STATE OF MICHIGAN
TRAUMA SYSTEM INJURY PREVENTION PLAN

Michigan Department of Health and Human Services
Bureau of EMS, Trauma & Preparedness

Trauma Section: Injury Prevention Workgroup
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Introduction

Injuries took the lives of more than 5,564 Michiganders in 2018 and sent more to the emergency department and hospital.[1] Living with a disability and years of potential life and work lost as a result of an unintentional injury contributes to the enormous burden caused by these injuries to Michigan residents.[2] Unintentional injury can cause suffering, disability, and loss, and yet is frequently predictable and preventable. An important component of Michigan's trauma system is a data-driven injury prevention plan with strategies that aim to reduce preventable unintentional injuries.

A public health approach was used in the development of this plan. This approach to injury prevention recognizes that injury is predictable and can be prevented or its negative impacts decreased by targeted interventions.[3] In addition to injury surveillance, a key component of using the public health approach includes forging effective collaborations among trauma system agencies, community health care facilities, and public health departments.[4] Implementing effective evidence-informed strategies for trauma networks with limited injury prevention resources can best be accomplished by collaborating with other agencies already working on injury prevention.

How to use this document

The goal of this document is to provide data and resources to help the Regional Trauma Networks (RTNs) and trauma system identify priorities and create data-driven, evidence-based injury prevention programming and initiatives. The most common causes and types of injuries, who is most at risk, and patterns and trends in injury epidemiology are explored. Links to important resources are provided and an injury prevention plan template with actionable strategies is provided in Appendix A. This document is also designed to support the Regional Trauma Networks (RTNs) in their injury prevention work as required by the State of Michigan trauma system Administrative Rules.

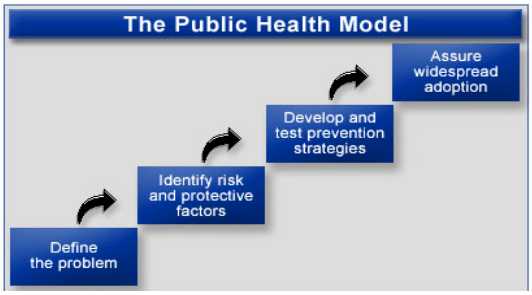
Data from multiple sources is provided for analysis in this document and provides the framework for the strategies contained in the Injury Prevention Plan template (Appendix A). The data should be further examined and analyzed by the RTNs to tailor and prioritize their work on injury prevention in their respective geographic areas and to develop then revise their strategies as needed. Additional data may be required by the Region to fully appreciate the injury patterns within the Region. Links to other databases are provided.

[1] 2016-2019 Michigan Inpatient Database (MIDB), Michigan Health and Hospital Association
2 Michigan Department of Health and Human Services Injury and Violence Prevention Section. (2018). https://www.michigan.gov/documents/mdhhs/Injury_Violence_Michigan_Burden_Report_643869_7.pdf
3 Pike, I, Rothman, L, Richmond, S, and Macpherson, A. (2015). https://parachute.ca/wp-content/uploads/2019/08/Canadian-Injury-Prevention-Resource.pdf
4 American College of Surgeons. (2008) https://www.facs.org/-/media/files/quality-programs/trauma/tscp/pdfs/regionaltraumasystems.ashx p viii

A Public Health Approach to Injury Prevention

This plan uses the CDC public health approach for injury prevention.
Surveillance and assessment are the first steps in the Public Health Approach. This is the process of collecting and analyzing the data. Data from the following sources are presented in this plan.

1. Mortality data, describing both prevalence and causes of death.
2. Hospitalization data describing both prevalence and cause of injury in hospitalized patients.
3. Emergency Department data describing the prevalence and cause of injury in patients treated and released from the Emergency Department.



Source:https://www.cdc.gov/violenceprevention/about/publichealthapproach.html

MDHHS Section Staff from Environmental Health Surveillance and Trauma System Section provided the data analysis and display for this document. The data set is available on the trauma website.[5] The analysis provides the opportunity to consider if the injury is a rare event, the rate, and frequency it occurs, the population it impacts and if there are interventions that can alter the trends. On-going surveillance will provide a means to evaluate the effectiveness of these strategies, detect inadequacies with respect to implementation, and identify gaps in strategies[6]

Identify Risk and Protective Factors

In this step, consider why an injury occurs in a population and what puts that population at risk. Risk and protective factors are often shared across injury patterns.

Develop and Test Prevention Strategies

Evidence-informed research is put into action in this step. This approach uses both evidence from the research and practice. "Following evidence-informed practice includes the actions needed to adopt, implement and evaluate effective interventions to reduce injury while recognizing the importance of context and the interactions between individuals".[7]

Assure Widespread Adoption

Sharing what is learned in the development and test steps is an important strategy to promote widespread adoption. The Regional Trauma Networks and their Injury Prevention Committees are encouraged to share lessons learned through the regional annual reports, meetings, conferences, and publications.

[5] https://www.michigan.gov/mdhhs/0,5885,7-339-71551_69345_76499---,00.html
[6] Pike, I, Rothman, L, Richmond, S, and Macpherson, A. (2015). https://parachute.ca/wp-content/uploads/2019/08/Canadian-Injury-Prevention-Resource.pdf
[7] Pike, I, Rothman, L, Richmond, S, and Macpherson, A. (2015). p 52 https://parachute.ca/wp-content/uploads/2019/08/Canadian-Injury-Prevention-Resource.pdf

Burden of Injury

While this plan uses surveillance data to plan appropriate interventions, surveillance data can also be used to describe the burden of injury in Michigan. The 2018 MDHHS *Injury and Violence in Michigan: Michigan's Core Violence and Injury Prevention Program Burden Report* [6] describes in detail the burden of injury and the extent to which leading causes of injury occur in Michigan and their cost.

According to the Burden Report "Injuries are a leading cause of death and disability. An estimated 1.4 million people in Michigan are living with a disability.[2] The estimated years of potential life lost (YPLL) before the age of 80 in Michigan in 2015 was 126,954, just for unintentional injuries. An additional 47,588 YPLL are estimated for suicide, and 27,052 YPLL for homicide. Besides the physical and emotional trauma that families endure, injuries come with a great financial cost. Lifetime medical and work-loss costs for unintentional and intentional injuries combined were estimated at more than 7.5 billion dollars for Michigan in 2014".[8]

Data

The data in this report were sourced from the following databases: A detailed description of data inclusion criteria can be found in Appendix B.

1. Michigan Vital Statistics: The data source is death certificate data compiled by the Michigan Resident Death File, Division of Vital Records and Health Statistics, Michigan Department of Health and Human Services.
2. Michigan Inpatient Data Base (MIDB): From the Michigan Health and Hospital Association (MHA), the data source is collected and compiled by the MHA on hospitalized patients. (YEARS) Linda
3. Emergency Department, the data source is the 2018-2019 Michigan Outpatient Database from the MHA. This data represents patients who were treated in the ED and discharged with an injury code.
4. State of Michigan Trauma Registry, The Michigan Trauma Registry collects data elements that meet the National Trauma Data Standards (NTDS). The NTDS standards are updated annually. Data for this report is based on NTDS Data Dictionaries from 2020 and 2021. These data are collected from trauma facilities nationally (Level I, II, and III) and stored in a trauma data clearinghouse managed by the American College of Surgeons. A national report on injuries and fatalities is published annually on the American College of Surgeons NTDB reports and publications webpage https://www.facs.org/quality-programs/trauma/tqp/center-programs/ntdb/docpub . Michigan collects this same data set quarterly from all designated trauma facilities.

