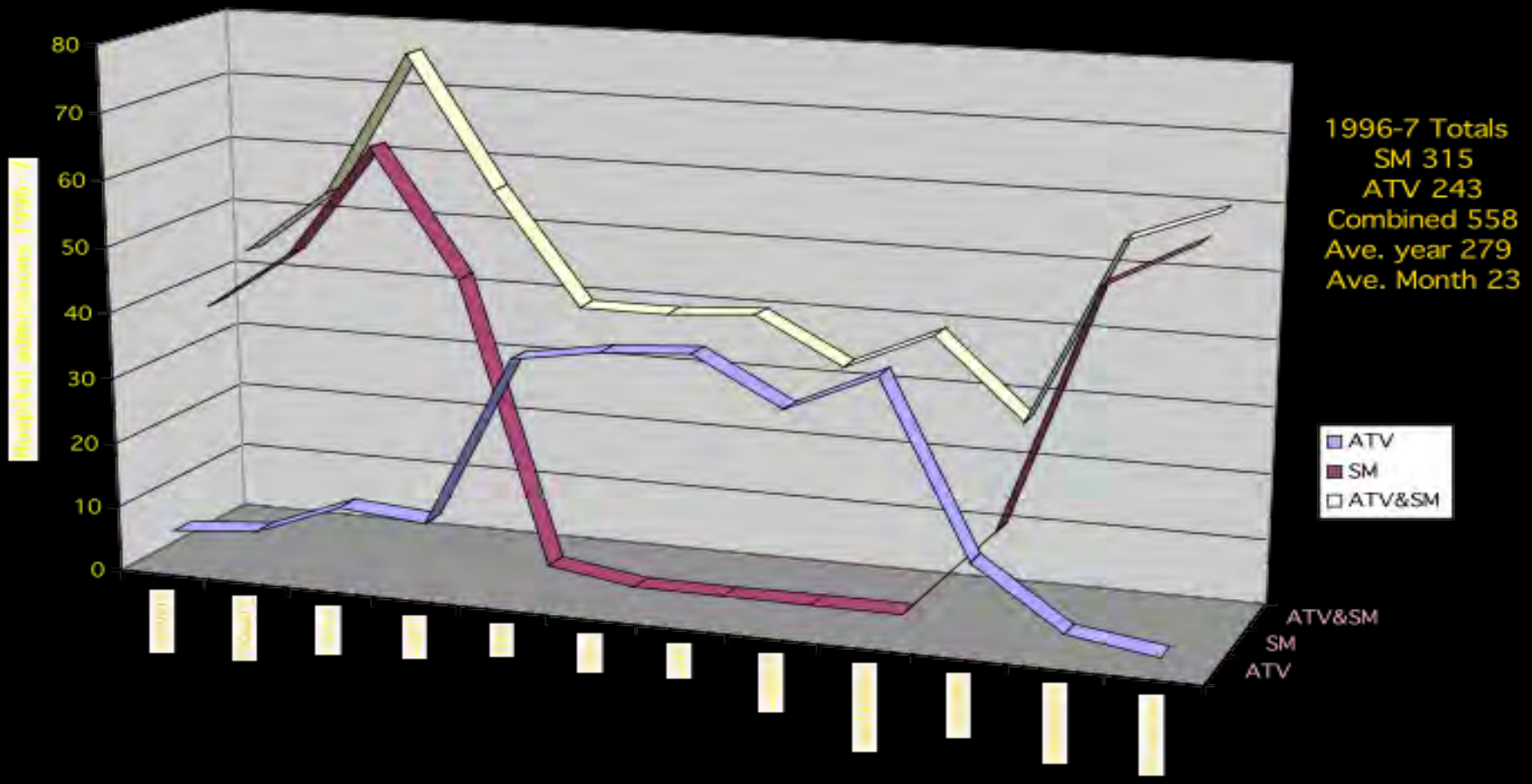
1990-1994 Alaskan Snowmachine related Deaths

- Mortality rate per 100,000 population 2.2
- Highest in the Nation
- Next highest Wisconsin rate of 0.3
  - Landon MG., Middaugh J, Dannenburg AL. Injuries Associated with Snowmobiles, Alaska, 1993-1994. Public Health Reports. 1999;114:48-52.

Monthly SM and ATV Admissions 1996-7



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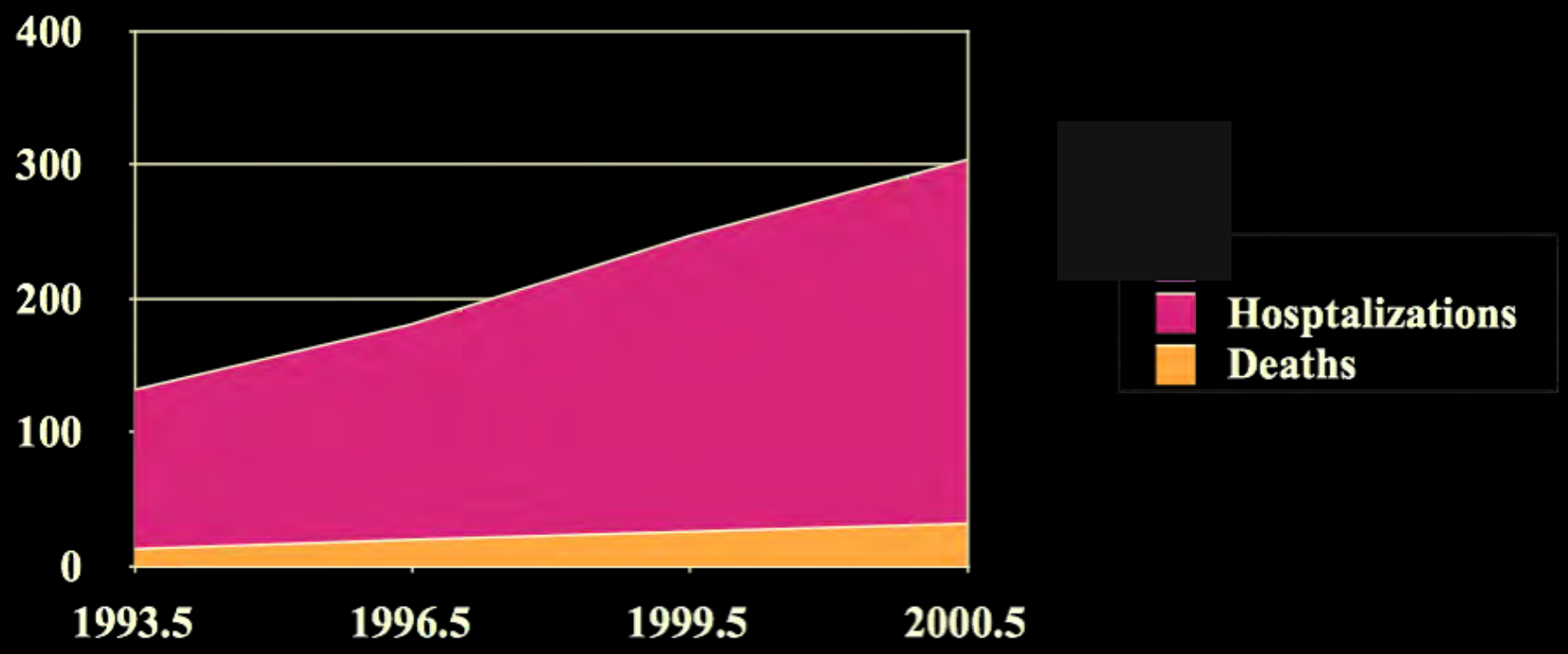
Snow Machine / ATV Death in Alaskans

- Proportional to population.
- Equivalent to 9/11/01 every four months

Trend in snow machine related death and hospitalization in Alaska



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1993-1994 Alaskan Snowmachine related Deaths and Hospitalizations

- 13.5 deaths , 119 hospitalizations per year
- Rate of death per mile driven 8.5X that of road traffic
- Rate of hospitalization per mile driven11.4X that of road traffic
- Median age of victims 29 years, range (10-61 years)
  - Landon MG., Middaugh J, Dannenburg AL. Injuries Associated with Snowmobiles, Alaska, 1993-1994. Public Health Reports. 1999;114:48-52.

Disability Related to Snow Machine / ATV Injury in Alaskan

- Proportional to population
- Equivalent to 9/11/01 every 2 days.

Children are at risk for Snowmachine/ATV related Death or Hospitalization

- Nationally of the thousands of snowmachine related injuries, 18% occur in children, 48% in adolescents of young adults.
- The American Academy of Pediatrics position statement: “Snowmobiles are inappropriate for use by children and young adolescents and should not be used by children younger than 16 years of age.”
  - Widome et.Al.. American Academy of Pediatric snowmobile Statement. Pediatrics 1988;82:798.

Any Lake in Alaska

Any Beach in Alaska

Snow Machine / ATV related Death and Hospitalization in Alaska

- WHY ?????????????
- 7 y.o. SM Driver
- Collision Dock
- 40 MPH

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Deaths Ages 1-14 from Unintended Injury 2004-2009

	MVA	total
2007-09	18	51
2004-6	23	58
2004-9	41	109
percent	38	
rate/ year	7	18

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Deaths Ages 1-14 from MVA 2004-2009

MVA	Car	airplane	Boat	PED/ BIKE	motor bike	ATV and SM	PED/ BikeMB/ ATV/SM	% PED/ BIKE/ ATV/ SM	total
2007-09	11	3		1	1	2	4	22	18
2004-6	12	5	1	4		5	9	39	23
2004-9							13	32	41
rate/ year							2		7

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Summary SM/ATV Death 1996-9

- 52 deaths
- 79% adult machine operators
- 19% minors (2-3 per year)
- 2% pedestrian
- Yearly rate 17
- Adjusted yearly rate 23
- SM fatalities 1999-0 season 24

Rank	<1	1-4	5-9	10-14	15-19	20-24
1	Falls 93	Falls 250	Falls 223	Falls 207	Suicide 640	Suicide 580
2	Assault 29	Poisoning 139	Fall from playground 61	ATV 105 Suicide 105	Falls 241	Assault 350
3	Burn 22	Burn 48	Bicycle 56	Bicycle 90	MV Traffic 235	MV Traffic 278
4	Poisoning 12	Acc. Struck 36	ATV 33	Sports 66	Assault 165	Falls 265
5	Foreign Object 11	Pedestrian 26	Acc. Struck 29	MV Traffic 59	ATV 142	ATV 102
6	Suffocation 10	Foreign Object 25	Pedestrian 27	Snow Machine 35	Sports 131	Snow Machine 87
7	Acc. Struck 5 MV Traffic 5	Assault 23	Cut 22	Poisoning 34	Poisoning 113	Cut 68
8		Dog Bite 22 MV Traffic 22	Dog Bite 20 MV Traffic 20	Acc. Struck 25	Snow Machine 99	Acc. Struck 48
9		Suffocation 21	Sports 14 Sledding 14	Fall from playground 24	Bicycle 57	Sports 43
10		Fall from playground 19	Poisoning 13	Acc. Firearm 21	Cut 30	Acc. Firearm 32

10 Leading Causes of Non-Fatal Hospitalized Injuries, Alaska Residents 2006-2010

Source: Alaska Trauma Registry, Division Public Health, Dept. Health & Social Services. Admitted to the hospital for 24 hours or greater. Occurrences less than 5 not listed. Created April 9, 2012

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1993-1994 Alaskan Snowmachine related Hospitalizations

- 38% Lower extremity fracture
- 19% TBI
- Mean ISS 7.6
  - Landon MG., Middaugh J, Dannenburg AL. Injuries Associated with Snowmobiles, Alaska, 1993-1994. Public Health Reports. 1999;114:48-52.

