Traumatic Brain Injury (TBI) Surveillance among American Indians in Arizona, Nevada, and Utah
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**Recommended Citation**
TO: Tribal Leaders and Tribal Health Directors

FROM: Inter Tribal Council of Arizona, Inc.
       Tribal Epidemiology Center
       Maria Dadgar, MBA, Executive Director

RE: Traumatic Brain Injury (TBI) Surveillance among American Indians in Arizona, Nevada, and Utah

The Inter Tribal Council of Arizona, Inc. (ITCA) Tribal Epidemiology Center (TEC) is pleased to present the Traumatic Brain Injury (TBI) Surveillance among American Indians in Arizona, Nevada, and Utah report.

This surveillance report was prepared in response to traumatic brain injury-related concerns among Tribal communities within the Phoenix and Tucson Indian Health Service (IHS) Areas. The TEC utilized data from the IHS, Arizona Department of Health Services; Nevada Division of Public and Behavioral Health; and Utah Department of Health to construct the report.

This surveillance report highlights trends in traumatic brain injury among American Indian populations in Arizona, Nevada, and Utah. For some indicators, results should be interpreted with caution due to missing data and small sample sizes. These data provide only a snapshot into the health status of a community and may not fully reflect ongoing trends in TBIs.
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PURPOSE
The purpose of the Traumatic Brain Injury (TBI) Surveillance among American Indians in Arizona, Nevada, and Utah report is to provide information about TBI and associated factors among American Indians in Arizona, Nevada, and Utah. The target audience for this report includes the following: Tribal Health Directors and public health professionals, tribal leadership, and health researchers. This report focuses on indicators of TBI in American Indian and Alaska Native (AI/AN) communities. The information presented herein demonstrates current trends in TBI using data requested from existing surveillance systems.

INTRODUCTION
This is the first publication of the report, Traumatic Brain Injury (TBI) Surveillance among American Indians in Arizona, Nevada, and Utah by the Inter Tribal Council of Arizona, Inc. (ITCA) Tribal Epidemiology Center (TEC). Using data obtained from existing surveillance systems, this surveillance report demonstrates current trends in TBI indicators among AI/AN in Arizona, Nevada, and Utah.

The surveillance data analyzed in this report were obtained from the Indian Health Service (IHS) and Arizona, Nevada, and Utah hospital discharge databases. This collation of information allowed for the monitoring of trends in TBI, thereby providing information that may be used to inform the development and implementation of interventions and programs to promote health in AI/AN communities. The TBI indicators utilized in this report were based on the Centers for Disease Control and Prevention blue book entitled Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations, and Deaths 2002-2006. The TBI surveillance data described in this report can be used by Tribal Leaders, Tribal Health Directors, community health representatives, health care providers (e.g., IHS), other clinicians and nurses, and researchers to identify emerging and ongoing trends, focus prevention efforts, plan programs, allocate resources, and develop public health policies.

Described as a “silent epidemic” due to its insidious presence, data suggest that a brain injury occurs every 21 second, resulting in a total of 1.5 million cases of TBI each year. At least 5.3 million Americans live with brain injury-associated disabilities, and TBI is the primary cause of death and disability among United States youth. AI/AN have been found to be disproportionately affected by TBI relative to other racial/ethnic groups in the US, and a relatively high prevalence of TBI has been documented in AI/AN populations. CDC data suggest that AI/AN may be over-represented among sufferers of TBI, with AI/AN having the greatest TBI hospitalization rates of any minority group. Among AI/AN, the highest rate of hospitalization has been observed in the group aged 15-24 years, followed by 25-34 years, 35-44 years, over 44 years, and 0-14 years. When compared to other populations, TBI mortality rates have also been found to be greatest among AI/AN across the age span, and unintentional injuries were the third leading cause of death among AI/AN in 2015, resulting in both personal disability and considerable economic costs.

Despite the magnitude of these statistics, they suggest that the rate of TBI may be severely underestimated in the AI/AN community. For example, while the rate of brain injury has been
estimated using IHS data, IHS facilities provide care to only approximately 50% of the AI/AN population. This report attempts to remedy this issue by focusing on three states and incorporating emergency department and hospitalization data from both the IHS and state-level hospital discharge databases.

IHS hospitalization data for visits occurring during 2012-2016 were analyzed. These data contained all hospital discharge records for AI/AN who received services at an IHS, tribal, contract, or non-federal hospitals, including data for both hospitalization and ambulatory visits. In all these data sources, primary diagnostic codes were coded using either the *International Classification of Diseases, Ninth Revision* (ICD-9-CM) or the *International Classification of Diseases, Tenth Revision* (ICD-10-CM). Records met our case definition when primary ICD-9 and ICD-10 codes indicating TBI were identified (pg. 22). The underlying causes of TBI-related injuries were categorized as motor-vehicle collisions, falls, assaults, struck by or against, and other or unspecified (pg. 23). Other variables of interest included age and sex. Hospital discharges were limited to single-incident visits. Due to the de-identified nature of our data, readmissions were treated as a separate injury events.