[8] Michigan Department of Health and Human Services Injury and Violence Prevention Section. (2018). https://www.michigan.gov/documents/mdhhs/Injury_Violence_Michigan_Burden_Report_643869_7.pdf

The inclusion criteria for the data in this document met the standards of the 2021 National Trauma Data Standard Data Dictionary. These standards can be downloaded from the MDHHS trauma system website:

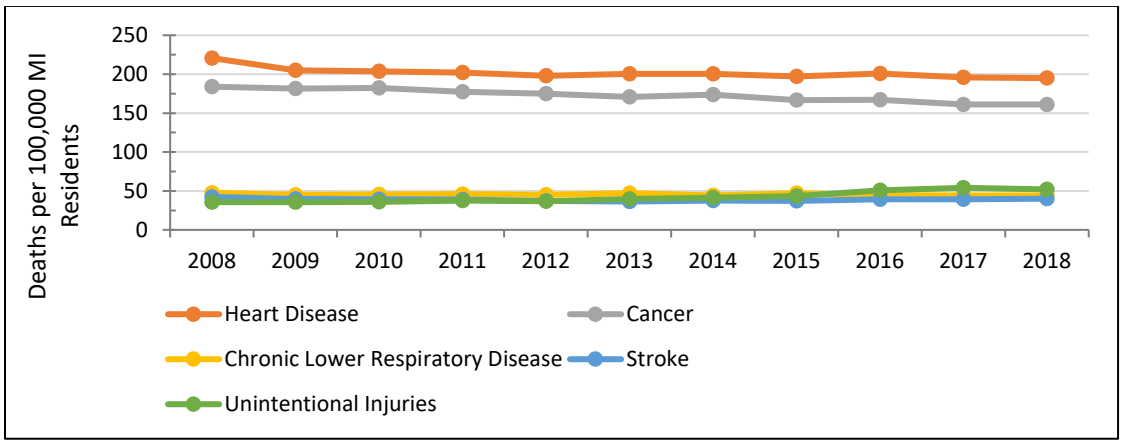
- 2021 National Trauma Data Standard Data Dictionary
- 2020 National Trauma Data Standard Data Dictionary

Each of these data sources describes injury from unique perspectives. Taken as a whole, it is possible to use these data to describe and refine interventions to address leading causes of injury at a micro (community) and macro (population health) level, beginning with mortality from injury.

Mortality Data

The mortality data represents 10 years of data, 2008 -2018, from the Michigan Resident Death File, Division of Vital Records and Health Statistics, Michigan Department of Health and Human Services. These data included deaths of Michigan residents that took place in the state of Michigan, whether or not the individual came to the hospital. To refine the data, each case has at least one ICD-10 code described in the NTDS case definition in the underlying cause of death field or any of the related cause of death fields.

Figure 1. Top 5 Leading Causes of Death, Age-Adjusted Mortality Rate per 100,000 Michigan Residents 2008-2018



Source MDHHS Michigan Health Statistics (https://www.mdch.state.mi.us/pha/osr/deaths/causrankcnty.asp)

Figure 1 shows the top 5 counts of deaths for all Michigan residents for **any reason**. The leading cause of death is heart disease followed by cancer. From 2008 to 2016 the 3rd leading cause of death was chronic lower respiratory disease. Unintentional injuries have been in the top 5 leading causes of death in Michigan for 11 years.

Figure 2. Count of Top 5 Causes of NTDS Injury Fatalities by State Injury Indicator, All Michigan Residents, 2008- 2018

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Grand Total
Any Trauma Injury*	3316	3160	3346	3395	3418	3442	3379	3284	3659	3593	3770	37762
Firearm	1065	1076	1062	1150	1217	1180	1082	1046	1188	1030	1240	12336
Fall	734	721	782	847	826	919	1016	864	899	1067	1166	9841
Suicide	607	614	654	659	659	705	711	713	769	710	853	7654
Homicide	597	595	548	617	695	586	540	435	541	430	512	6096
Motor Vehicle Transport	510	417	458	445	444	419	340	315	367	402	377	4494

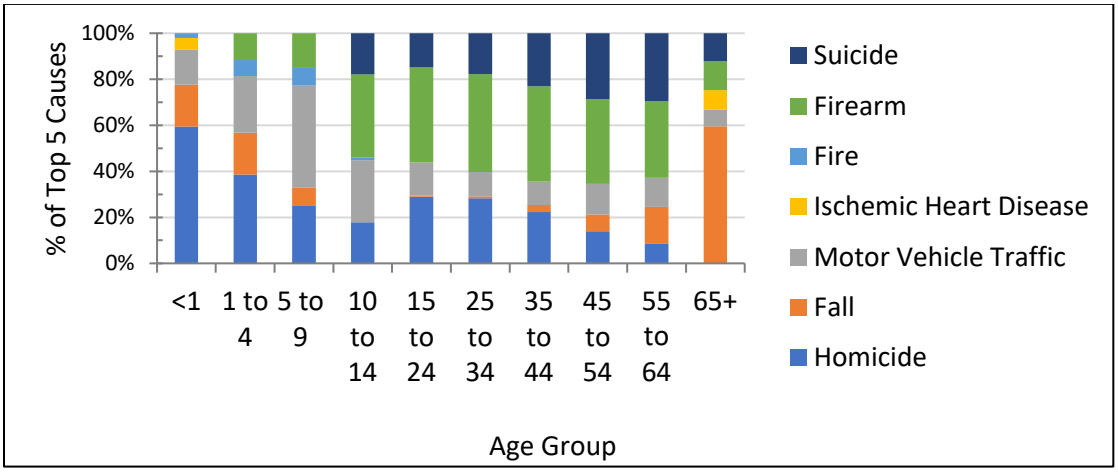
Note: a single case may be represented in multiple groups.

**Any Trauma Injury indicates the presence of any NTDS injury; a single case may be represented in multiple groups therefore categories will not sum to Any Trauma Injury total. See Injury Indicator case definitions*

Source Data from Michigan Vital Statistics, CDC & State Injury Indicators

Figure 2 describes the number of Michigan residents that died with any injury cause. These causes include both unintentional and intentional injury fatalities. For example, firearm injuries are the leading cause of injury fatalities and include both suicide and homicide (intentional injuries) and accidental (unintentional) deaths by firearm. Importantly, a single case may be represented in multiple groups therefore categories will not sum to any trauma injury total. For example, a fall could be counted in the Fall category as well as the Homicide category. Firearm injuries are followed by falls and motor vehicle transport as the leading causes of injuries. With the exception of motor vehicle accidents, the number of fatal traumatic injuries are increasing in Michigan.

Figure 3. Percent of Top 5 Causes of Injury Fatalities for NTDS Cases by Age Group, Michigan Residents 2008- 2018

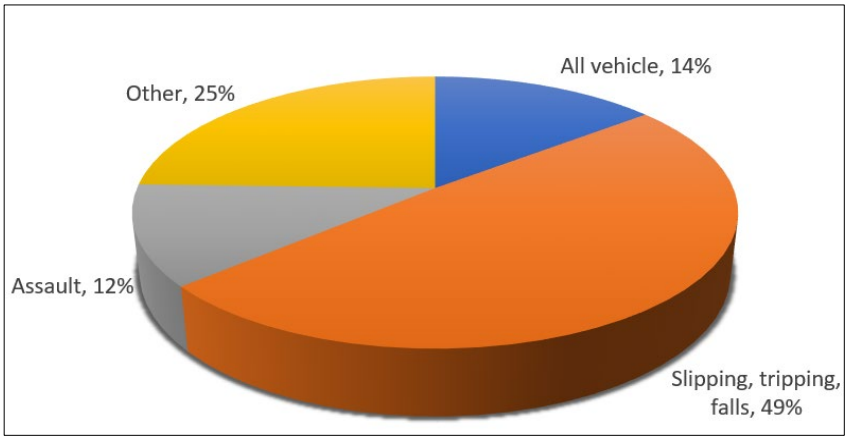


Source Michigan Resident Death File, 2008-2018

Figure 3 describes the top 5 causes of injury fatalities by age group. Falls are prevalent in the 0-4 age groups and the 55 and older age groups. For Michigan children less than 5 years, homicide is the leading cause of death related to injury fatalities.