SM Injury 1996-7

- 161 hospitalizations, 949 hospital days per year
- Up 36% in three years
- 19% TBI
- 2% spinal injury

SM Injury 1991-2000 0-18 yo

- 311 Hospitalizations (now 10 per year ages 1-14)
- 60 TBI (19%)
- About 1500 hospital days
- 52% Alaskan Native
- 64% + operating machine at time of injury
- 55% of TBI's known not to be using helmet
- 66% of medical care publicly funded

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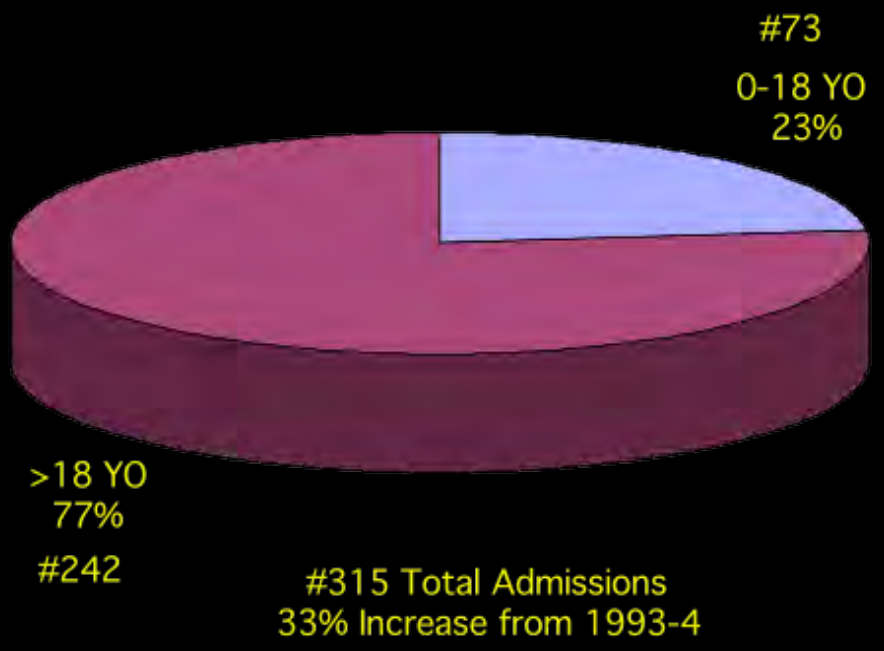
Ages of SM Hospitalizations 1996-7



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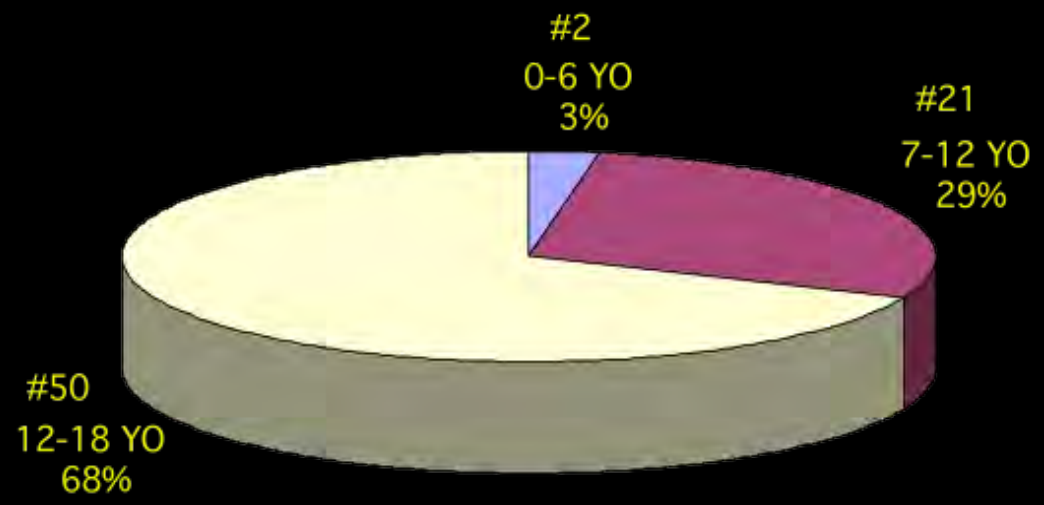
Ages of SM Hospitalizations 1996-7



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Snowmachine/ATV related Death or Hospitalization in Children

- Snowmachine/ ATV trauma is the second leading cause of death and hospitalization in Alaskan children ages 10-14.
  - State of Alaska. Serious and Fatal child and Adolescent Injuries in Alaska 1991-1994, pg..23.

ATV Hospitalizations 1996-7 All Ages

- 122 admissions / Year
- 937 hospital days / year
- 29% TBI
- 2% spine fracture

ATV Hospitalizations 1991-2000 0-18 yo

- 432 Hospitalizations
- About 2580 Hospital days
- 116 TBI's (27%)
- 58% Native Alaskans
- 64%+ operating machine at time of injury
- 68% of TBI's noted not to be using helmet
- 66% medical care publicly funded

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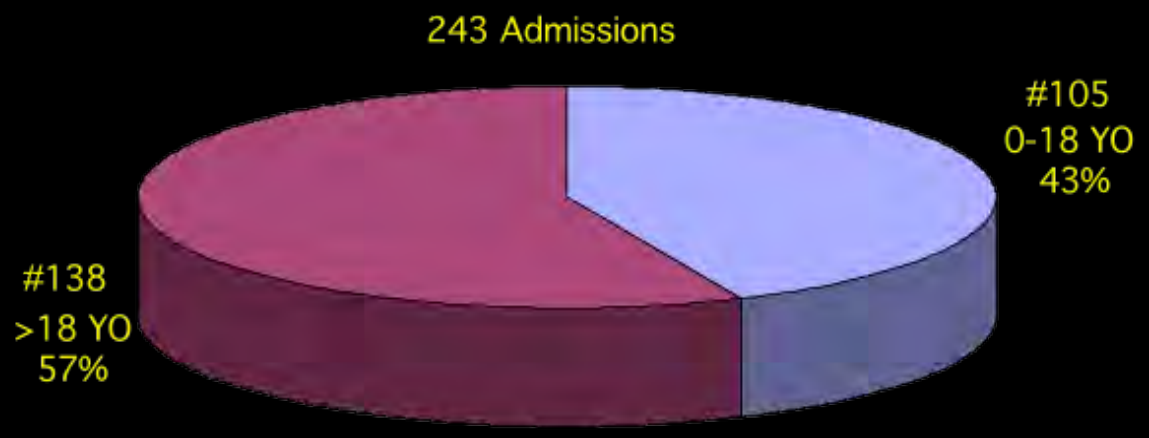
Ages of ATV Hospitalizations 1996-7



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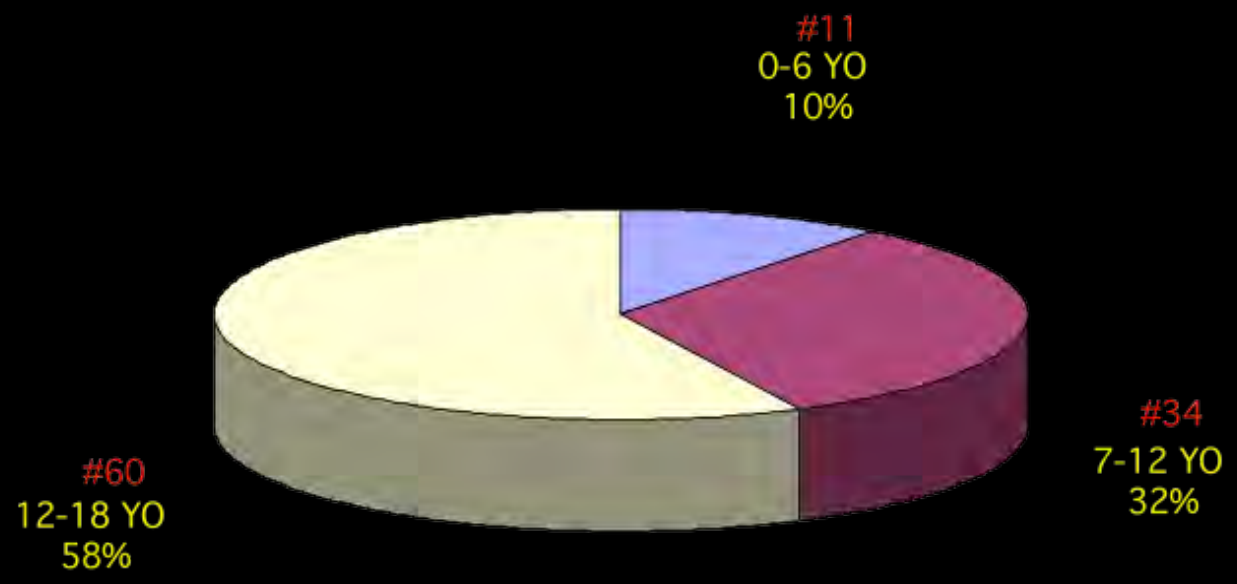
Ages of ATV Kids Hospitalized 1996-7



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Alaska Trauma Registry 2004-2010 Data

–Margaret B. Young, MPH

MCH Epidemiology Unit

Alaska Division of Public Health, Section of Women's, Children's, and

Family Health

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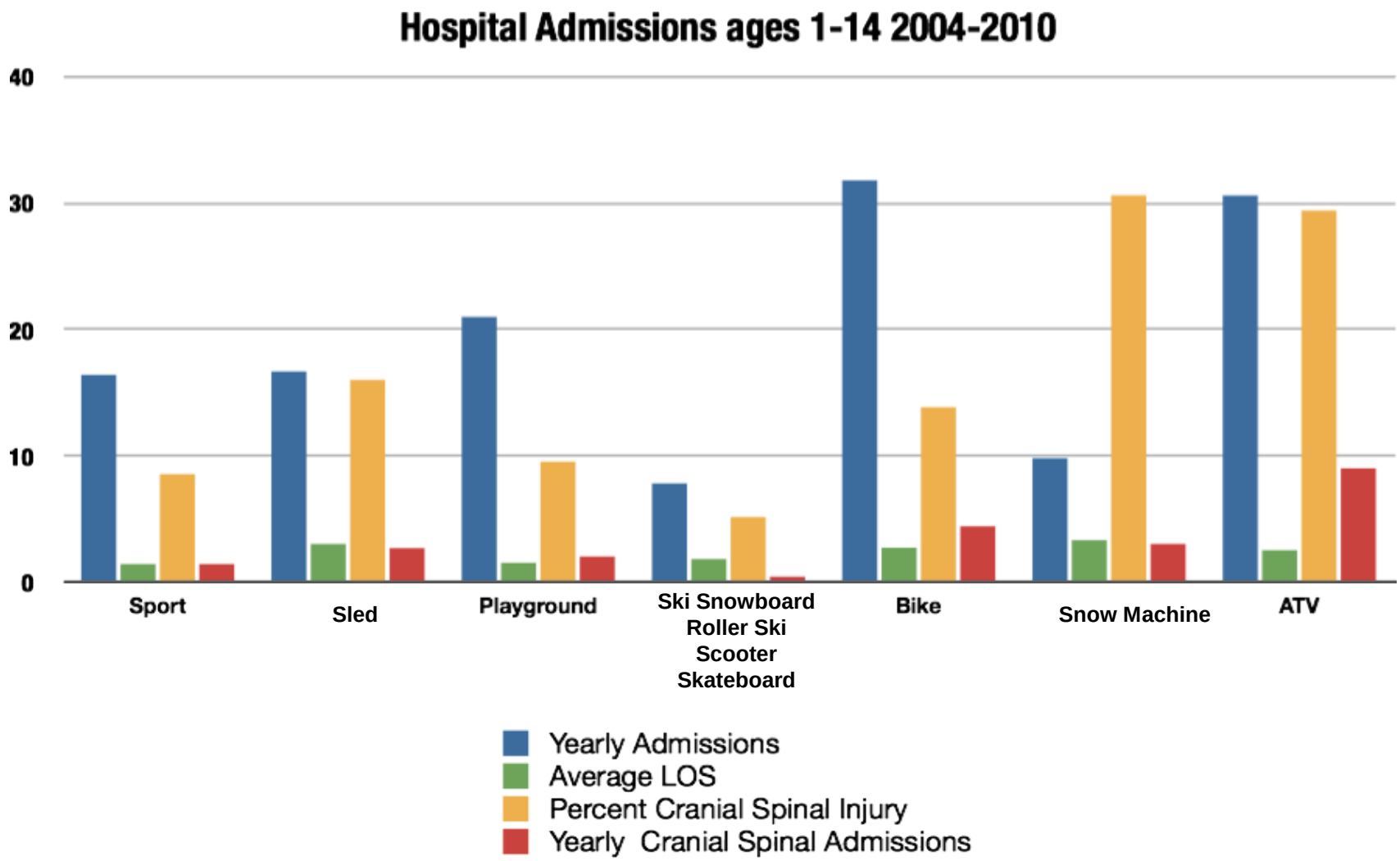