The latest year for which IHS hospital discharge data were available was 2017; however, only data up to 2016 were included in this analysis to maintain consistency. Data availability varied by state. Where possible, data are provided for each included state. Not all data sources provided high enough counts to report accurate results for each indicator, and data for said indicators were, therefore, left unreported. The data provided in this report are ecological in nature, and they should not be used by healthcare providers to determine how to meet an individual patient’s health needs.

This report is organized into eight main sections:

- Purpose
- Introduction
- Executive Summary
- Analysis Highlights
- Action Items
- Technical Notes
- Glossary
- Statistical Notes Table

The Analysis Highlights section includes summary data for TBI and associated factors among American Indians in Arizona, Nevada, and Utah. Additional analyses of other TBI data may be provided to ITCA TEC Tribal partners upon request by contacting us directly at: TECinfo@itcaonline.com.
EXECUTIVE SUMMARY

The purpose of the *Traumatic Brain Injury (TBI) Surveillance among American Indians in Arizona, Nevada, and Utah* report is to provide data on emergency department visits, hospitalizations, and deaths and associated risk and protective factors (where possible) for TBIs among American Indians in Arizona, Nevada, and Utah. Due to confidentiality reasons, it was decided that if a sample size of less than six individuals was available per indicator per state, data would not be presented in this report. Results should be interpreted with caution, since the availability of race/ethnicity data varied by indicator. There may be considerable variability in the quality of the hospitalization and emergency department data, including the presence of missing or unknown variables. This may be particularly important for race/ethnicity variables, which may be collected based upon visual inspection rather than patient report, resulting in misclassification. Race/ethnicity data may exhibit similar inconsistency in mortality data; however, these data were not available at the time of release.

The results of this analysis suggest that TBI places a substantial burden on AI/AN. The majority of TBIs were identified in IHS facilities, followed by facilities in Arizona, Nevada, and Utah. With the exception of Utah, the combined number of emergency department visits and inpatient hospitalizations was highest in the 25 to 24 year old age group, with the highest count of TBIs in Utah being identified in the age group containing those aged 0 to 4 years. In IHS facilities and Arizona, males outnumbered females with regards to TBI in the majority to age groups; however, this trend was not exhibited in the age group containing those aged 65 years and older. The number of females affected by TBI exceeded the number of males in a greater number of age groups in Nevada, however, and insufficient data were available in Utah to examine either age or external cause of injury. No consistent trends in external cause of injury were identified.

Several action items can be initiated by individuals; tribal communities, health care providers, and leaders; and researchers to prevent and detect TBI. Individuals can see a healthcare practitioner if they exhibit symptoms of TBI and use protective equipment. Tribal communities can engage in community-initiated TBI prevention. Tribal health providers can utilize standardized instruments and brain scans to evaluate brain injuries and determine the need for surgery. Tribal leaders can support tribal codes that address TBI, including appropriating funding for TBI prevention and treatment programs. Lastly, non-tribal public health organizations can work to improve the quality of AI/AN surveillance data and participate in data sharing between organizations to better serve the AI/AN population and allow for more extensive assessment of TBI.
ANALYSIS HIGHLIGHTS

TBI Overall

- Our data suggest that a total of 10,670 AI/AN patients with TBI sought care at IHS facilities in the time period between 2012 and 2016. Of these:
  - 119 (1.1%) were inpatient hospitalizations and
  - 10,551 (98.9%) were emergency department visits
- Our data suggest that a total of 7,298 AI/AN patients with TBI sought care at facilities in Arizona between 2012 and 2016. Of these:
  - 262 (3.64%) were inpatient hospitalizations and
  - 7,036 (96.4%) were emergency department visits
- Our data suggest that a total of 935 AI/AN patients with TBI sought care at facilities in Nevada between 2012 and 2016. Of these:
  - 10 (1.1%) were inpatient hospitalizations and
  - 925 (98.9%) were emergency department visits
- Our data suggest that a total of 55 AI/AN patients with TBI sought care at facilities in Utah between 2012 and 2016. Of these:
  - 0 (0.0%) were inpatient hospitalizations and
  - 55 (100.0%) were emergency department visits

TBI by Age

- In IHS facilities, AI/AN adults aged 25 to 34 years and children aged 0 to 4 years more frequently sustained a TBI when compared with AI/AN in other age and sex groups.
- In Arizona facilities, AI/AN adults aged 25 to 34 years and children aged 0 to 4 years more frequently sustained a TBI when compared with AI/AN in other age groups.
- In Nevada facilities, AI/AN adults aged 25 to 34 years and adults aged 35 to 44 years more frequently sustained a TBI when compared with AI/AN in other age groups.
- In Utah facilities, very young AI/AN children (0 to 4 years) and adults aged 25 to 34 years more frequently sustained a TBI when compared with AI/AN in other age groups.