A different view of injury patterns is represented in the Michigan Trauma Registry data in Figure 4. The populations in the Vital Statistics data Figures 1 and 2 and Michigan Trauma Registry Figure 4 are different. For example, the Vital Statics data reflects all injury deaths in Michigan regardless of whether the patient went to the hospital whereas Michigan Trauma Registry data reflects only those cases that went to the hospital and met NTDS criteria. Although the populations in the Vital Statistics and Michigan Trauma Registry are not the same, they both show similar trends - slips, trips, and fall are consistently a significant contributing cause of death.

Figure 4. Fatalities by Injury Cause Code

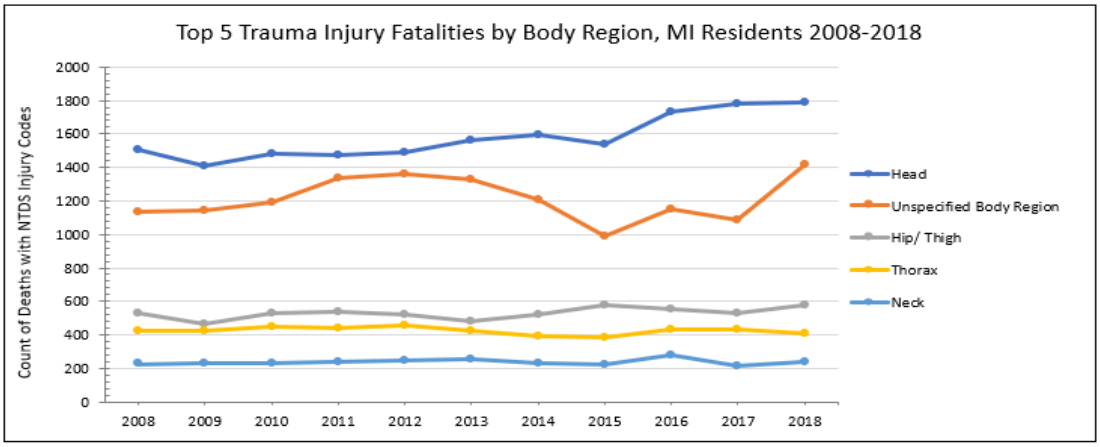


Source MDHHS Michigan Health Statistics (https://www.mdch.state.mi.us/pha/osr/deaths/causrankcnty.asp)

Note: Incidents that meet NTDS criteria may be counted more than once and represented in more than one group. Accidental firearm injury is captured in the "other category while intentional firearm injury is in the "assault" category.

Slipping, tripping, and falls, firearms, motor vehicles are all top causes of fatalities in Michigan requiring intervention planning

Figure 5. Top 5 Trauma Injury Fatalities by Body Region, MI Residents 2008-2018

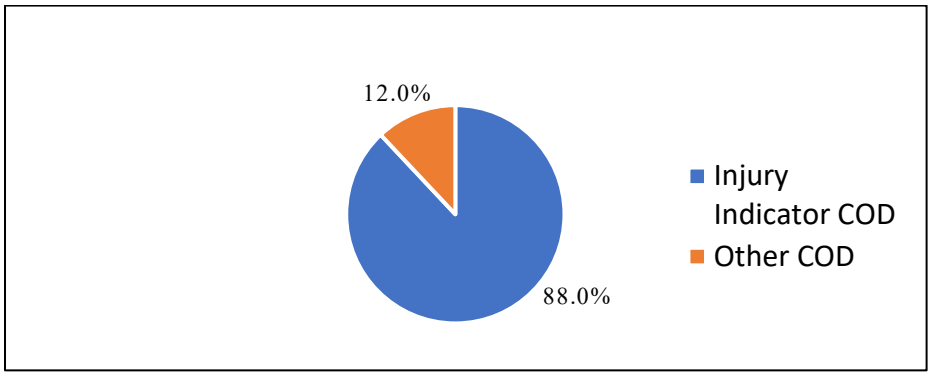


Source Michigan Resident Death File, 2008-2018

Injury to the head was the most prevalent body region affected for fatalities

Further analysis of the mortality data of patients' vital statistics death data show that 12% did not have an injury code associated with the cause of death (Figure 6). This means that 12% of fatalities, that met the NDTS inclusion criteria, had a non-injury code as the underlying cause of death. The most frequent cause of death, within this 12% of cases, was ischemic heart disease (ICD-10 Coding: 120-125), comprising 3.5% of the cases.

Figure 6. Percent of NTDS Cases with a State Injury Indicator as the Underlying Cause of Death, MI Residents 2008-2018



Source Michigan Resident Death File, 2008-2018

Non-Fatal Hospitalization Data

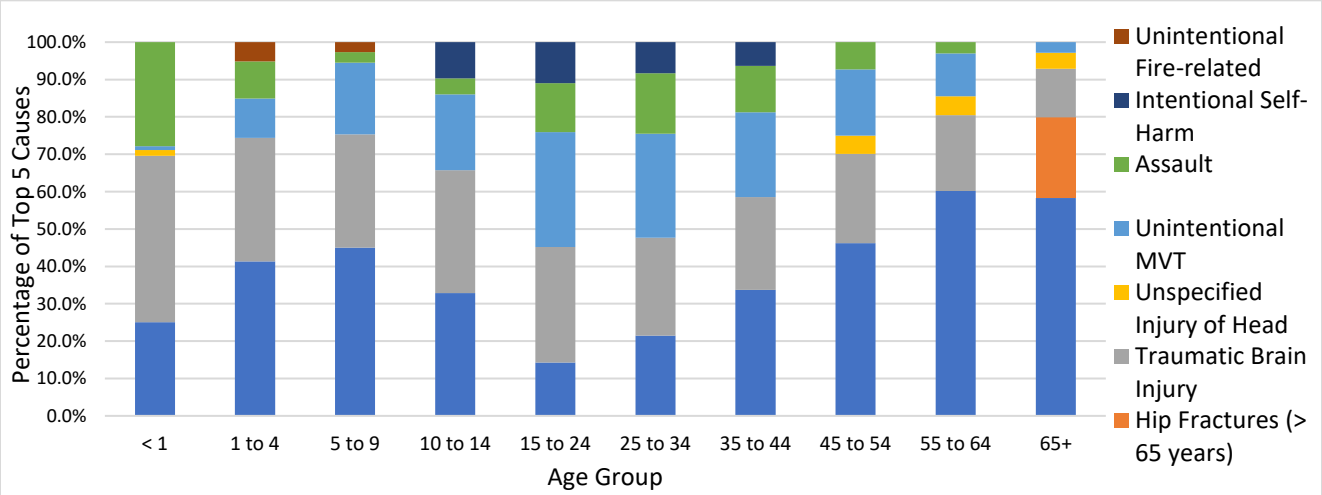
Non-fatal hospitalization data was pulled for 2016 - 2019 from the Michigan Inpatient Database, Michigan Health and Hospital Association (MHA). Inclusion criteria were initial encounters of Michigan residents at identified MHA trauma level hospitals that met the NTDS Patient Inclusion

Criteria.

More than 272,000 Michiganders are hospitalized with a non-fatal traumatic injury every year. For children less than 1-year, traumatic brain injury, assault, and unintentional falls are the leading cause of hospitalization. Unintentional falls rise significantly in those 45 and older while traumatic brain injury remains a consistently major cause of hospitalizations for all age groups. For all ages combined, the frequency of unintentional falls is followed by motor vehicle crashes. The data also show that while unintentional falls result in many different types of injuries, head injury is the most common (Figure 10).