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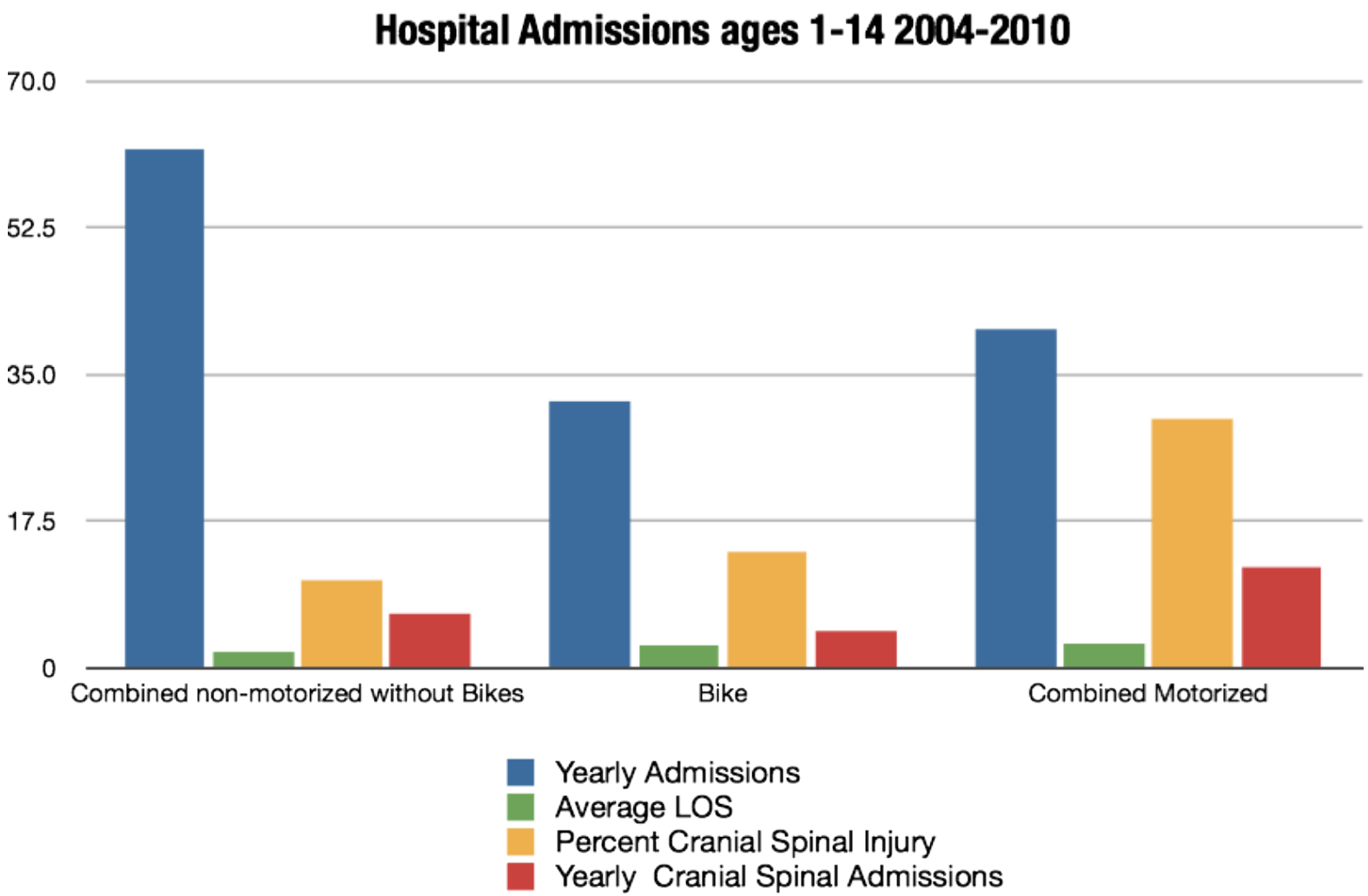

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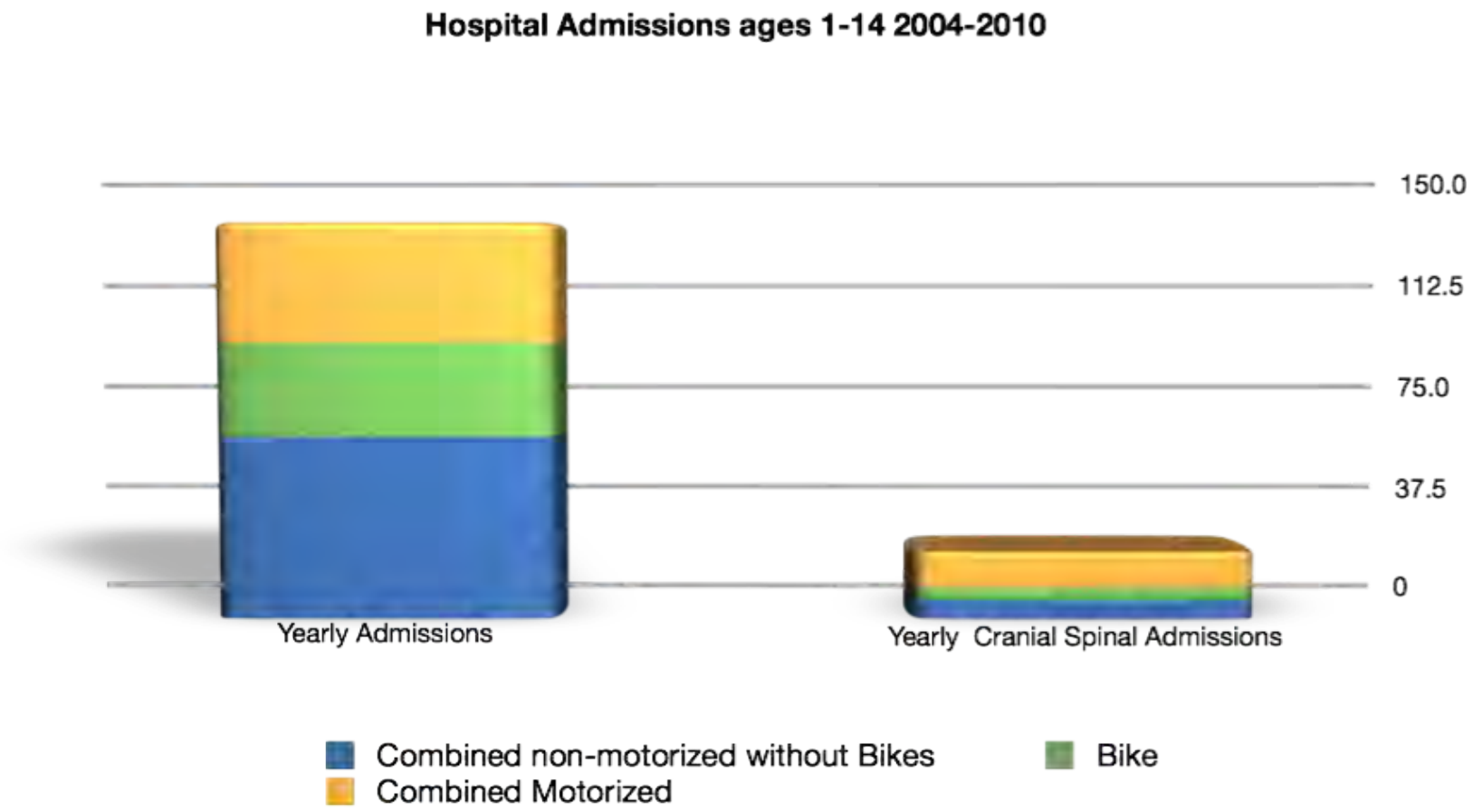

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TBI Sagital

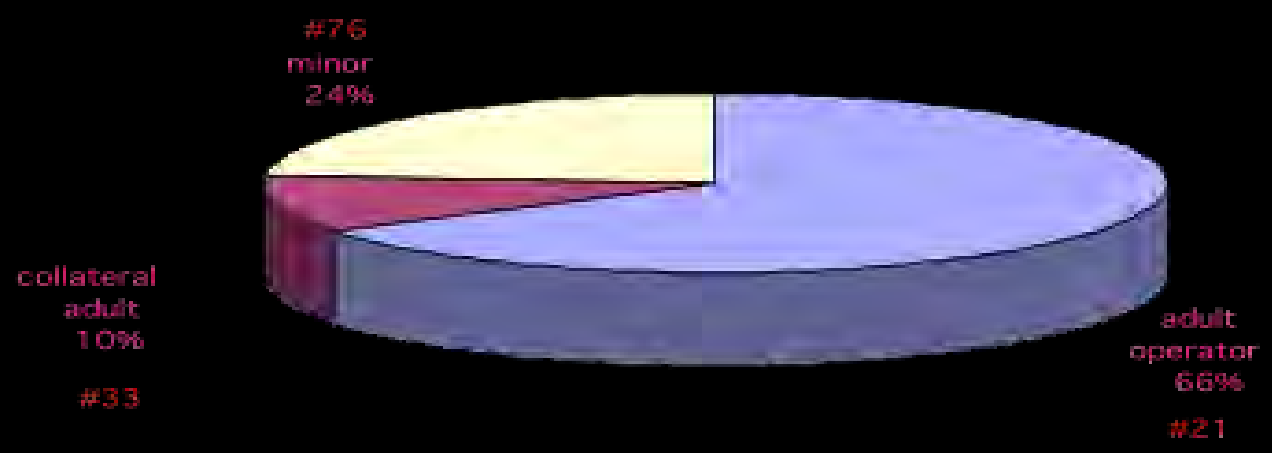

FL:
ROT:
P
1
2
0
:14
:1/1 15.6kHz
EAD
JV:24x24
.0thk/2.5sp
2/02:16
56X256/1.00 NEX
t:I/VB
I 133
W = 761 L = 463

C-spine 3 time loser

Dr

1996-7 Snowmachine related Hospitalizations:

Category of Hospitalized #322



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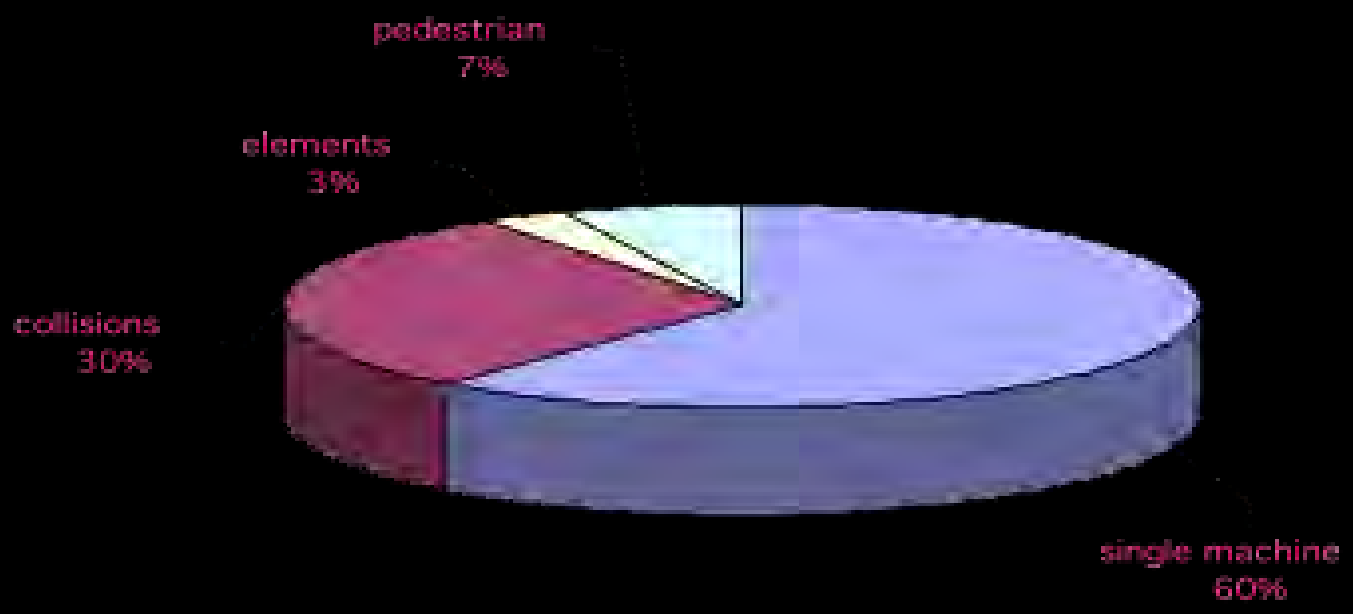
Mechanism of SM injury resulting in Hospitalization 1996-7 #322