TBI by Sex

- In IHS facilities, AI/AN males and females aged 0 to 4 years and 25 to 34 years more frequently sustained a TBI when compared with AI/AN in other age and sex groups.
- In Arizona facilities, AI/AN males and females aged 0 to 4 years and 25 to 34 years more frequently sustained a TBI when compared with AI/AN in other age and sex groups.
- In Nevada facilities, AI/AN males aged 20 to 24 years and 15 to 19 years and females aged 20 to 24 years and 10 to 14 years more frequently sustained a TBI when compared with AI/AN in other age and sex groups.
Insufficient data were available to examine age and sex patterns in the occurrence of TBI among AI/AN in Utah.

**TBI by External Cause**

- It was not possible to obtain external cause of injury data from the IHS Epi Data Mart.
- In Arizona facilities, the most frequently identified external causes of injury among AI/AN TBI patients were falls and assault.
- In Nevada facilities, the most frequently identified external causes of injury among AI/AN TBI patients were falls and other or unintentional causes of injury.
- Insufficient data were available to examine patterns in the external cause of TBI among AI/AN in Utah.
Of the 10,670 TBIs identified among AI/AN at IHS facilities in the Phoenix Service Area between 2012 and 2016, 98.9% were emergency department visits and 1.1% were hospitalizations.

*Data for these categories are not included in this report. Please see the Technical Notes section for further information.

Abbreviations: AI/AN: American Indians/Alaska Natives; CAIR: Countable Active Indian Registrants; IHS: Indian Health Service; FY: Fiscal Year; TBI: Traumatic Brain Injury

TBI by Age Group
A total of 2,738 TBIs were identified among children aged 0 to 14 years at IHS facilities between 2012 and 2016. In contrast, 756 TBIs were identified among adults aged 65 years and older. TBI-related emergency department visits accounted for a slightly greater proportion of TBI events in children (100.0%) than older adults (96.5%).
Table 1. Numbers of TBI-Related Emergency Department Visits and Hospitalizations among AI/AN Seeking Care at IHS Facilities in the Phoenix Service Area by Age Group, FY 2012-2016

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>EMERGENCY DEPARTMENT VISITS</th>
<th>HOSPITALIZATIONS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children (0-14 years)</td>
<td>2738</td>
<td>*</td>
<td>2738</td>
</tr>
<tr>
<td>Older Adults (≥65 years)</td>
<td>730</td>
<td>26</td>
<td>756</td>
</tr>
</tbody>
</table>

Data from the Indian Health Service Epi Data Mart
Abbreviations: AI/AN: American Indians/Alaska Natives; CAIR: Countable Active Indian Registrants; IHS: Indian Health Service; FY: Fiscal Year; TBI: Traumatic Brain Injury

TBI events most frequently involved adults aged 25 to 34 years (n=1,968), followed by very young children (0 to 4 years; n=1,268) and adults aged 35 to 44 years (n=1,251). TBI events least frequently involved older adults aged 65 to 74 years (n=374) and 75 years and older (n=382).

Figure 2. Age of AI/AN Seeking Emergency or Inpatient Care for TBI at IHS Facilities in the Phoenix Service Area, FY 2012-2016

Data from the Indian Health Service Epi Data Mart
Abbreviations: AI/AN: American Indians/Alaska Natives; CAIR: Countable Active Indian Registrants; IHS: Indian Health Service; FY: Fiscal Year; TBI: Traumatic Brain Injury
Overall, 6,189 TBIs (58.0%) were identified among males, while 4,481 TBIs (42.0%) were identified among females. Approximately 1.4 times as many TBIs occurred among males. Of those identified as having TBI events, males were more frequently hospitalized (n=1.2%) than were females (n=0.8%).

Table 2. Numbers of TBI-Related Emergency Department Visits and Hospitalizations among AI/AN Seeking Care at IHS Facilities in the Phoenix Service Area by Sex, FY 2012-2016

<table>
<thead>
<tr>
<th>SEX</th>
<th>EMERGENCY DEPARTMENT VISITS</th>
<th>HOSPITALIZATIONS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>6109</td>
<td>80</td>
<td>6189</td>
</tr>
<tr>
<td>Female</td>
<td>4442</td>
<td>39</td>
<td>4481</td>
</tr>
</tbody>
</table>

The greatest number of combined TBI-related emergency department visits and hospitalizations was observed in males aged 25 to 34 years (n=1,177); followed by females aged 25 to 34 years (n=791); and males aged 35 to 44 years (n=746), 0 to 4 years (n=740), and 45 to 54 years (n=672).

Figure 3. Age of AI/AN Seeking Emergency or Inpatient Care for TBI at IHS Facilities in the Phoenix Service Area by Sex, FY 2012-2016

Data from the Indian Health Service Epi Data Mart
Abbreviations: AI/AN: American Indians/Alaska Natives; CAIR: Countable Active Indian Registrants; IHS: Indian Health Service; FY: Fiscal Year; TBI: Traumatic Brain Injury
Overall TBI

Figure 4. Numbers of TBI-Related Emergency Department Visits and Hospitalizations among AI/AN in Arizona, 2012-2016

Of the 7,298 TBIs identified among AI/AN in Arizona between 2012 and 2016, 3.6% were hospitalizations and 96.4% were emergency department visits.