Non-fatal hospitalization data is further broken down by sex, state injury indicator and body region or type in the MDHHS Trauma Injury Prevention (IP) Figures.

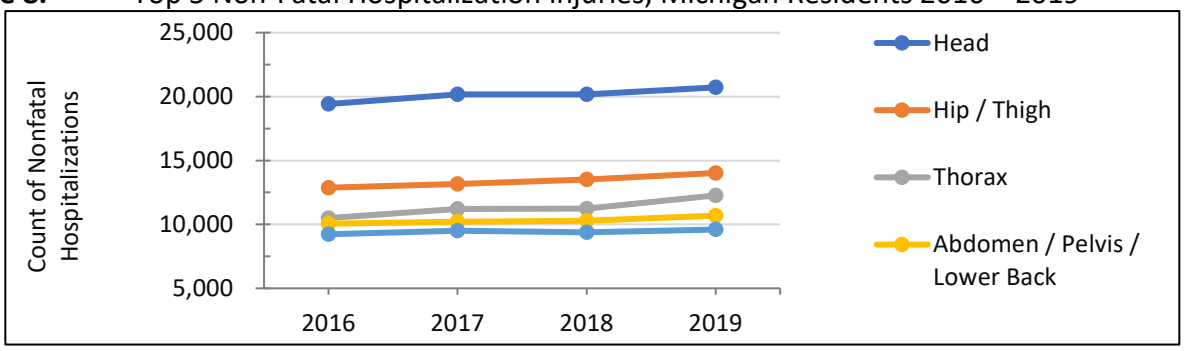
Figure 7. Percent of Top 5 Causes of Nonfatal Injury Hospitalizations for NTDS Cases by Group, MI Residents, 2016-2019



Source MDHHS Trauma IP Figures. 2021

In Figure 7 a single case may be represented in multiple groups. For example, traumatic brain injury incidents may be represented in both motor vehicle incidents and hip fracture incidents. Head injuries are overall the most common bodily injury for non-fatal hospitalized trauma patients (Figure 7 -9).

Figure 8. Top 5 Non-Fatal Hospitalization Injuries, Michigan Residents 2016 – 2019



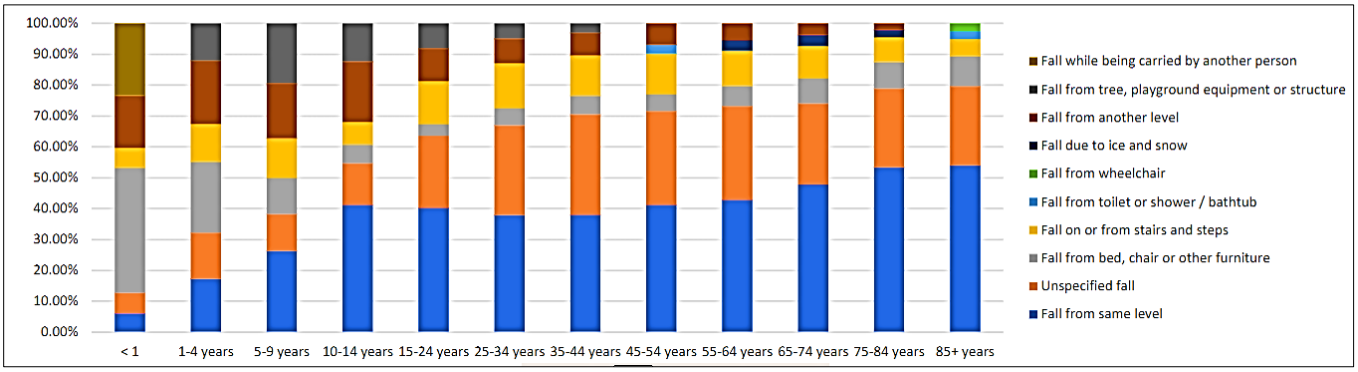
Source MHA, Michigan Inpatient Database (MIDB), 2016-2019

Figure 9. Count of Top 10 NTDS Nonfatal Hospitalization Unintentional Falls by Body Region or Type, All Michigan Residents, 2016-2019

Count of Top 10 NTDS Nonfatal Hospitalization Unintentional Falls by Body Region or Type, All Michigan Residents, 2016 - 2019					
	2016	2017	2018	2019	Grand Total
Unintentional Falls	30,756	33,971	35,043	39,144	138,914
Head	8,102	9,289	9,943	10,631	37,965
Hip / Thigh	7,275	7,551	7,854	8,905	31,585
Knee / Lower Leg	3,470	3,757	3,805	4,240	15,272
Abdomen / Pelvis / Lower Back	2,820	3,131	3,009	3,458	12,418
Thorax	2,656	3,183	3,024	3,676	12,539
Shoulder / Upper Arm	2,278	2,431	2,545	2,805	10,059
Elbow / Forearm	1,624	1,787	1,833	2,010	7,254
Ankle / Foot	1,013	1,153	1,227	1,410	4,803
Wrist / Hand / Fingers	697	784	903	981	3,365
Neck	668	759	756	887	3,070

Source MHA, Michigan Inpatient Database (MIDB), 2016-2019

Figure 10. Percent of Top 6 Causes of Nonfatal Hospitalization for Head Injury due to an Unintentional Fall by Age Group, MI



Source MHA, Michigan Inpatient Database (MIDB), 2016-2019

Figure 10 highlights how data can guide injury prevention activities and interventions based on understanding greatest cause factors in conjunction with age. For example, injury prevention related to falls for patients greater than 55 should be focused on same level falls (i.e. slip,trip). Injury prevention efforts for patients less than 14 should focus on falls from another level (windows, balconies, etc.) and may require a more unique approach.

Like in the case of mortality data where the traumatic event may not have been the cause of death for hospitalized patients, the traumatic injury may not be the primary reason for admission to the hospital. One-third of the cases meeting NTDS inclusion criteria did not have a State Injury Indicator code present, indicating the primary reason for admission was not the injury.

Emergency Department Data

This section provides data representing patients who were treated in the Emergency Department (ED) and discharged with an injury code. Head injury remains the most common injury, however, firearm-related injuries are a smaller percentage of the total injuries than in the fatality and non-fatal hospitalization data in the previous section.

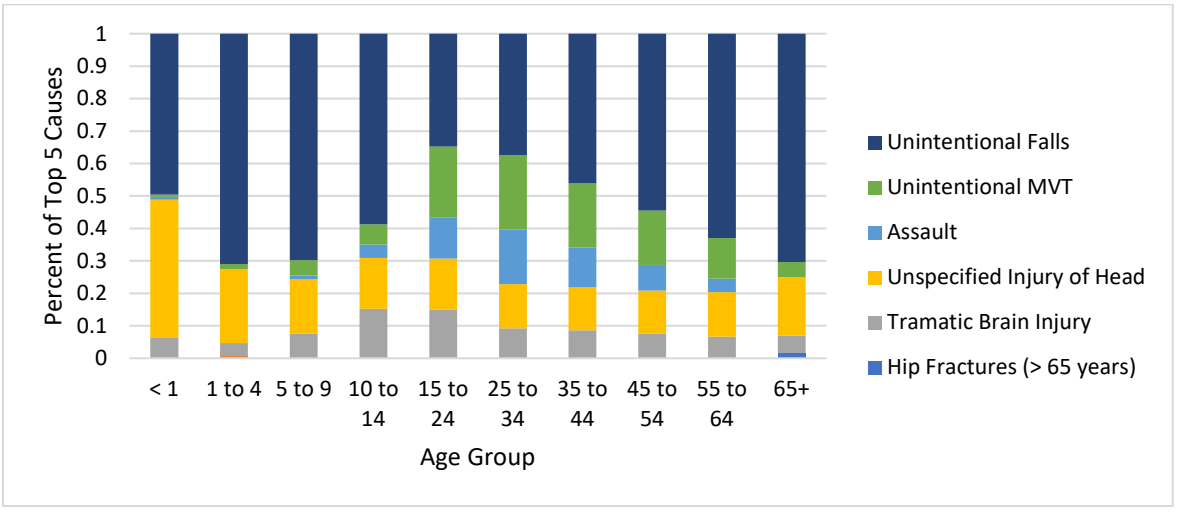
Figure 11. Count of Top 10 Causes of NTDS Nonfatal Emergency Department Visits by State Injury Indicator, Michigan Residents, 2018-2019