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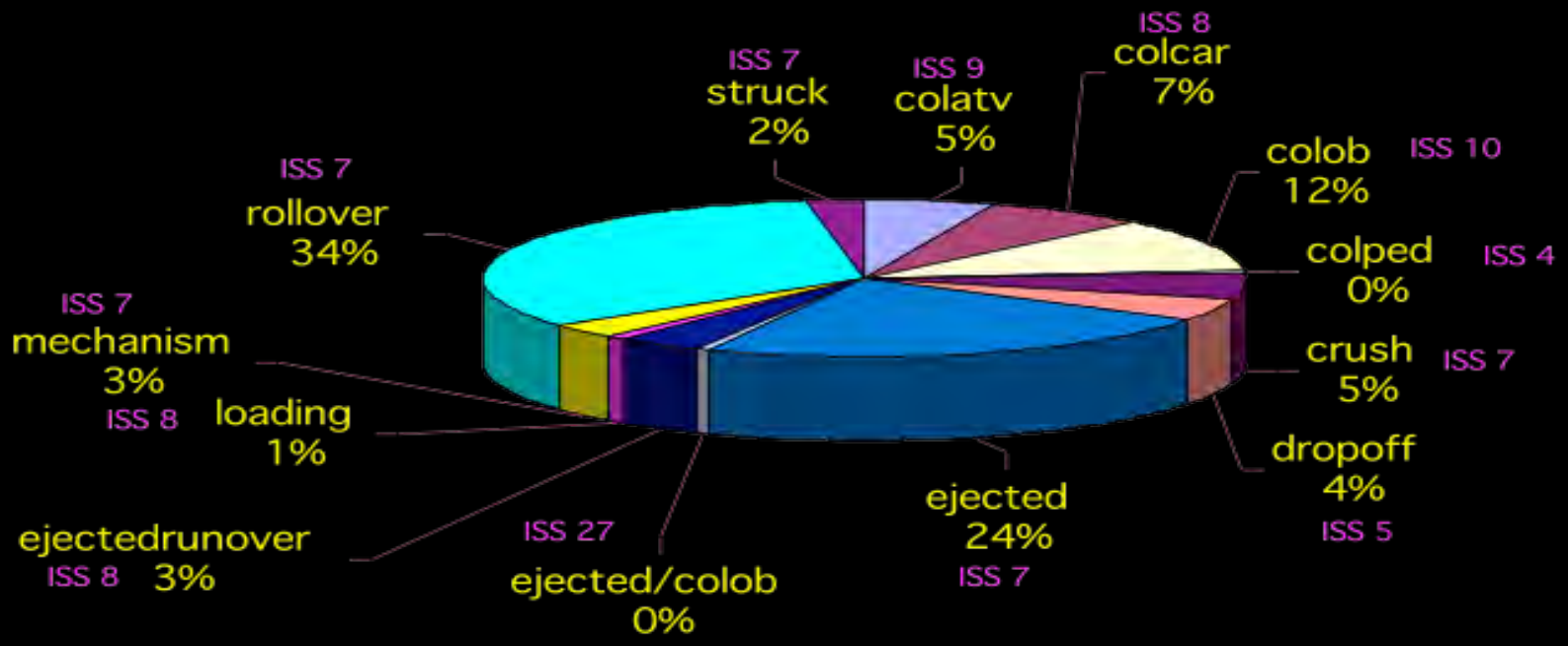
Mechanism of Injury ATV 1996-7



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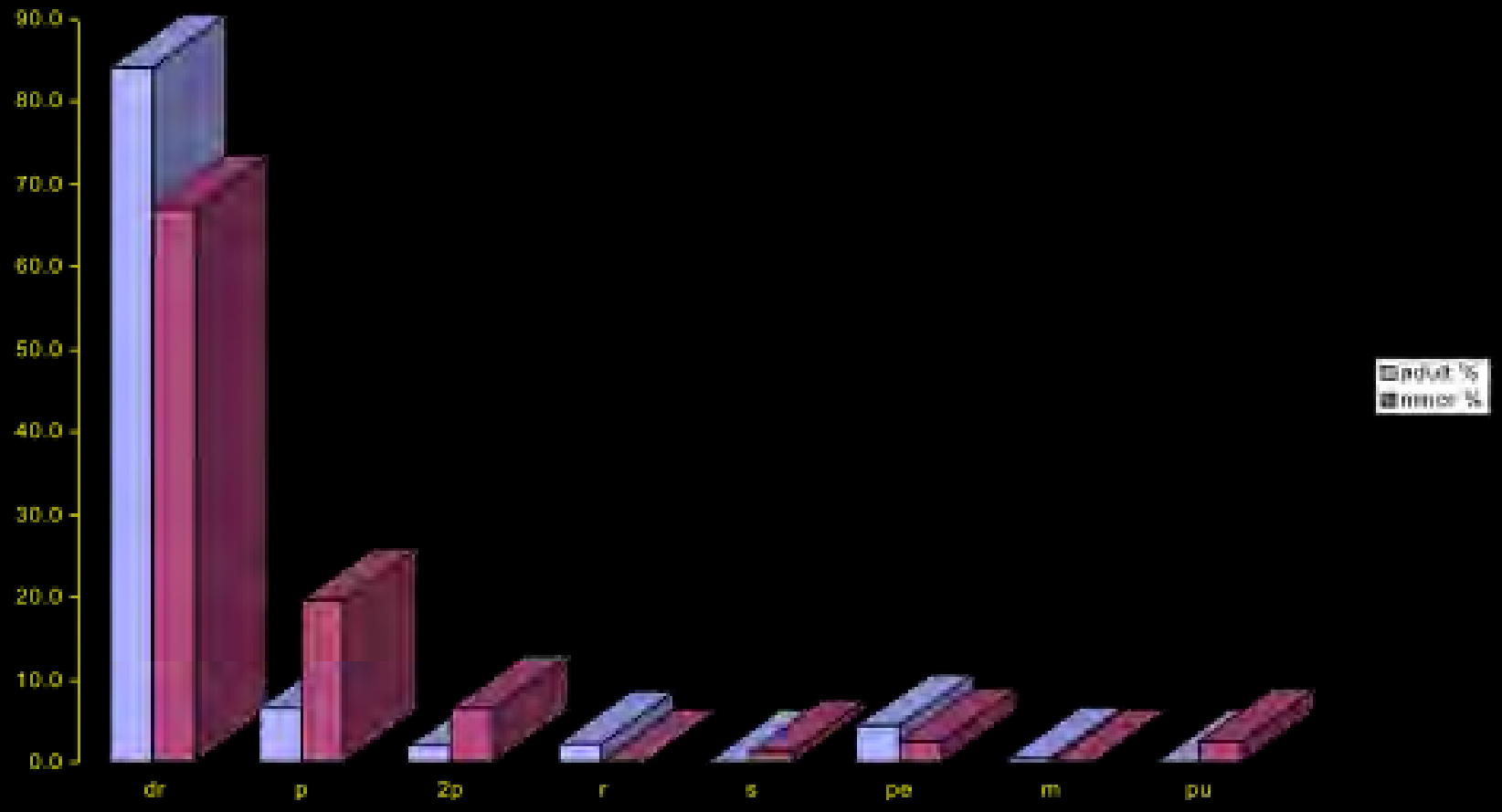
Role of injured adults / minors 1996-7 Snow Machines



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SM Pedestrian (both pediatric)

- Bilateral tibial fractures
- Hepatic laceration
- Rib fractures
- Pulmonary contusion
- Clavicle fracture

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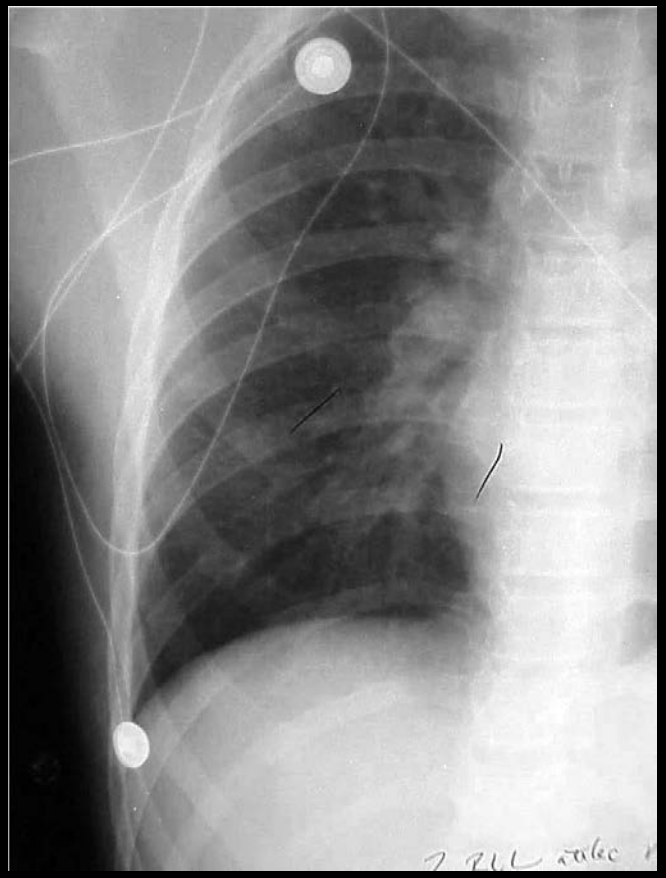
SM Pedestrian (both pediatric)



- Bilateral tibial fractures
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- Pulmonary contusion
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SM Pedestrian (both pediatric)

- Bilateral tibial fractures
- Hepatic laceration
- Rib fractures
- Pulmonary contusion
- Clavicle fracture

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17 y.o. “jumping my machine to impress my girlfriend”

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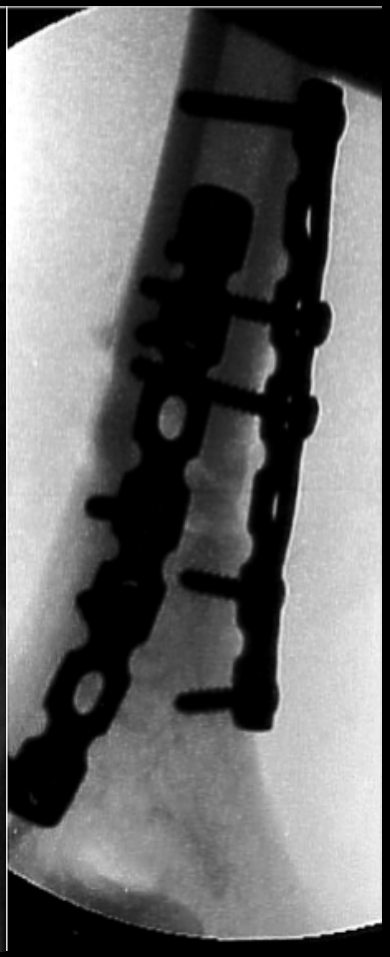
17 y.o. “jumping my machine to impress my girlfriend”



SM Adult Track Injury

- Avascular Foot
- Segmental bone loss
- Soft Tissue Deficit

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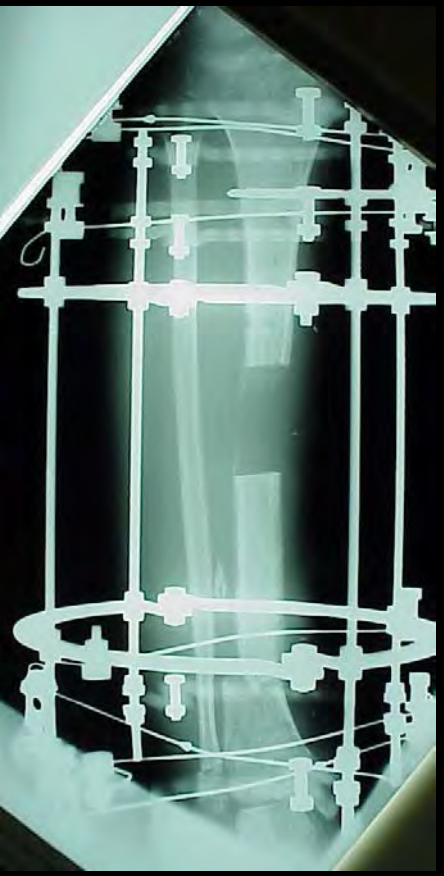
SM Adult Track Injury



- Illizarov Device
- Docked bone transport
- Early bone regenerate

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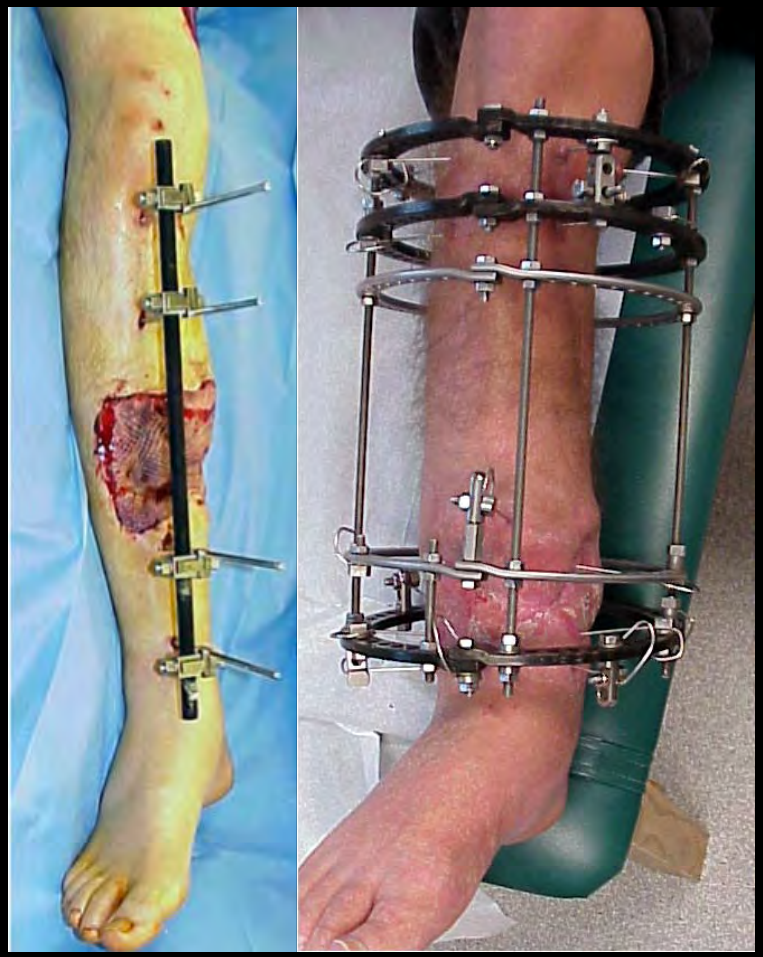
Illizarov Limb Salvage