*Data for these categories are not included in this report. Please see the Technical Notes section for further information. Data from Arizona Department of Health Services, Bureau of Public Health Statistics

Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury

TBI by Age Group

Between 2012 and 2016, a total of 2,223 TBIs were identified among children aged 0 to 14 years. In contrast, the number of TBIs identified among adults aged 65 years and older was 444. TBI-related emergency department visits accounted for a slightly greater proportion of TBI events in children (99.5%) than in older adults (96.8%).
Table 3. Numbers of TBI-Related Emergency Department Visits and Hospitalizations among AI/AN in Arizona by Age Group, 2012-2016

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>EMERGENCY DEPARTMENT VISITS</th>
<th>HOSPITALIZATIONS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children (0-14 years)</td>
<td>2211</td>
<td>12</td>
<td>2223</td>
</tr>
<tr>
<td>Older Adults (≥65 years)</td>
<td>430</td>
<td>14</td>
<td>444</td>
</tr>
</tbody>
</table>

Data from Arizona Department of Health Services, Bureau of Public Health Statistics
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury

TBI events most frequently involved adults aged 25 to 34 years (n=1,309), followed by very young children (0 to 4 years; n=1,299), and adults aged 35 to 44 years (n=845). TBI events least frequently involved older adults aged 65 to 74 years (n=203) and 75 years and older (n=241).

Figure 5. Age of AI/AN Seeking Emergency or Inpatient Care for TBI in Arizona, 2012-2016

Data from Arizona Department of Health Services, Bureau of Public Health Statistics
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury
Overall, 3,893 TBIs (53.3%) were identified among males, while 3,405 TBIs (46.7%) were identified among females. Approximately 1.1 times as many TBIs occurred among males. Of those identified as having TBI events, males were more frequently hospitalized (n=4.9%) than were females (n=2.2%).

Table 4. Numbers of TBI-Related Emergency Department Visits and Hospitalizations among AI/AN in Arizona by Sex, 2012-2016

<table>
<thead>
<tr>
<th>SEX</th>
<th>EMERGENCY DEPARTMENT VISITS</th>
<th>HOSPITALIZATIONS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>3704</td>
<td>189</td>
<td>3893</td>
</tr>
<tr>
<td>Female</td>
<td>3332</td>
<td>73</td>
<td>3405</td>
</tr>
</tbody>
</table>

Data from Arizona Department of Health Services, Bureau of Public Health Statistics
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury

The greatest number of combined TBI-related emergency department visits and hospitalizations was observed in males aged 0 to 4 years (n=737), followed by males aged 25 to 34 years (n=686), females aged 25 to 34 years (n=623), and females aged 0 to 4 years (n=562).

Figure 6. Age of AI/AN Seeking Emergency or Inpatient Care for TBI in Arizona by Sex, 2012-2016

Data from Arizona Department of Health Services, Bureau of Public Health Statistics
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury
TBI by External Cause

Of TBIs identified in Arizona between 2012 and 2016, 3,159 were fall-related, 702 were motor vehicle traffic-related, 992 were related to struck by/against events, 1,691 were assault-related, and 754 had other or unintentional causes. Falls resulted in the greatest number of emergency department visits (n=3,108); however, assaults resulted in the greatest number of hospitalizations (n=114)

Table 5. Numbers of TBI-Related Emergency Department Visits and Hospitalizations among AI/AN in Arizona by External Cause, 2012-2016

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>EMERGENCY DEPARTMENT VISITS</th>
<th>HOSPITALIZATIONS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor vehicle traffic-related (unintentional)</td>
<td>634</td>
<td>68</td>
<td>702</td>
</tr>
<tr>
<td>Falls (unintentional or undetermined)</td>
<td>3108</td>
<td>51</td>
<td>3159</td>
</tr>
<tr>
<td>Assault (includes firearm and other)</td>
<td>1577</td>
<td>114</td>
<td>1691</td>
</tr>
<tr>
<td>Struck by and against</td>
<td>986</td>
<td>6</td>
<td>992</td>
</tr>
<tr>
<td>Other or unintentional</td>
<td>731</td>
<td>23</td>
<td>754</td>
</tr>
</tbody>
</table>

Data from Arizona Department of Health Services, Bureau of Public Health Statistics
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury

Figure 7. Percentage of Combined Emergency Department Visits and Hospitalizations Attributable to TBI among AI/AN in Arizona by External Cause, 2012-2016

Data from Arizona Department of Health Services, Bureau of Public Health Statistics
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury
NEVADA

Overall TBI

Figure 8. Numbers of TBI-Related Emergency Department Visits and Hospitalizations among AI/AN in Nevada, 2012-2016

Of the 935 TBIs identified among AI/AN in Nevada between 2012 and 2016, 98.9% were emergency department visits and 1.1% were hospitalizations.