Count of Top 10 Causes of NTDS Nonfatal Emergency Department Visits by State Injury Indicator, Michigan Residents, 2018 - 2019			
	2018	2019	Grand Total
Any Trauma Injury*	596,223	568,725	1,164,948
Unintentional Falls	144,321	182,066	326,387
Unspecified Injury of the Head	43,459	51,157	94,616
Unintentional Motor Vehicle Traffic (MVT)	33,927	39,439	73,366
Traumatic Brain Injury	23,696	25,904	49,600
Assault	18,028	20,967	38,995
Intentional Self-Harm	3,170	4,618	7,788
Unintentional Fire-related	1,875	2,132	4,007
Firearm-related	1,192	1,341	2,533
Hip Fractures (Fall-related > 65 years)	1,110	1,258	2,368
Nondrug Poisoning	500	775	1,275

**Any Trauma Injury indicates the presence of any NTDS injury; a single case may be represented in multiple groups therefore categories will not sum to Any Trauma Injury total.*

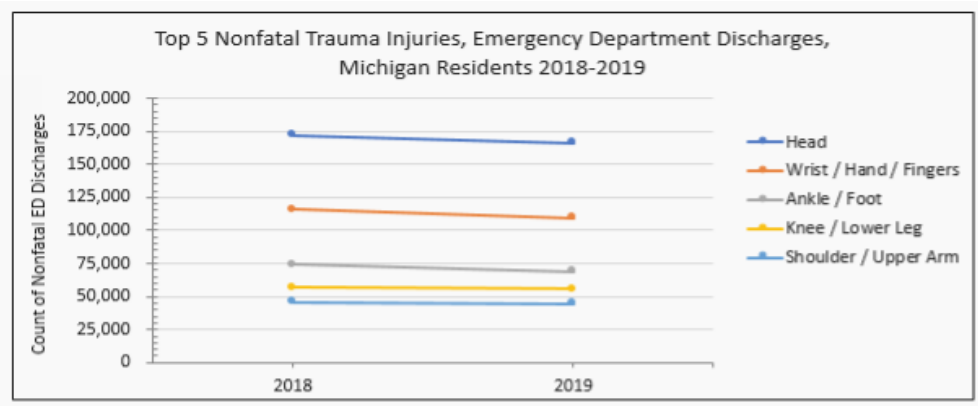
Source MHA, Michigan Outpatient Database (MODB), 2018-2019

Figure 12. Percent of Top 5 Causes of Nonfatal Emergency Department Visits for NTDS Cases by Age Group Michigan Residents, 2018-2019



Source MHA, Michigan Outpatient Database (MODB), 2018-2019

Figure 13. Top 5 Nonfatal Trauma Injuries, Emergency Department Discharges, Michigan Residents 2018-2019



Source MHA, Michigan Outpatient Database (MODB), 2018-2019

Using Regional and Local Data to Develop Injury Prevention Initiatives

When developing injury prevention plans, it is important to recognize that regional and local differences in injury patterns exist. For example, in the last half of 2020, Region 6's third leading cause of injury was other land transport accidents whereas in Region 3 the third leading cause was assaults and more specifically penetrating trauma. In addition to the data presented in this document, several important areas of special interest in injury prevention are discussed below. These may be helpful to RTNs as they prioritize their strategies.

Focused Areas

Injury prevention plans, both state and local, need to be driven by data with evidence and population-based practices for the greatest impacts. The most frequent causes of injury need to have organized, multilayered, concerted, efforts from multiple partners to be impactful.
While these data reflect both intentional and unintentional injuries, the focus of this trauma injury prevention plan is on the unintentional, recognizing that some prevention activities will overlap into both. The following focus areas may be helpful to RTNs in their injury prevention planning.

Michigan's Aging Population – Fall Prevention

The proportion of Michigan's population that is 60 and older is growing more rapidly than other components of the population. The U.S. Census Bureau estimates that 24 percent of Michigan's population will be 60 and older by the year 2030, an increase of 32 percent from 2012 (US Bureau Statistics). The significance of this for public health and injury prevention is profound because injuries among older adults tend to be more severe and require longer recovery times.

The prevalence of head and hip injuries in older adults resulting in death must be considered in injury prevention plans. These injuries are the most prevalent reasons for hospitalization. Head injury in the age 55 and older is highest in males and females' hip injury exceeds head injury in the 65 + group. Note in the following Figures 14 and 15 how injuries to the hip for both men and women over age 65 resulted in fatalities.

Figure 14. Count of Top 10 NTDS Nonfatal Hospitalization Unintentional Falls by Body Region or Type, All Michigan Residents, 2016 – 2019

	2016	2017	2018	2019	Grand Total
Unintentional Falls	30,756	33,971	35,043	39,144	138,914
Head	8,102	9,289	9,943	10,631	37,965
Hip / Thigh	7,275	7,551	7,854	8,905	31,585
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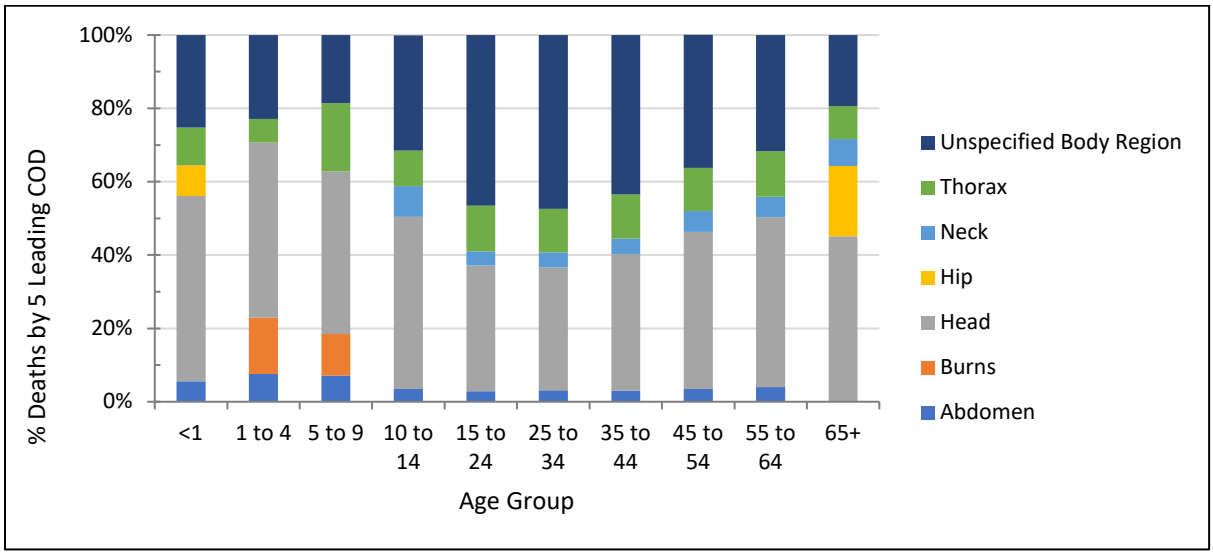
Ankle / Foot	1,013	1,153	1,227	1,410	4,803
Wrist / Hand / Fingers	697	784	903	981	3,365
Neck	668	759	756	887	3,070