- Initial unilateral fixator
- Multiple debridements
- Soft tissue management with STSG
- Bone transport to manage segmental bone defects

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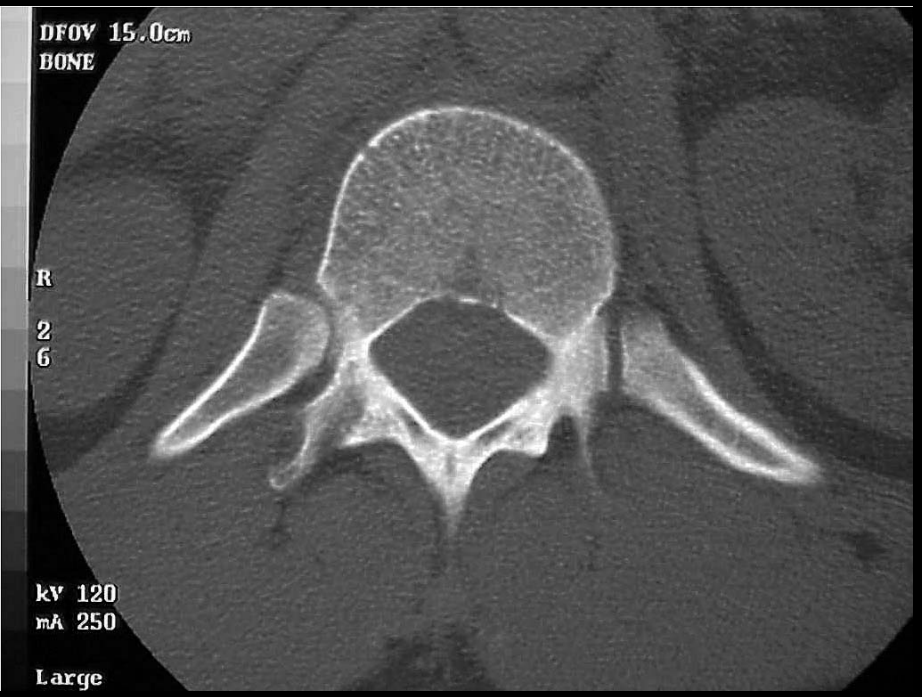
Went of a drop off on my snowmachine



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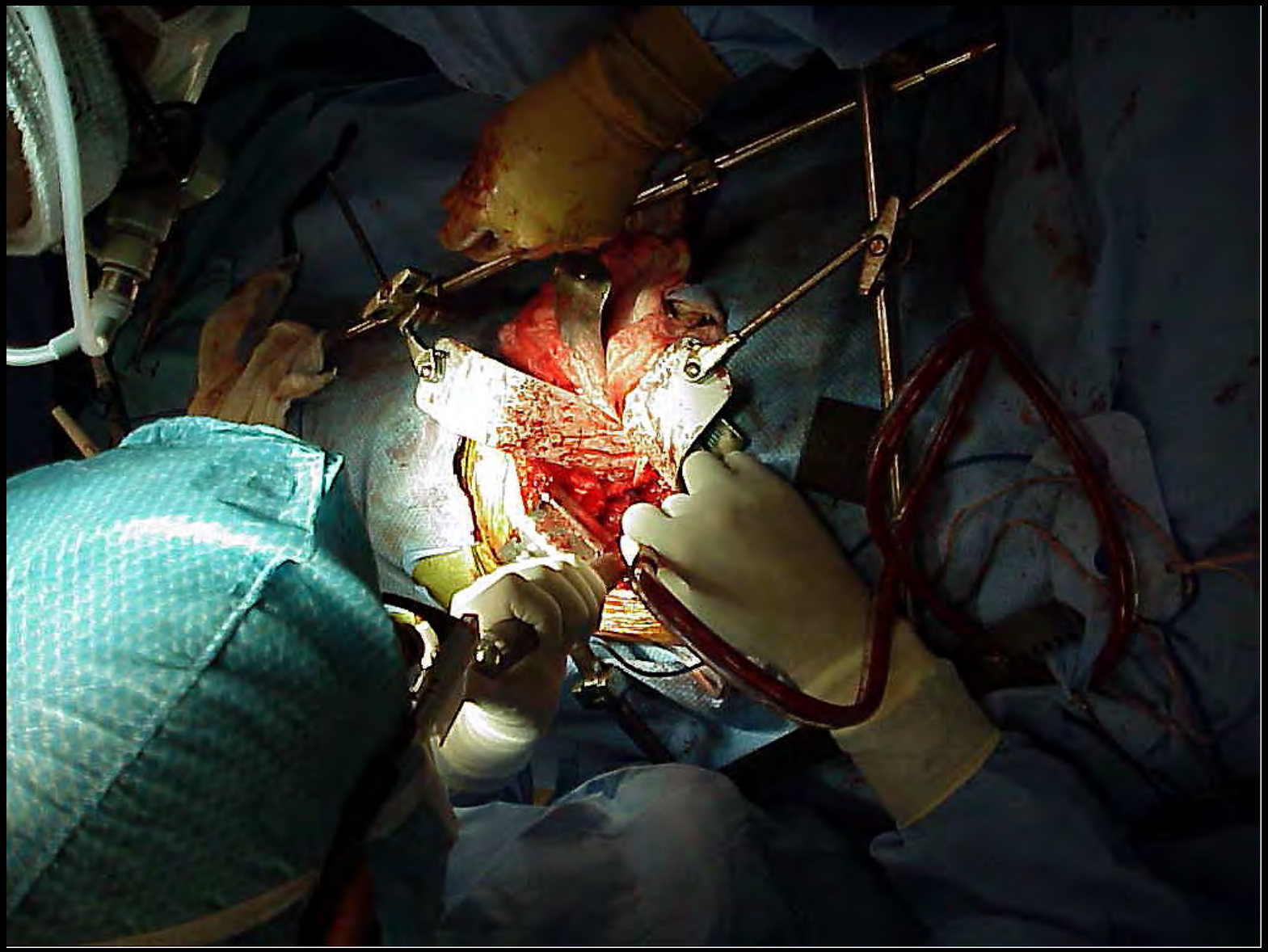
10 hour operation 12 units blood



0-18 yo SM/ATV 1991-2000

- 75 kids hospitalized yearly (now 40 1-14 ages)
- About 400 hospital days a year
- About half at Native
- About a quarter are brain injured
- Majority of brain injured know not to be using helmet
- Two thirds of funding for medical care is publicly funded

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So What?

- Unintentional injury is the leading cause of potential year of life loss in Alaska (37.9%).
- Single most common cause of unintentional injury is motor vehicle injury (21.3%).
  - Causes of Death in Alaska 1980-9, Epi. DHHS, State of Alaska

Dangerous compared to what?

- Snowmachine 24 months 322 hospitalizations, 1897 hospital days.
- Skiing, skating, sledding, hockey combined 130 hospitalizations, 380 hospital days, same review period.

So What?

- If a disease were killing our children at the rate unintentional injuries are, the public would be outraged and demand that the killer be stopped.
- C. Everett Koop, M.D.

Cost of ATV/SM injuries Alaska

- Death is cheap!
- Cost of initial hospitalization per year 5.9 million dollars (hospital cost only, 1897 hosp. Days, $3,140 dollar per day)
- This is a fraction of the societal cost
- 42% of the hospitalized are not insured and the cost is borne by public sources.

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Machine Factors

- Exposed mechanism
- Freeway speeds obtainable
- No operator restraint or protection

Traffic Factors:

- No traffic code
- No traffic enforcement
- Mad max scenario
- Admixed pedestrians on same trails

Terrain Factors

- Limited visibility
- Irregular surface, variable control and braking
- Remote locations of accidents
- Hostile environment

Operator Factors

- No operator training or licensure
- Full power machines operated by minors
- Intoxication
- No deterrent to unsafe machine operation
- Protective equipment variably used

Pedestrians are endangered by SM and ATV use

- A snowmachine traveling 60 MPH travels 130 feet in the reaction time of the driver. Visibility and trail width limit make these speeds much more hazardous to pedestrian traffic than in a freeway setting. Non-motorized traffic is banned from freeways.
  - Wisconsin Medical Journal, December 1993, pg.. 673.
- Off road exclusive pedestrian space is not defined.
- 5% dead and hospitalized are pedestrians

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16 y.o. pedestrian struck by SM

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SM with 14 y.o. operator strikes Pedestrian

Conclusions SM/ATV Pediatric Death and Hospitalizations

- SM/ATV should not be operated by children
- Children at risk for hospitalization and death as operators, passengers, and pedestrians.

Conclusions SM/ATV Pediatric Death and Hospitalizations

- Helmet use should be universal
- SM/ATV traffic code and enforcement needed
- Operator age limits, education and licensure needed
- Off road motorized and non-motorized space needs definition
- ? Insurance of SM/ATV operators similar to road traffic
- Such an approach slashed SM/ATV injury rates in N.H.

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Public Education to the risk of SM/ATV operation

- 14 y.o. unsupervised boy dies after being crushed by his high power 600 lb. machine doing unsupervised aerial maneuvers.
- Mother's comment " it was a freak accident"

AAP Position Statement on ATVs

- AAP strengthens its recommendations for passage of legislation in all states prohibiting the use of 2- and 4- wheeled off road vehicles by children younger than 16 years as well as a ban on the sale of new and used 3- wheeled ATVs, with a recall of all used 3-wheeled ATVs.
  - Pediatrics, v. 105(6), June 2000.

High risk

8 y.o. full power machine no Helmet

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Helmets are at least a start

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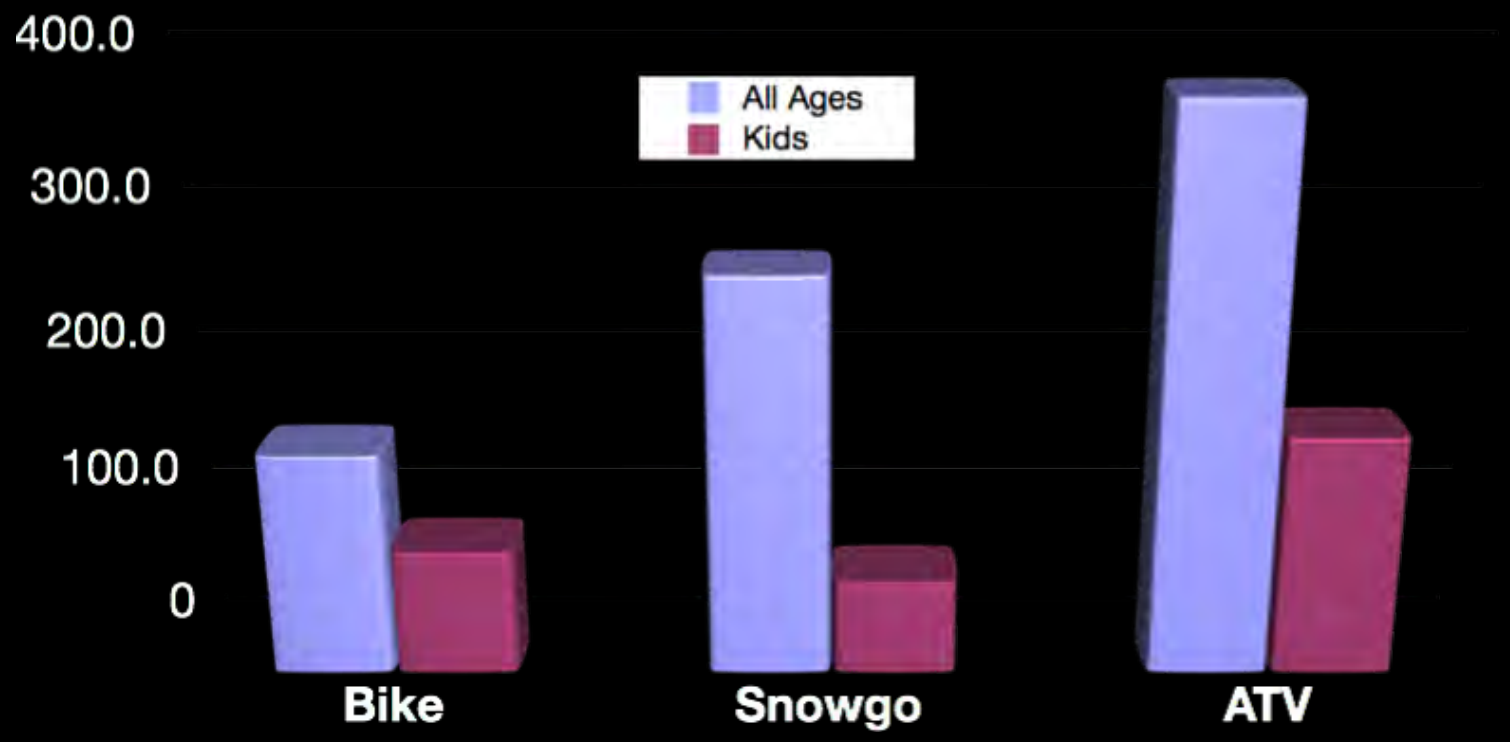
Helmet use reduces disability

Reducing TBI related to SM/ATV/BIKE in Minors

- Operator age limits and training may not be politically achievable in Alaska.
- Mandatory use of helmets in operators and passengers 16 years of age and less should be achievable.