*Data for these categories are not included in this report. Please see the Technical Notes section for further information. Data from Nevada Division of Public and Behavioral Health, State Biostatistician

Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury

TBI by Age Group

Data suggest that 213 TBIs identified among children aged 0 to 14 years between 2012 and 2016. In contrast, the number of TBIs identified among adults aged 65 years and older was 85. TBI-related hospitalizations accounted for a greater proportion of TBI events in children than in older adults.
Table 6. Numbers of TBI-Related Emergency Department Visit and Hospitalizations among AI/AN in Nevada by Age Group, 2012-2016

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>EMERGENCY DEPARTMENT VISITS</th>
<th>HOSPITALIZATIONS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children (0-14 years)</td>
<td>213</td>
<td>*</td>
<td>213</td>
</tr>
<tr>
<td>Older Adults (≥65 years)</td>
<td>85</td>
<td>0</td>
<td>85</td>
</tr>
</tbody>
</table>

Data from Nevada Division of Public and Behavioral Health, State Biostatistician; *Data suppressed due to low counts (n<6)
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury

TBI events most frequently involved adults aged 25 to 34 years (n=138), 35 to 44 years (n=127), and 45-54 years (n=110); followed by very young children (0 to 4 years; n=89); and older adults aged 65 years or older (n=85). The lowest numbers of TBI events were identified in children aged 10 to 14 years (n=55) and children aged 5 to 9 years (n=69).

Figure 9. Age of AI/AN Seeking Emergency or Inpatient Care for TBI in Nevada, 2012-2016

Data from Nevada Division of Public and Behavioral Health, State Biostatistician
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury
TBI by Sex

Overall, 484 TBIs (51.8%) were identified among males, while 448 TBIs (48.2%) were identified among females. Approximately 1.1 times as many TBIs occurred among males. Of those identified as having TBI events, males were more frequently hospitalized (n=1.4%) than were females (n=2.2%).

Table 7. Numbers of TBI-Related Emergency Department Visit and Hospitalizations and among AI/AN in Nevada by Sex, 2012-2016

<table>
<thead>
<tr>
<th>SEX</th>
<th>EMERGENCY DEPARTMENT VISITS</th>
<th>HOSPITALIZATIONS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>477</td>
<td>7</td>
<td>484</td>
</tr>
<tr>
<td>Female</td>
<td>448</td>
<td>*</td>
<td>448</td>
</tr>
</tbody>
</table>

Data from Nevada Division of Public and Behavioral Health, State Biostatistician; *Data suppressed due to low counts (n<6)
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury

The greatest number of combined TBI-related emergency department visits and hospitalizations was observed in males aged 25 to 29 years (n=72), followed by males aged 35 to 40 years (n=70), and females aged 25 to 34 years (n=69).

Figure 10. Age of AI/AN Seeking Emergency or Inpatient Care for TBI in Nevada by Sex, 2012-2016

Legend

<table>
<thead>
<tr>
<th>Count</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>42</td>
<td>48</td>
</tr>
<tr>
<td>60</td>
<td>35</td>
<td>42</td>
</tr>
<tr>
<td>40</td>
<td>31</td>
<td>44</td>
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<td>20</td>
<td>24</td>
<td>31</td>
</tr>
<tr>
<td>0</td>
<td>20</td>
<td>24</td>
</tr>
</tbody>
</table>

Data from Nevada Division of Public and Behavioral Health, State Biostatistician
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury
Of TBIs identified in Nevada between 2012 and 2016, 308 were fall-related, 93 were motor vehicle traffic-related, 112 were related to struck by/against events, 151 were assault-related, and 261 had other or unintentional causes.

**Table 8. Numbers of TBI-Related Emergency Department Visit and Hospitalizations among AI/AN in Nevada by External Cause, 2012-2016**

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>EMERGENCY DEPARTMENT VISITS</th>
<th>HOSPITALIZATIONS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor vehicle traffic-related (unintentional)</td>
<td>93</td>
<td>*</td>
<td>93</td>
</tr>
<tr>
<td>Falls (unintentional or undetermined)</td>
<td>308</td>
<td>*</td>
<td>308</td>
</tr>
<tr>
<td>Assault (includes firearm and other)</td>
<td>151</td>
<td>*</td>
<td>151</td>
</tr>
<tr>
<td>Struck by and against</td>
<td>112</td>
<td>*</td>
<td>112</td>
</tr>
<tr>
<td>Other or unintentional</td>
<td>261</td>
<td>*</td>
<td>261</td>
</tr>
</tbody>
</table>

Data from Nevada Division of Public and Behavioral Health, State Biostatistician; *Data suppressed due to low counts (n<6)

Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury

**Figure 11. Percentage of Combined Emergency Department Visits and Hospitalizations Attributable to TBI among AI/AN in Nevada by External Cause, 2012-2016**

Data from Nevada Division of Public and Behavioral Health, State Biostatistician

Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury
UTAH

Overall TBI

*Data for these categories are not included in this report. Please see the Technical Notes section for further information. Data from Utah Department of Health, Bureau of Epidemiology

Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury

TBI by Age Group
Twenty-two TBIs were identified among children aged 0 to 14 years between 2012 and 2016. TBI events most frequently involved very young children (0 to 4 years; n=12), followed by adults aged 25 to 34 years (n=8).
Table 9. Numbers of TBI-Related Emergency Department Visit and Hospitalizations among AI/AN in Utah by Age Group, 2012-2016

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>EMERGENCY DEPARTMENT VISITS</th>
<th>HOSPITALIZATIONS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children (0-14 years)</td>
<td>22</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>Older Adults (≥65 years)</td>
<td>*</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Data from Utah Department of Health, Bureau of Epidemiology; *Data suppressed due to low counts (n<6)
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury

Figure 13. Age of AI/AN Seeking Emergency or Inpatient Care for TBI in Utah, 2012-2016

Data from Utah Department of Health, Bureau of Epidemiology; *Data suppressed due to low counts (n<6)
Abbreviations: AI/AN: American Indians/Alaska Natives; TBI: Traumatic Brain Injury

**TBI by Sex and External Cause**

Gender and external cause data were missing for all Utah TBI cases. As such, patient gender could not be categorized, and all (n=55) cases technically fell under the “other or unintentional” external cause of injury category.
ACTION ITEMS

Below are points of action specifically geared toward individuals, tribal communities, tribal health care providers, tribal leaders, and researchers working in tribal communities in an effort to prevent and detect TBIs.

**Individuals**
- Wear a helmet, use recommended fall protection, buckle seat belts, secure loose objects in the environment (vehicle, home, etc.), be visible in traffic, and take precautions to prevent slips and falls
- If there are any signs or symptoms of TBI following a recent blow or other traumatic injury to the head
  - Seek medical care
  - Request a referral to see a head injury specialist to learn rehabilitation exercises
  - Request a referral to see a board certified neuropsychologist to cope with behavioral changes

**Tribal Communities**
- Build Tribally-driven TBI prevention capacity
- Implement community strategies that ensure that TBI survivors minimize the risk of further damage or re-injury and regain and maintain health and function

**Tribal Health Care Providers**
- Improve patient health outcomes through early diagnosis, management, and appropriate referrals
- Utilize standardized instruments and brain scans to evaluate brain injuries and determine the need for surgery among suspected TBI patients
- Identify important modifiable risk factors for and provide guidance about how to prevent TBIs

**Tribal Leaders**
- Support tribal codes that address TBI prevention, research, and service delivery, including appropriating funding for TBI prevention and treatment programs

**Non-Tribal Public Health**
- Work to improve AI/AN surveillance data with tribes, IHS, state registries and TECs
- Participate in data sharing
- Promote best practices in the prevention, assessment, and management of TBI
Emergency Department and Hospitalization Data

Hospitalization and emergency department data were derived using discharge data obtained from Arizona, Nevada, and Utah and the IHS Epidemiology Data Mart. IHS data for facilities in the Phoenix Service Area were obtained from the Epidemiology Data Mart, which contains patient registration and encounter data that has been processed in the National Data Warehouse. The three states under study collect hospital discharge records for inpatient and emergency department visits occurring at all licensed hospitals. These data have several limitations. The numbers and prevalence of emergency department visits and hospitalizations were calculated using administrative hospital discharge data. As such, these data were limited to basic demographic and diagnostic information. Because these data were collected from numerous facilities throughout the IHS Phoenix Service Area, including Arizona, Nevada, and Utah, there may be considerable variability in data quality, including the presence of missing or unknown variables. This may be particularly important for race/ethnicity variables, which may be recorded based upon visual inspection rather than patient report, resulting in misclassification; furthermore, even if these data are collected accurately, they may go unrecorded on the chart or be inconsistently coded. Another variable highly impacted by this variability is external cause of injury, with coding practices varying widely across providers. With the exception of the IHS dataset, the datasets utilized in this report were based on visits or hospitalizations instead of individual patients; as such, we were not able to identify unique patients or which visit for a given condition occurred first.5,6

Mortality Data

The IHS does not independently collect mortality data. State-level mortality data were not available for the time period under study; however, these data have been requested and will be included in an upcoming supplement at a later date.

Data Analysis

For the discharge data, ICD-9 and ICD-10 codes for TBIs and external causes were identified based upon those utilized by the CDC, with codes translated from one to another using the Nextgen Healthcare online tool when necessary.1,7 We determined the number of inpatient hospitalizations and emergency department visits occurring in IHS facilities in the Phoenix Service Area, including Arizona, Nevada, and Utah, over the five year period under study (2012-2016); used these data to populate burden of injury pyramids; and assessed the frequency distributions of these counts by age group, sex, and external cause of injury.