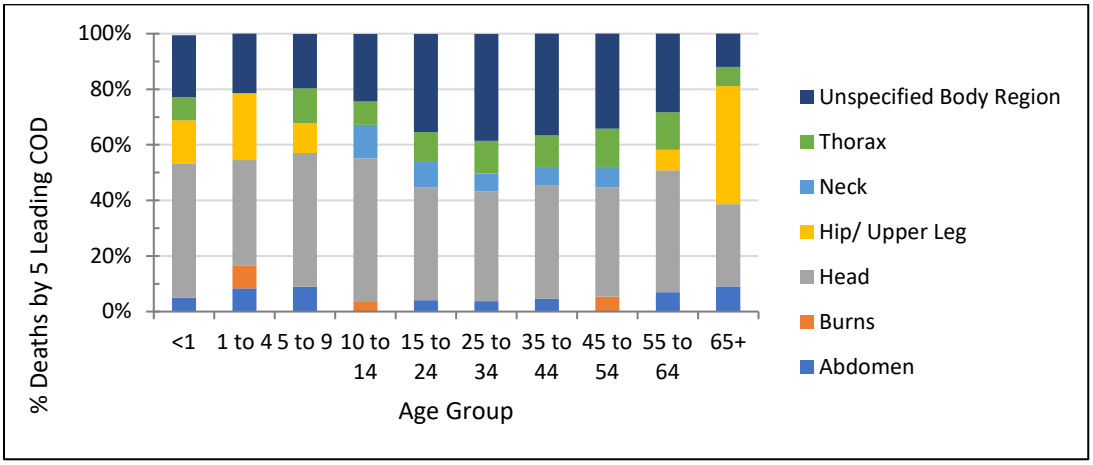
Source MHA, Michigan Outpatient

Figure 15. Percent of Top 5 Trauma Injury Fatalities by Body Region or Type, Male MI Residents 2008 – 2018



Source Michigan Resident Death File, 2008-2018

Figure 16. Percent of Top 5 Trauma Injury Fatalities by Body Region or Type, Female MI Residents 2008 - 2018



Source Michigan Resident Death File, 2008-2018

Despite research describing the causes, risks, and effectiveness of fall prevention interventions, falls continue to be the leading cause of injury and death in older adults. [9] The US Census Bureau (2018) estimates that the population of those 65 and older will nearly double in the next 30 years. The fastest growing group of older adults are those 85 years and older. It is expected that the number of falls in the aging population will rise proportionally.

In addition to the quality of life and risk of death from an older person's fall, the substantial economic costs of medically treated fall injuries are also concerning with the average hospital costs now reaching over $30,000.[7] Every fall averted by an intervention has the potential for significant cost savings.

Estimated lifetime medical and work-loss costs of fatal injuries- United States, 2013. Morbidity and Mortality Weekly Report. Retrieved from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6438a4.htm

The CDC website is a source for evidence-based fall prevention programs. The resources listed in the Resource section of this document may also be helpful. There is strong evidence that exercise-focused fall interventions can be effective. Sherrington's systematic Cochrane review, updated for the World Health Organization, of the estimated effects of exercise on falls confirms previous findings that exercise prevents falls in older adults.[10]

9 Center for Disease Control and Prevention. (2015, October2) https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6438a4.htm

10 Sherrington, C., Fairhall, N., Kwok, W., Wallban, K. G., Tiedemann, A., Michaleff, Z. A., Ng, C. A. C. M., Bauman, A. (2020). *International Journal of Behavioral Nutrition and Physical Activity*, 17(1):144. doi: 10.1186/s12966-020-01041-3.

It is recommended all regional injury prevention plans consider evidence-based fall prevention exercise programs in their plan.

The Magnitude of the Problem

One in four older adults (30%) will fall each year or 36 million adults.
The likelihood of falling increases with age resulting in over 3 million injuries every year.
32,000 older adults will die after a fall related injury.
Fall related cost expected to have reached $68 Billion in 2020.

(CDC 2020)

Traumatic Brain Injuries

Traumatic brain injuries (TBIs), are a type of injury that affects the function or mechanics of the brain. Although all other areas of injury in this report focus on either different causes or intent for injury and death, many of which can result in a TBI, this type of injury is uniquely highlighted because of its magnitude and consequences. Traumatic brain injuries contribute to a substantial number of deaths and cases of permanent disability. On average, more than 29 people died every week in Michigan in 2015 from a TBI. Nearly seventy-five percent of these fatalities were men, and nearly forty-five percent of these fatalities were firearm related.[13]

TBIs are also the most prevalent cause of fatalities and hospital admissions after a fall. The incidence of falls and head injuries increases with advanced age (see Figure 21). Motor vehicle crashes are the 2nd leading cause of TBIs in Michigan. Many regional injury prevention efforts appropriately include fall prevention and motor vehicle injury prevention to impact prevention of head injuries.

Pediatric Injuries

As of July 2019, Michigan Census data estimated that 21.5% of Michigan's population is under 18 years. With children comprising one-fifth of our state's population, we know that every system must be equipped to handle pediatric cases. It is important to realize that pediatric patients are not just "little adults" and injury prevention initiatives for adults may not be adaptable to children. A prime example of this difference is motor vehicle crashes where the laws, resources and requirements available for the pediatric population are very different. Road injuries are the leading cause of preventable deaths and injuries to children in the United States. Effective, age-appropriate restraints for pediatric patients can reduce the likelihood of death by 71%[11]. Despite this, a 2018 State of Michigan observational study revealed that 79.8% of child passenger restraints were used

[11] https://www.safekids.org/car-seat

incorrectly in children less than 8 years old.[12] While plans related to reducing risk of injuries in motor vehicle crashes for adults may be focused on initiatives preventing distractions for the driver, pediatric safety should be focused on appropriate restraint use for all passengers in the vehicle.

It is imperative that injury prevention plans reflect the unique needs of the pediatric patient and the caregivers who are responsible for ensuring the child's safety. Resources for pediatric injury prevention are listed in the resource section of this document. Additionally, there are several Pediatric Trauma centers in the State of Michigan that have resources available for injury prevention collaboration.

Firearm Injuries

The research and availability of effective fall prevention programs are more readily available than it is for firearms injury prevention. While firearm injury prevention research is not as extensive as fall prevention research it is gaining momentum. In 2020, the National Center for Injury Prevention and Control, Division for Violence Prevention committed $7,836,869 to fund sixteen research grants to prevent firearm-related violence and injuries.[13] In 2021, the University of Michigan launched the new Institute for Firearm Injury Prevention to advance knowledge about this significant public health issue.[14]

Fatal and non-fatal firearm injuries are further categorized as intentional, non-intentional, interpersonal violence, legal intervention, and undetermined intent.[12] The CDC recommends using a public health approach to address the growing gun violence issues which strive to "provide the maximum benefit for the largest number of people".[12] While gun violence is a large, multifaceted, complex public health issue, regional injury prevention efforts can begin to address the issue with surveillance data to assess the extent and types of violence that are occurring within their region. Prevention efforts can then be developed using available regional trauma and public health resources. This is an area that requires further research and exploration for future Injury Prevention Plans.