TBI Morbidity by Age and Activity
In annual Hospital Days 1996-7



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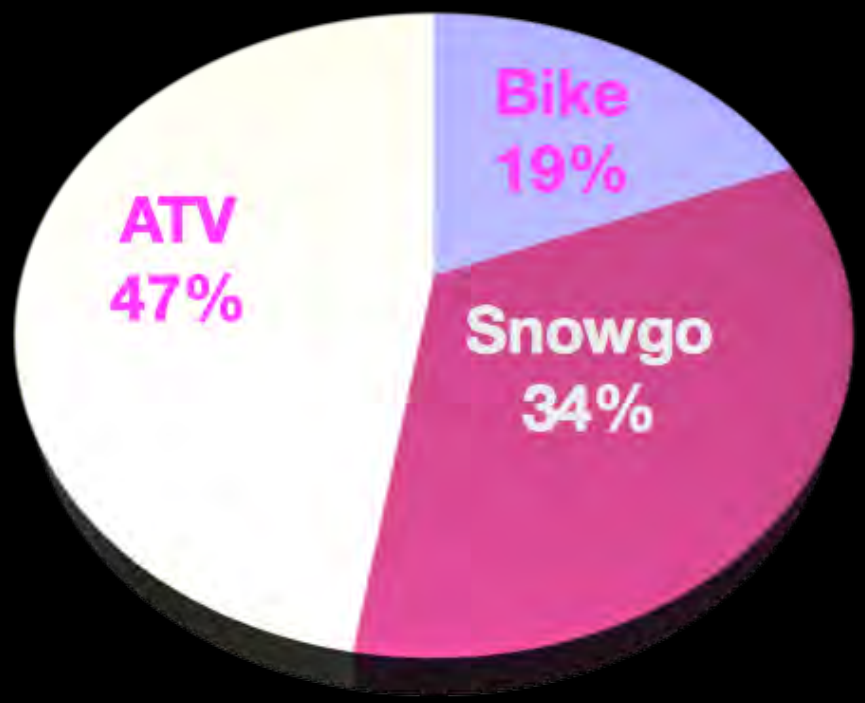
TBI Morbidity by Activity Minors 1996-7



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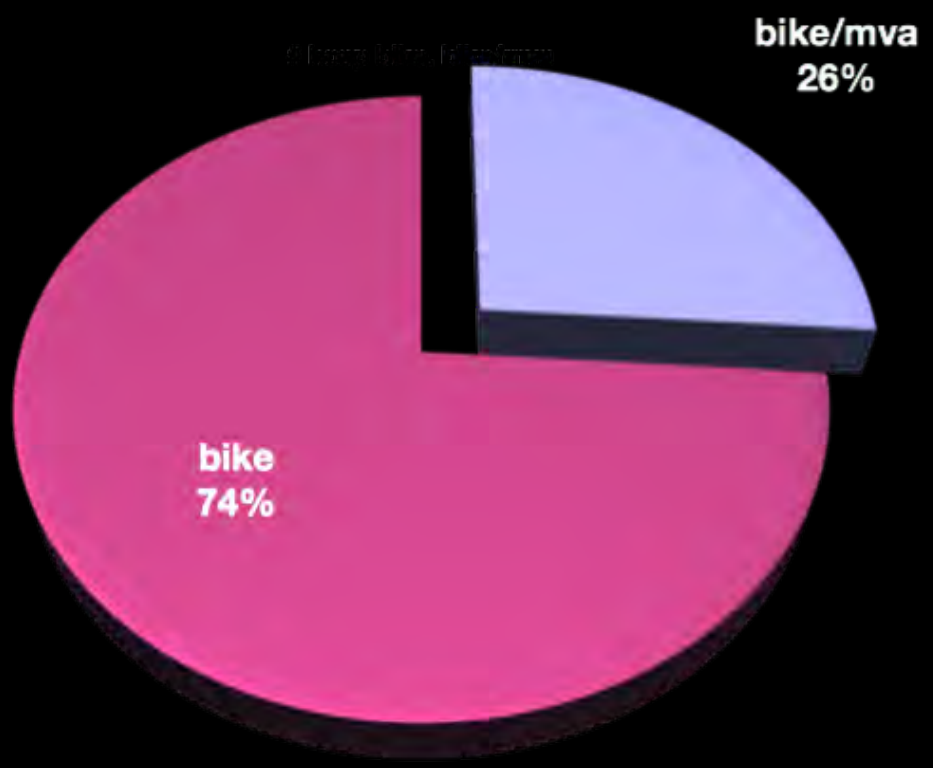
Annual Hospitalizations Bike, Bike/MVA Minors 1996-7



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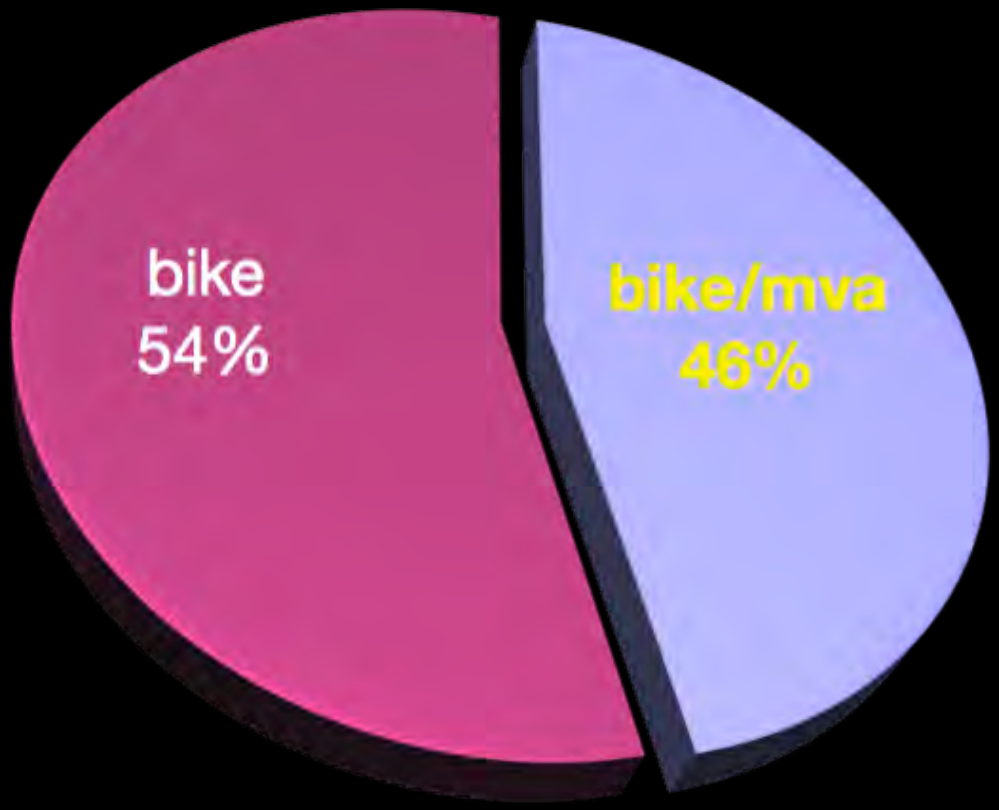
TBI Admissions Bike , Bike/MVA, Minors 1996-7



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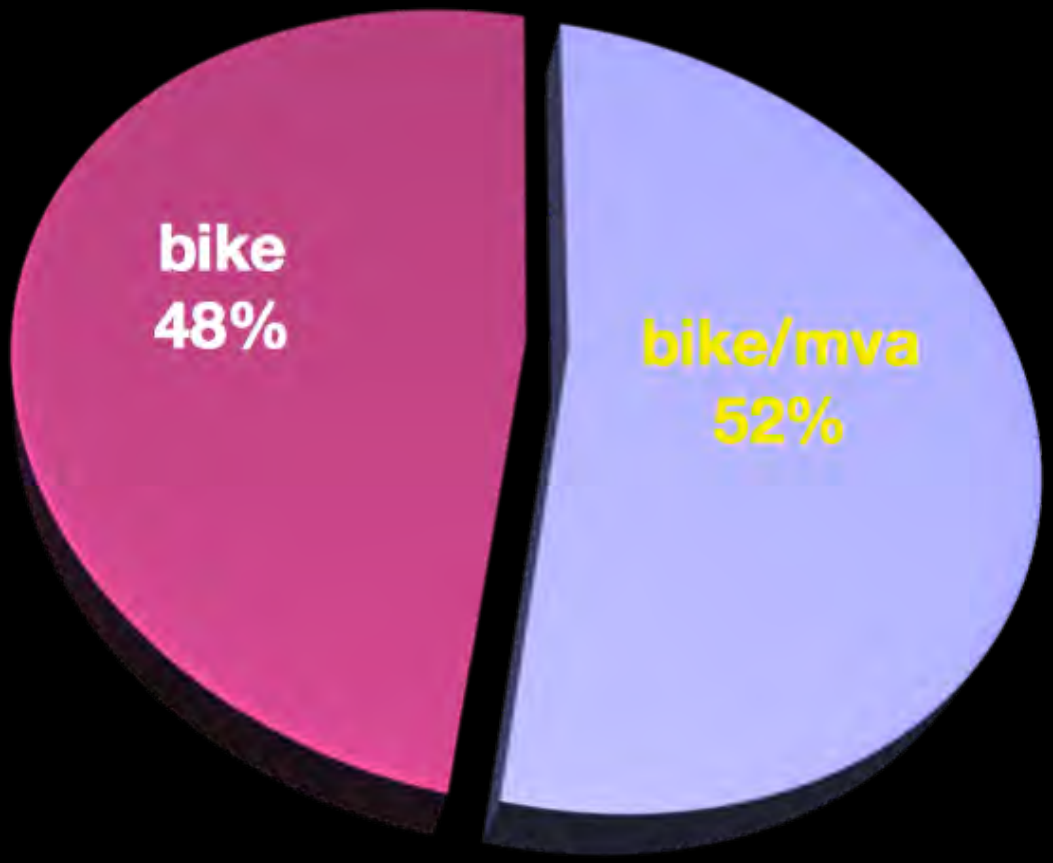
TBI Morbidity Bike, Bike/MVA, Minors 1996-7



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Brain Injury in Alaskans

- An Overview of Cost and Consequences

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National Scope of TBI

- 1 million treated and released from ER every year.
- 80,000 experience long term disabilities.
- 50,000 die as a result of TBI.
- Risk is highest among adolescents, young adults, and people over 75.
- Incidence: 96 per 100,000

National Costs of TBI

- NIH estimates cost of hospitalization at 25 billion annually.
- Brain Injury Association estimates hospitalization costs at 31.7 billion.