Data Barriers

There are several barriers that are important to this report; as such, any comparisons of data from Arizona, Nevada, and Utah should be completed with care. For the Arizona TBI data, it was not possible to extract only those cases occurring in the IHS Phoenix and Tucson Service Areas, so the Navajo Service Area is included as well. The data in this report is not directly comparable to the state-reported and nationally-reported counts and rates for AI/ANs because Hispanic AI/ANs are included as AI/ANs in this report. In other reports, Hispanic AI/ANs are classified as Hispanic. This primarily affects the Arizona
AI/AN counts and rates. It is known that race/ethnicity, particularly among AI/AN, is often misclassified, or AI/AN persons may be considered to belong to a different race/ethnicity group. The aforementioned race/ethnicity misclassification likely results in underreporting of the number of cases among AI/AN. The lower number of cases would then lower the rate of TBI observed within this population. At the time of writing, none of the included surveillance systems had formally investigated misclassification of race/ethnicity among AI/AN. TBI cases with a race classified as unknown, missing, other, unspecified, or multiple were considered non-AI/AN in this report. Data for TBI cases discharged between 2012 and 2016 were collapsed into a single number due to the small number of cases to protect confidentiality. Finally, bear in mind that this report only captures reported cases, and the actual community rates are suspected to be higher.

**Other Limitations**

Two different types of data sources were used. Results should be interpreted with caution because differences in study methods may have influenced the findings. IHS data was based on inpatients and emergency department patients who were discharged from hospitals and emergency department in the Phoenix Service Area, and the IHS does not independently record mortality data. State data were based on inpatients and emergency department patients who were discharged from nonfederal hospitals. However, these data were not always available; for example, no inpatient TBI hospitalizations were identified in the state of Utah during the period under study, emphasizing the importance of complete and quality data collection. Mortality data have been requested from Arizona, Nevada, and Utah and will be included in an upcoming supplement. Also limiting this report is the fact that the overall burden of TBI was underestimated because persons who did not seek care for their TBI or who sought outpatient care were not included. Lastly, the difference in the way years are reported in IHS and state-level discharge data may serve as a limitation; while IHS reports data based on the fiscal year, the state-level data is reported based on the calendar year.
Table 10. Principal/Primary Diagnosis Code Categorization for TBI ICD-9-CM and ICD-10-CM Codes

<table>
<thead>
<tr>
<th>PRINCIPAL AND PRIMARY DIAGNOSIS CODES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ICD-9-CM</strong></td>
</tr>
<tr>
<td>800.00, 800.01, 800.02, 800.03, 800.04, 800.05, 800.06, 800.09, 800.10, 800.11, 800.12, 800.15, 800.19, 800.20, 800.21, 800.22, 800.23, 800.25, 800.26, 800.29, 800.30, 800.31, 800.32, 800.35, 800.36, 800.40, 800.41, 800.46, 800.49, 800.50, 800.51, 800.52, 800.53, 800.55, 800.59, 800.6, 800.60, 800.61, 800.63, 800.70, 800.71, 800.75, 800.76, 800.79, 800.83, 800.86, 800.89, 800.90, 800.91, 800.93, 800.99, 801.00, 801.01, 801.02, 801.03, 801.04, 801.06, 801.09, 801.10, 801.11, 801.12, 801.14, 801.15, 801.16, 801.19, 801.20, 801.21, 801.22, 801.23, 801.24, 801.25, 801.26, 801.29, 801.30, 801.31, 801.35, 801.36, 801.40, 801.41, 801.42, 801.45, 801.46, 801.49, 801.50, 801.51, 801.52, 801.55, 801.56, 801.60, 801.65, 801.70, 801.75, 801.79, 801.90, 801.91, 801.96, 803.00, 803.01, 803.02, 803.05, 803.06, 803.09, 803.11, 803.15, 803.16, 803.20, 803.21, 803.22, 803.23, 803.25, 803.26, 803.29, 803.30, 803.31, 803.32, 803.35, 803.36, 803.39, 803.40, 803.41, 803.42, 803.50, 803.51, 803.55, 803.56, 803.60, 803.70, 803.72, 803.75, 803.80, 803.81, 803.86, 803.89, 803.90, 803.91, 803.93, 803.95, 803.96, 804.00, 804.01, 804.02, 804.03, 804.06, 804.1, 804.10, 804.11, 804.12, 804.13, 804.16, 804.19, 804.20, 804.21, 804.22, 804.26, 804.30, 804.31, 804.33, 804.35, 804.40, 804.41, 804.50, 804.51, 804.60, 804.63, 804.65, 804.73, 804.9, 850.0, 850.1, 850.11, 850.12, 850.2, 850.3, 850.4, 850.5, 850.9, 851.00, 851.01, 851.05, 851.06, 851.09, 851.1, 851.11, 851.12, 851.20, 851.22, 851.26, 851.30, 851.35, 851.40, 851.41, 851.42, 851.45, 851.46, 851.51, 851.50, 851.60, 851.61, 851.80, 851.81, 851.82, 851.85, 851.86, 851.89, 851.90, 851.91, 851.95, 851.96, 852.00, 852.01, 852.02, 852.03, 852.04, 852.05, 852.06, 852.09, 852.1, 852.10, 852.11, 852.13, 852.15, 852.20, 852.21, 852.22, 852.23, 852.24, 852.25, 852.26, 852.29, 852.30, 852.32, 852.36, 852.39, 852.40, 852.41, 852.42, 852.45, 852.46, 852.49, 852.5, 852.50, 853.00, 853.01, 853.02, 853.04, 853.05, 853.06, 853.09, 853.10, 854.00, 854.01, 854.02, 854.03, 854.04, 854.05, 854.06, 854.09, 854.10, 854.11, 854.12, 854.13, 854.14, 854.15, 854.16, 854.19, 950.1, 950.2, 959.01, 995.55</td>
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<tr>
<td>S01.90XA, S02.0XXA, S02.0XXB, S02.0XXD, S02.0XXS, S02.10XA, S02.10XD, S02.10X</td>
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</table>
### Table 11. External Cause of Injury Categorization for TBI ICD-9-CM and ICD-10-CM Codes