Unintentional Motor Vehicle Crashes

Motor vehicle crashes include unintentional incidents of injury and death for motor vehicle occupants as well as bicyclists and pedestrians. Motor vehicle crash deaths in Michigan are leading injury-related cause of death. Over the past 10 years, nearly 19 people died in a motor vehicle crash every week on average in Michigan. More than 74 people were hospitalized in an average week between October 2014 and September 2015 in the state from injuries sustained in a motor

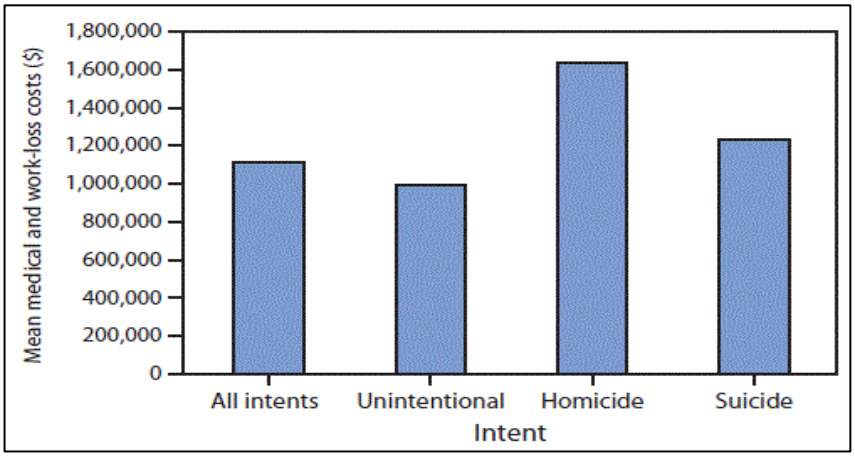
[12] https://www.michigan.gov/documents/msp/2015_Child_Restraint_and_Booster_Seat_Report_-_REVISED_FINAL_DRAFT_9-8-15_505073_7.pdf
[13] CDC, 2021, May 18 https://www.cdc.gov/violenceprevention/firearms/fastfact.html
[14] University of Michigan. (2021, June 4 https://news.umich.edu/u-m-to-establish-new-institute-for-firearm-injury-prevention/

vehicle crash.[15] It is recommended that RTNs review data from multiple sources to understand their regional epidemiology of motor vehicle crashes and use some of the many public health resources available when planning interventions.

Economic Costs of Injuries

Injuries create a substantial economic burden in the United States. According to the CDC, the estimates that the "costs of lifetime medical and work-loss costs associated with fatal injuries in 2013 were $214 billion".[16]

Figure 17. Mean medical and work-loss costs per injury death, by intent* — United States, 2013



Source https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6438a4.htm?s_cid=mm6438a4_w#Tab

Figure 17 shows the breakdown of the 2013 CDC medical and work-loss data. "Approximately 61% of the total costs were attributable to unintentional injuries ($129.7 billion), followed by suicide ($50.8 billion [24%]) and homicide ($26.4 billion [12%]). Drug poisonings as a mechanism accounted for the largest share of injury costs (27%), followed by transportation (23%) and firearm-related injuries (22%)."[17]

While these data are older, we can assume the economic costs are much higher in 2021 and underscore the substantial economic burden of injuries and the need for prevention programs to not only save lives but reduce costs.

Health Disparities

Health disparities are health differences between different groups of people and may include various factors such as how many people get certain diseases, die from diseases, or can get health care.

[15] Michigan Department of Health and Human Services Injury and Violence Prevention Section. (2018). https://www.michigan.gov/documents/mdhhs/Injury_Violence_Michigan_Burden_Report_643869_7.pdf
[16] CDC 2015, October 2 https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6438a4.htm
[17] CDC, 2013 https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6438a4.htm?s_cid=mm6438a4_w#Tab

This report describes the extent to which the leading types of injury occur in Michigan on a statewide scale. Further analysis is needed to explore where the injury surveillance data may be different for people based on race, ethnicity, sex, immigrant status, disability, gender identity, sexual orientation, age, income, level of education, and geography.[18] If a health outcome is seen to a greater or lesser extent between populations, there is disparity

Future iterations of the plan will describe more detailed and specific strategies based on experience gained to more fully develop effective initiatives to address unintentional injuries for disparate population level.

Health Disparities in Michigan: Further analysis is needed to explore where the injury surveillance data may be different for people based on race, ethnicity, sex, immigrant status, disability, gender identity, sexual orientation, age, income, level of education, and geography.

Resources

Once regional data is assessed and actionable priorities are established, prevention activities can be planned. There are numerous state, local, and national resources available to assist in developing injury prevention plans and initiatives. The following list is not inclusive as programs and initiatives are ongoing and changing.

- American College of Surgeons https://www.facs.org/quality-programs/trauma/advocacy/ipc/resources, This site contains an extensive list of injury prevention resources from organizations with narrower goals aimed at children's injury prevention (Safe Kids) to larger research centers.
- Centers for Disease Control and Prevention https://www.cdc.gov/injury/index.html
- U of M Injury Prevention Center https://injurycenter.umich.edu/
- MDHHS Injury and Violence Prevention https://www.michigan.gov/mdhhs/0,5885,7-339-71548_54879---,00.html
- Michigan Office of Highway Safety Planning https://www.michigan.gov/msp/0,4643,7-123-72297_64773---,00.html
- Web-based Injury Statistics Query and Reporting System - WISQARS™ https://www.cdc.gov/injury/wisqars/index.html
- ImageTrend®, Inc. The State of Michigan trauma registry. https://www.mi-emsis.org/patientregistry/.

[18] National Institute on Minority Health and Health Disparities. (2021). https://www.nimhd.nih.gov/about/strategic-plan/nih-strategic-plan-directors-foreword.html

- Community Needs Assessments. A community needs assessment provides a snapshot of local policy, systems, and environmental change strategies currently in place and helps to identify areas for improvement. These assessments may be another tool for injury prevention coordinators to use when creating strategies for specific communities. These are available for each county in Michigan and can be found on each county's website. For an example of a county's community needs assessment see https://accesskent.com/Health/CHNA/default.htm. There may also be valuable information in hospital or health system community needs assessments.

Summary

This document provides a snapshot of state-wide injury epidemiology data for injury prevention planning. Each Region is encouraged to further study their individual data using the resources provided in this document. These data and resources can be used to guide the development of regional specific injury prevention plans.

Further study is required to understand the specific injuries by cause. Although older adult falls, firearm and traumatic brain injuries, pediatric injuries, and motor vehicle crashes were highlighted, this does not suggest that these are the only injury patterns that should be addressed when planning. Each region must continuously re-assess data and prioritize their strategies.

Forging collaborative relationships with existing community agencies, providing evidence-informed strategies, in using a public health model is an important approach. This is particularly important for Michigan's Regional Trauma Networks because injury prevention may not be fully resourced. Collaboration with community agencies is an important step in developing a regional plan based on the analysis of regional data.

Michigan's trauma system has a significant rural component supported by Level IV trauma hospitals, many of which are critical access hospitals. While these Level IV hospitals and their EMS partners in the trauma system are often resource-constrained, an achievable public health approach is possible using existing standard workflows and forging injury prevention collaborations that leverage resources for a population health impact.

Finally, understanding the impact of health disparities on injury epidemiology and the development of specific strategies needs further exploration and will be considered in future iterations of this plan.

In closing, the next step is the implementation of the **Michigan Trauma Injury Prevention Plan** (Appendix A) as written in the Michigan Trauma System Strategic Plan, 2018-2023. RTNs should address the appropriate sections and create actionable plans that utilize available community resources to the greatest extent possible.

Appendix A

Michigan's Trauma Injury Prevention Plan Template

The Michigan Trauma System is uniquely positioned to address unintentional injury. Trauma facilities can utilize subject matter experts from within their organizations or existing community resources to plan interventions and improve monitoring. It is recommended that MDHHS Trauma System Section and each Region use the following template to develop a regional specific injury prevention plan.