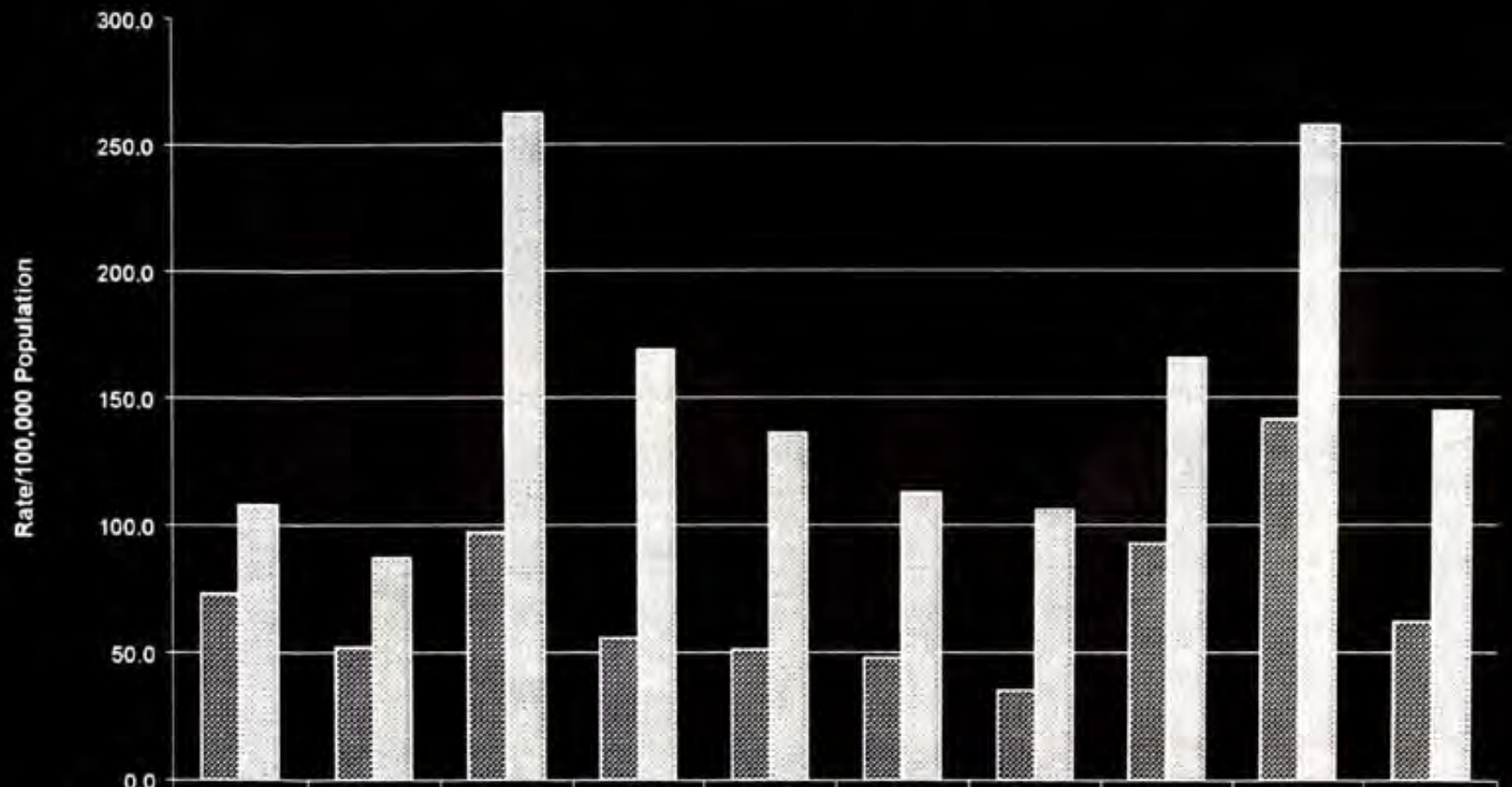
State Scope of TBI

- 1996-1998 1932 hospitalizations or deaths from TBI among Alaska Residents.
- Average Incidence: 105.2 per 100,000
- Approximately 10% higher than national average.

Traumatic Brain Injuries in Alaska, 1996-98.

Ranked by Number			*Ranked by Rate*	
Region	***Number***		***Region***	***Rate/100,000***
Aleutians	14		Aleutians	60.8
Barrow/North Slope	36		Fairbanks North Star	67.4
Dillingham/Bristol Bay	41		Juneau/Southeast	82.1
Valdez-Cordova/Copper River	49		Anchorage	88.8
Kodiak Island	50		Kenai Peninsula	109.0
Kotzebue/Northwest Arctic	51		Kodiak Island	120.9
Nome/Norton Sound	61		Matanuska-Susitna	133.0
Bethel/Yukon-Kuskokwim	114		Valdez-Cordova/Copper River	157.2
Interior	121		Barrow/North Slope	165.4
Kenai Peninsula	156		Bethel/Yukon-Kuskokwim	168.7
Fairbanks North Star	167		Dillingham/Bristol Bay	178.8
Juneau/Southeast	182		Nome/Norton Sound	221.0
Matanuska-Susitna	209		Kotzebue/Northwest Arctic	252.7
Anchorage	681		Interior	277.1
Total	1932		Average	105.2

Figure 1. Rate of Traumatic Brain Injuries* in Alaska by Age and Gender, 1996-1998



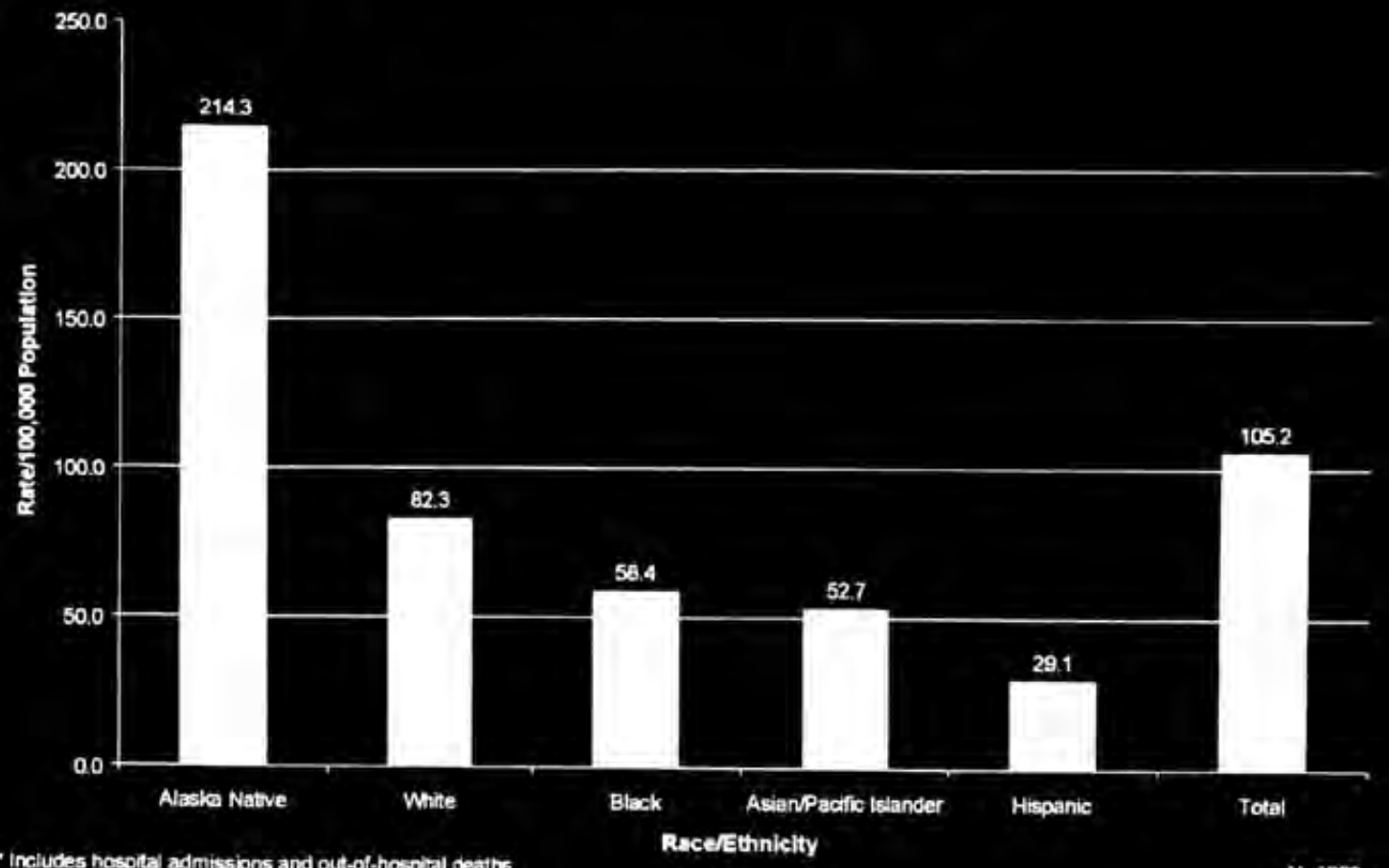
	00-04	05-14	15-24	25-34	35-44	45-54	55-64	65-74	75&UP	All ages
Females	72.9	52.0	97.1	55.7	51.3	48.0	35.4	92.9	141.3	62.0
Males	107.7	87.2	262.2	168.8	135.8	112.7	105.9	165.7	257.2	144.5

Age Group

* Includes hospital admissions and out-of-hospital

N=1932

Figure 2. Rate of Traumatic Brain Injuries* in Alaska by Race/Ethnicity, 1996-1998



* Includes hospital admissions and out-of-hospital deaths.

N=1932

Definition of Costs

- Direct Costs
- Indirect Costs

Direct Costs

- Hospital Charges and Professional Fees for Acute Care.
- Pre-hospital (EMS, Emergency Room, Medivac)
- Rehospitalization
- Rehabilitation
- Outpatient Medical Care
- Attendant Care
- Special Education

Correlation Between Direct Costs and Injury Severity (GCS)

Mild	Moderate	Severe
$598	$12,022	$53,332

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Direct Costs Represent Only 12% of Overall Lifetime Costs.

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Indirect Costs

- Reduced Economic Output
- Caregiver Burden
- Mortality Costs

Productivity Losses

- Only 8% of TBI survivors are able to return to the job they previously held within 6 months of sustaining a TBI.

Caregiver Burden

- 80% of adults with TBI cannot be left unattended.
- 33% of caregivers stop working because of care giving responsibilities.
- 75% of people with TBI are male.
- 75% of caregivers are women.

Injury Severity, Cost, and Incidence (1997-8)

AIS	1	2	3	4	5
Cost per Patient	859	5,438	8,655	14,248	53,000*
#Cases	1	33	34	10	4
Total Cost	859	179,454	294,270	142,480	212,000

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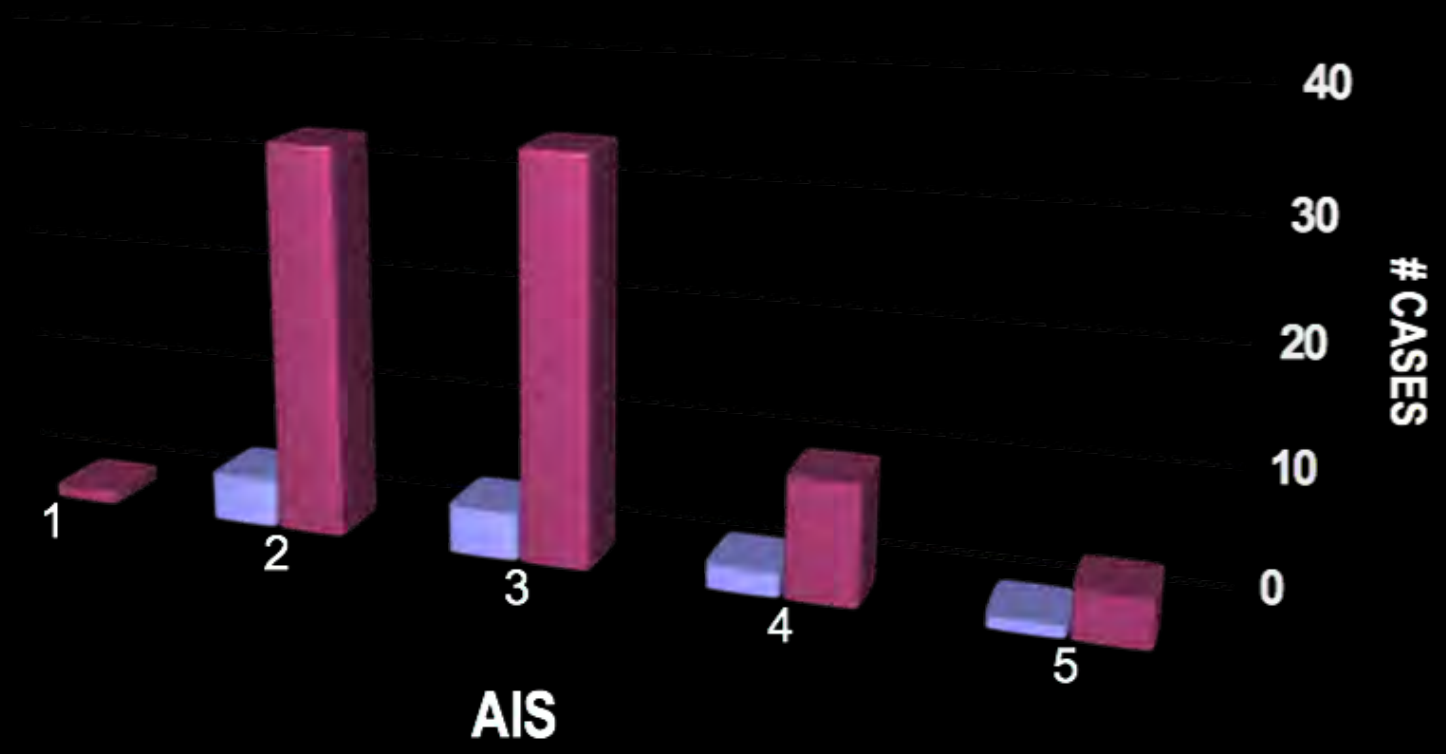
Helmet Effectiveness

- Helmets reduce the risk of TBI by 88%.