<table>
<thead>
<tr>
<th>EXTERNAL CAUSE OF INJURY</th>
<th>ICD-9-CM</th>
<th>ICD-10-CM/ICD-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor vehicle traffic–related (unintentional)</td>
<td>E810–E819</td>
<td>V02–V04 (.1, .9), V09.2, V12–V14 (.3–.9), V19(.4–.6),</td>
</tr>
<tr>
<td>Falls (unintentional or undetermined)</td>
<td>E880–E886, E888, E987</td>
<td>W00–W19, Y30</td>
</tr>
<tr>
<td>Assault (includes firearm and other)</td>
<td>E960–E969</td>
<td>X85–Y09, Y87.1</td>
</tr>
<tr>
<td>Struck by and against</td>
<td>E916, E917</td>
<td>W20–W22, W50–W52, Y29</td>
</tr>
<tr>
<td>Other and unspecified</td>
<td>All other E-codes</td>
<td>All other cause codes</td>
</tr>
</tbody>
</table>
REFERENCES


GLOSSARY

Alaska Native (AN) – a member or descendant of indigenous peoples in Alaska.

American Indian (AI) – a member or descendant of indigenous people in the United States; this term is generally used for indigenous peoples who are members of tribes in all states except Alaska and Hawaii.

Count – the number of disease, events, or other health-related occurrences.

Data – items of information expressed as measurements or statistics used to learn more about a disease or risk factor. Data are used for calculations, support of evidence, assessments, and often for decision making.

Ethnicity – relating to cultural factors such as a shared creation narrative, ancestry, language, and beliefs. A social group characterized by ethnic affiliation or distinctiveness. Ethnicity is largely self-identified.

Indian Health Service (IHS) – U.S. Department for Health and Human Services funded agency responsible for providing health services to AI/AN. The IHS provides health services for approximately 1.9 million AI/AN who belong to 566 federally recognized Tribes, state recognized Tribes, and California Indians in 35 states. The IHS is divided into 12 geographic “Areas” of the United States: Alaska, Albuquerque, Aberdeen, Bemidji, Billings, California, Nashville, Navajo, Oklahoma, Phoenix, Portland, and Tucson.

Misclassification – the incorrect assignment of a person, value, or item into a grouping which it should not be assigned.

Phoenix Service Area – the Phoenix Service Area is one of 12 geographic “Areas” within the Indian Health Service (IHS). The Phoenix Service Area serves the majority of its tristate “Area” in Arizona, Nevada, and Utah.

Prevalence – the proportion of a population that is found to have a specified condition. This measure is often presented as a percentage, a fraction, or the number of cases per 10,000 or 100,000 people.

\[
\text{Prevalence} = \frac{\text{Number of new and existing cases in specified period}}{\text{Population during the same time period}} \times 10^n
\]

Race – a social construct created to categorize human beings into broad and generic groupings that are self-identified.

Rate – a measure of how fast a disease is occurring in the population. Rate is measured by the following formula:

\[
\text{Rate} = \frac{\text{Number of events in specified period}}{\text{Total population during the same time period}} \times 10^n
\]
**Standard population** – A set population that is used to standardize age-adjusted rates so rates in different populations are comparable.

**Statistics** – the act of collecting, summarizing, and analyzing data.

**Surveillance** – systematic (orderly) and continuous collection, analysis and interpretation of data, along with the timely dissemination (distribution) of the results to those who have the right to know so that action can be taken.

**Traumatic Brain Injury (TBI)** – a disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head, or penetrating head injury.