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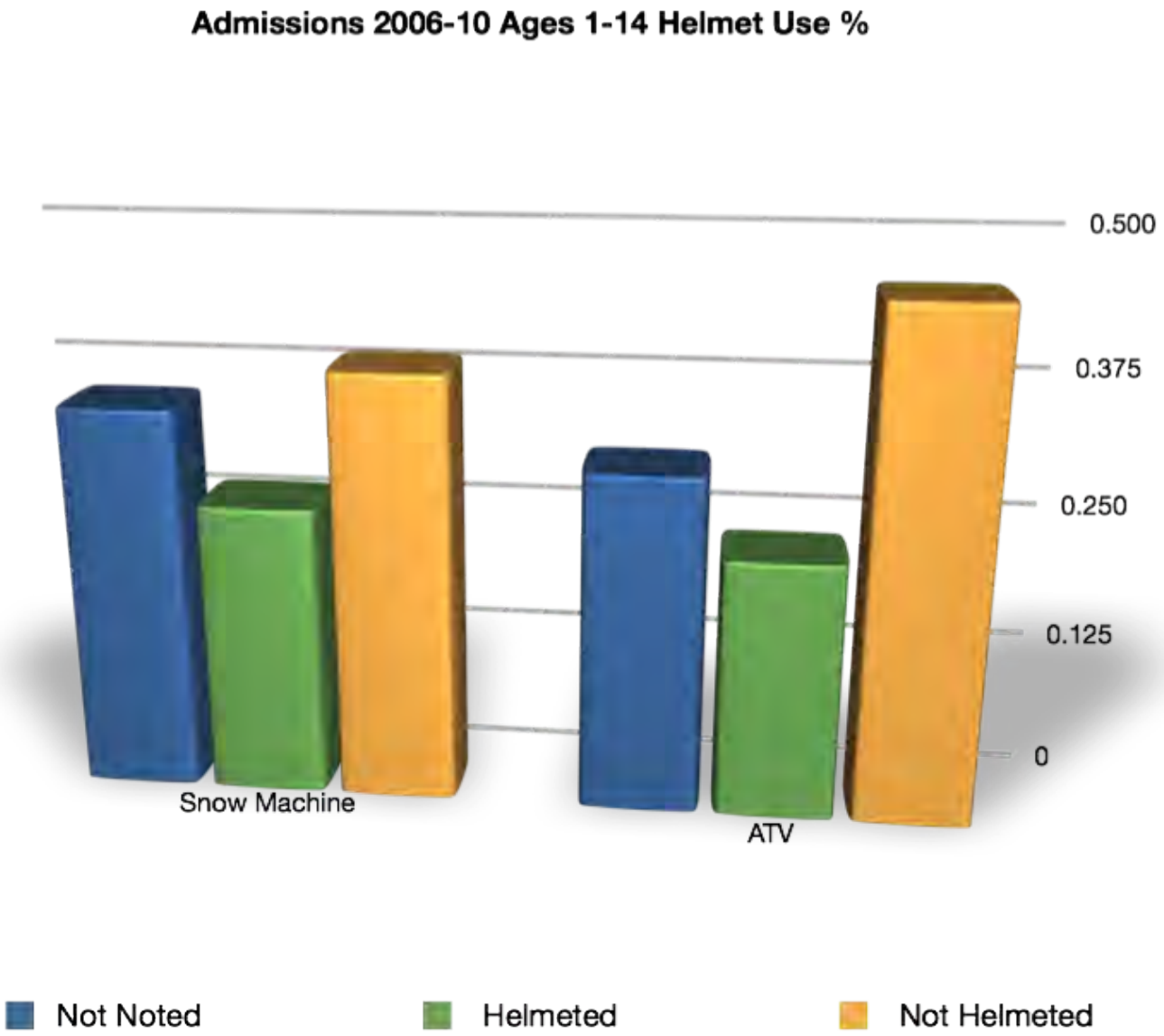

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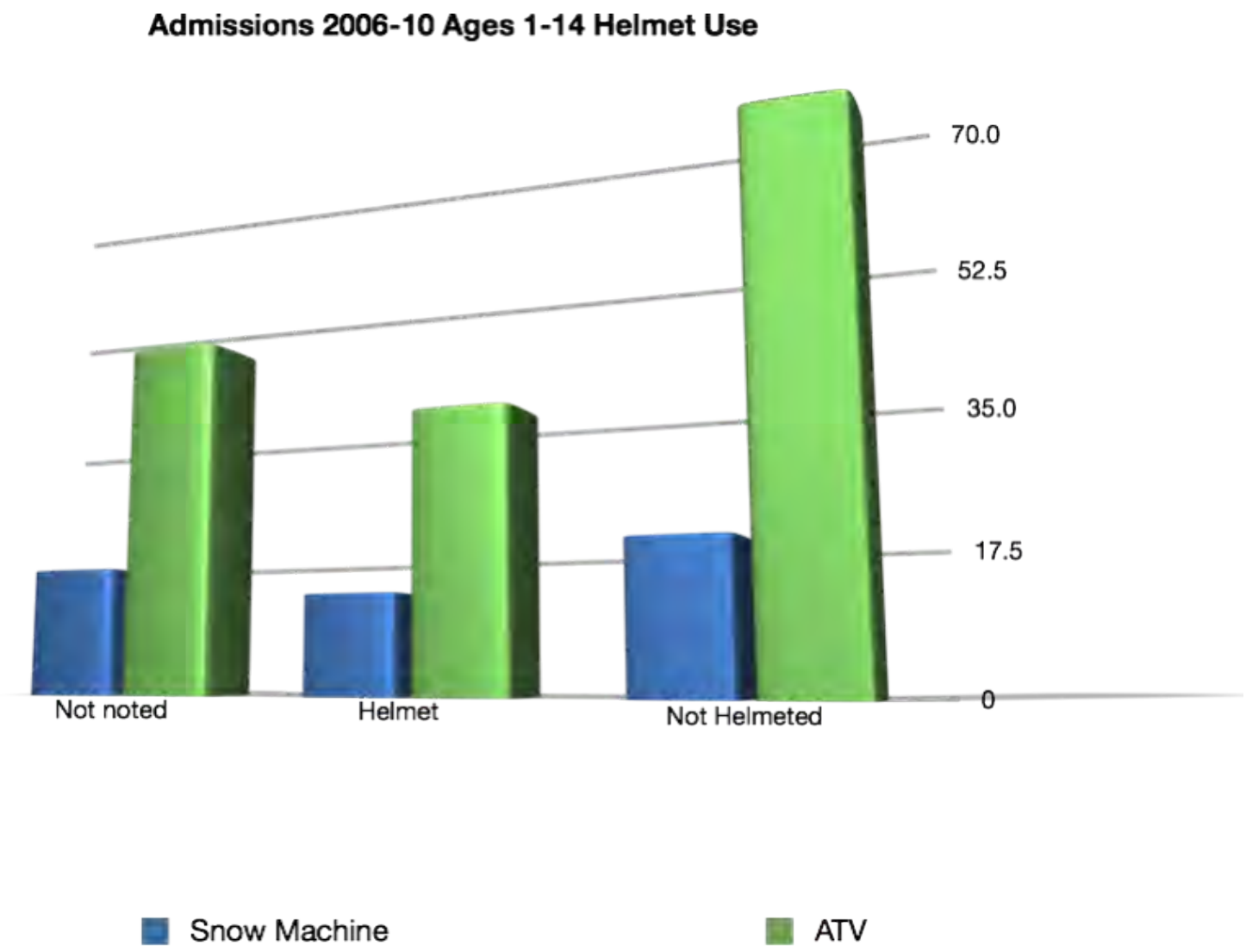

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Reduction in Costs

- Total anticipated savings in hospital costs alone if all children age 0-16 were to have worn helmets in 1997-8: $ 729,575

Who Pays?

PAYER	% Patients
Private	38
Medicaid	23
Indian Health Service	18
Patient Self Pay	17
Champus	2
Automotive	1
Other	1

Helmets

- Cost Effective?

Norwegian Case Study

- For children age 4-16, incidence of TBI from bicycle related injuries requiring hospitalization is approximately 100 per 100,000
- 1 year cumulative risk = .001
- 5 year cumulative risk = .005

Absolute Reduction in Risk

- .005 X .88 = .0044
- .0044 is the reduction in risk of TBI for one child over a five year span due to helmet use. (ARR)

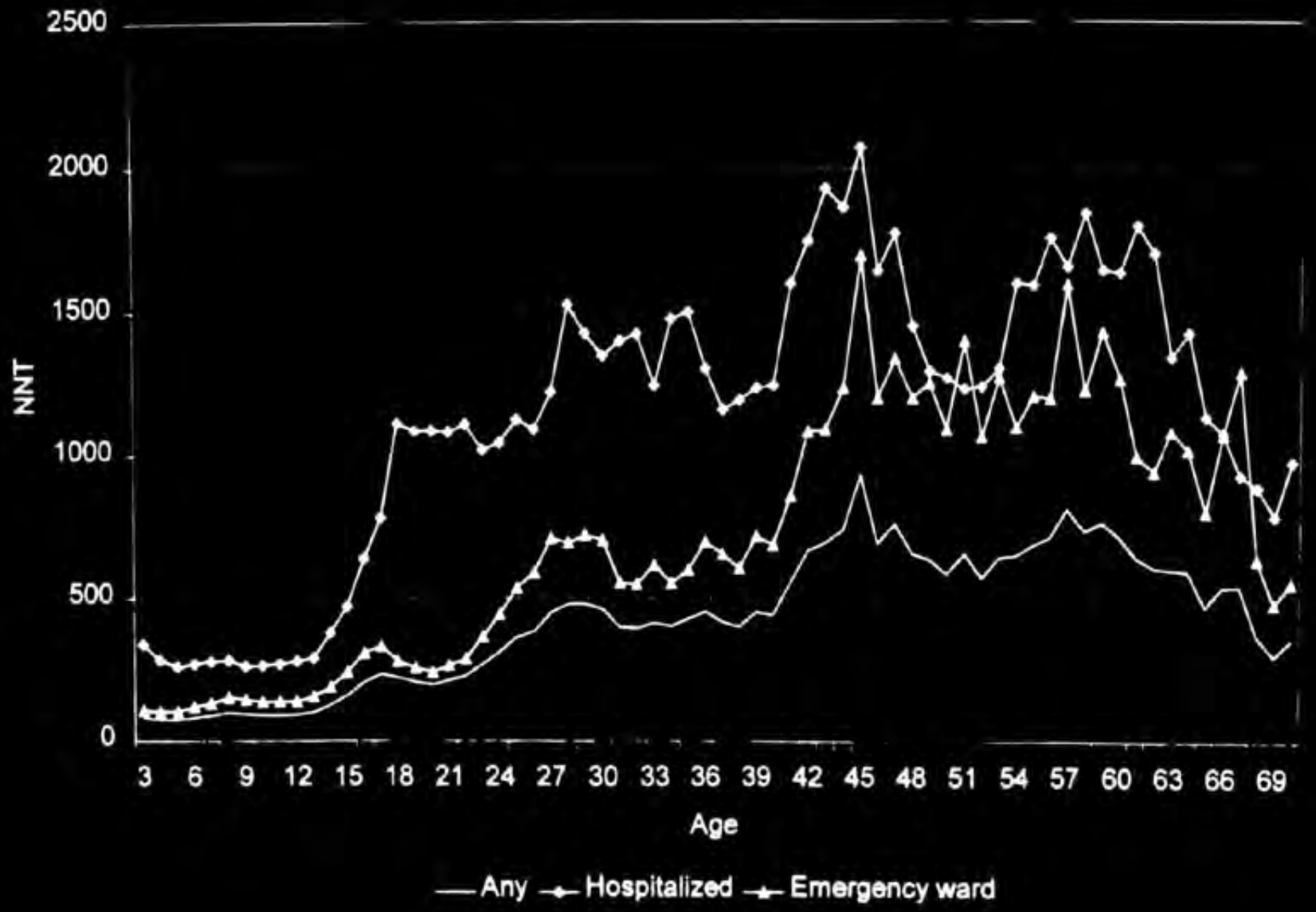

0.0160
0.0140
0.0120
0.0100
0.0080
0.0060
0.0040
0.0020
0.0000
Absolute reduction in risk
3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69
Age
Any
Hospitalized
Emergency ward

Number Needed to Treat

- The reciprocal of the AAR yields the Number Needed to Treat (NNT)
- 1/ARR = NNT
- NNT: Number of children who need to wear helmets for 5 years to prevent one injury.

NNT

- 1/.0044 = 272


2500
2000
1500
1000
500
0
NNT
3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69
Age
Any
Hospitalized
Emergency ward

Cost of Prevention

- (NNT)(individual cost of prevention) = Total cost of preventing one injury

- (272 children) ($20) = $5440 to prevent one injury.

Prevent or Pay

- Cost of Prevention = $5440
- Average Hospital Charge = $6,311

What's the Point?

- **TBI is very expensive to Alaskans.**
- **TBI erodes the health, wealth, and happiness of families and communities.**
- **TBI is 88% preventable by using a helmet.**

Let's Have Helmet Legislation for Children

- It's a no brainer.

Helmets

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Questions, References

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