Assessment and On-going Surveillance

1. By_____, the MDHHS Trauma System Section will implement the following plan for ongoing surveillance of injury epidemiology data reports and capturing of trends. These reports will be distributed to the STAC and Regional Trauma Networks.
    a. Bi-annual surveillance reports from the Michigan Trauma Registry for the regional inventories will include, at a minimum, the top 3 causes of injury in the region.
    b. Periodic updates of the epidemiologic data in this plan will be completed by MDHSS and reported to the Trauma Section Injury Prevention Committee every 2 – 5 years. Where possible, future data should be broadened from analysis by frequency, sex, age, type and cause of injury, and geography to include race, ethnicity, and gender identity.
    c. Future epidemiological data will also provide detailed data on the etiology of the most common causes of injuries. For example, what are the causes of traumatic brain injury, or the most common injuries associated with falls?
2. By_____, each Regional Trauma Advisory Council (RTAC) Injury Prevention (IP) committee will report on which injury prevention programs have been implemented in their region.
    a. The regional IP committee will analyze the number and type of programs that directly address the top 3 injuries programs in their region as reported in the Inventory. Policy Development.

Trauma System Regional Plans

3. By_____, each regional IP committee will identify and address gaps in their regional programs. IP plans will be updated. Progress on this objective will be reported on the RTC's annual report.
4. By _____ each regional IP committee will report on injury prevention outcome data for at least one implemented program. This will be recorded in the Region's Annual Report.

Collaborate with Local and National Partners

The ACS (2008) recommends forging partnerships with public health agencies, trauma system managers, and health care providers. The Michigan Trauma System is in a unique position to develop a coordinated plan that integrates the trauma system agencies, community health care facilities, and public health agencies. Engaged, committed partners and stakeholders such as the health care facilities, local public health departments, Area Agencies on Aging, and the Red Cross

exist in each of eight State Trauma Regions. Collaborations with Michigan Department of Health and Human Services (MDHHS) Chronic Disease Injury Prevention and Epidemiology, University of Michigan Injury Prevention Center: a CDC Injury Control Research Center, Office of Highway Safety and Planning, Department of Natural Resources, and the Michigan Trauma Coalition already exist and will be further developed as part of this plan.

Several national evidence-based injury prevention programs are currently integrated into segments of the public health and the trauma system; however, the extent of integration needs to be assessed. Several examples of these programs include Safe Kids programs, Tai Chi and Matter of Balance for fall prevention, Think First for safe teen driving, and DNR hunter and gun safety courses.

The development of effective collaborations and integration of existing community health programs are important strategies in this injury prevention plan.

5. By _____, the Regional Trauma Networks, with the assistance of the MDHHS Trauma Section, will promote regional evidence-informed primary injury prevention activities and projects.
    a. The RTNs will work with a minimum of one other local agency on injury prevention education and/or interventions to mitigate a minimum of one of the top 3 injuries in their region. This can be accomplished at the regional or hospital level.
    b. Allocate funds or grants, if available, based on identified injury prevention needs that include an evaluation component.
    c. MDHHS Trauma Section staff will educate the STAC, RTNs, Injury Prevention Committees, and their hospital representatives about this plan; how the components of the plan are interconnected, how the plan is integrated into existing work, and how the work will be reported.

Inform, Educate, Empower. Raise Public Awareness

6. By _____, develop an internet-based public education system with hyperlinks and resources which could be accessed from the michigan.gov/trauma website. Build a resource page with hyperlinks to websites that support the identified priorities for injury prevention and education in the state of Michigan, such as those listed in the Resource section of this document. Links to prevention tips for the top 3 identified injuries from the state trauma registry should be included.
7. By_____, will promote evidenced-informed injury prevention activities and/or projects by implementing two of the following:
    a. Each region will implement an annual community event to correlate with trauma awareness month [May].
    b. The MDHHS to assist with the development of a media release to recognize trauma awareness month and distribute trauma awareness materials.
    c. Identify topics and talking points to increase public awareness that trauma is a

preventable disease.

d. Level 1 and 2 trauma centers within each region will provide support for level 3 and 4 centers with the development of community events.
e. Collaborate with the Michigan Trauma Coalition on an injury prevention project.

Support Effective Legislation and Enforcement

8. By _____, The MDHHS Trauma Section will promote awareness of legislation and make the case for its value by:
   a. Emailing informational notices.
   b. RTNs will educate their constituents at the regional meetings as evidenced by documentation in their quarterly reports.

Appendix B

Mortality Data Sources

1. MDHHS Michigan Health Statistics query: https://www.mdch.state.mi.us/pha/osr/deaths/causrankcnty.asp
    - 2018 Geocoded Michigan Death Certificate Registry. Division for Vital Records & Health Statistics, Michigan Department of Health & Human Services; Population Estimate (latest update 7/2019), National Center for Health Statistics, U.S. Census Populations With Bridged Race Categories.
    - Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2017 on CDC WONDER Online Database, released 2019.
    - Last updated: 11/22/2019
2. 2008- 2018 Michigan Resident Death File, Division of Vital Records and Health Statistics, Michigan Department of Health and Human Services

    - **Inclusions:** Deaths of Michigan residents that took place in the state of Michigan. Each case has at least one ICD-10 code described in the National Trauma Data Standard (NTDS) case definition (slide 5) in the underlying cause of death field or any of the related cause of death fields.
    - **Suppression:** Counts <6 and rates based on counts <6 have been suppressed.
    - **Population data for calculation of rates:** National Center for Health Statistics. Vintage 2019 postcensal estimates of the resident population of the United States (April 1, 2010, July 1, 2010-July 1, 2019), by year, county, single-year of age (0, 1, 2, .., 85 years and over), bridged race, Hispanic origin, and sex. Prepared under a collaborative arrangement with the U.S. Census Bureau. Available from: /nchs/nvss/bridged_race.htm as of July 9, 2020, following release by the U.S. Census Bureau of the unbridged Vintage 2019 postcensal estimates by 5-year age group on June 25, 2020.

Hospitalization Data Source

3. 2016 - 2019 Michigan Inpatient Database, Michigan Health and Hospital Association (MHA)
    - **Inclusions:** Initial encounters of Michigan residents at identified MHA trauma level hospitals that met the National Trauma Data Standard (NTDS) Patient Inclusion Criteria
    - Trauma patient sustains a traumatic injury within 14 days of initial hospital encounter.
    - At least one of the below diagnostic codes listed in the Data Notes & Definitions section is included in addition to:
    - Patient transferred from one acute care hospital to another acute care hospital or
    - Patient directly admitted to the hospital or
    - Patients who were an in-patient admission and/or observed

- **Exclusions:** Hospitalization discharges of out-of-state residents admitted to an identified Michigan trauma level hospital. Visits for a subsequent encounter and sequela, along with patients who died before discharge are not included.
- **Suppression:** Counts <6 and rates based on counts <6 have been suppressed.
- **Population data for calculation of rates:** National Center for Health Statistics. Vintage 2019 postcensal estimates of the resident population of the United States (April 1, 2010, July 1, 2010-July 1, 2019), by year, county, single-year of age (0, 1, 2, .., 85 years and over), bridged race, Hispanic origin, and sex. Prepared under a collaborative arrangement with the U.S. Census Bureau. Available from: /nchs/nvss/bridged_race.htm as of July 9, 2020, following release by the U.S. Census Bureau of the unbridged Vintage 2019 postcensal estimates by 5-year age group on June 25, 2020.
- **Limitations:** The MIDB is an event-level dataset, therefore it is possible the same individual will be represented multiple times if they were admitted and discharged more than once a calendar year.
- **Hospitals not reporting:** The MIDB has six hospitals that did not report at least one year during the data period of 2016-2019 (Pontiac General Hospital (Oakland County) - did not report 2016-2019; Sheridan Community Hospital (Montcalm County) - did not report 2016-2019; Henry Ford Health Center - Brownstown (Wayne County) - did not report 2016-2019; McLaren Northern Michigan, Cheboygan Campus (Cheboygan County) - did not report 2016-2019; Baraga County Memorial Hospital (Baraga County) - did not report 2016-2017; At least one of the below diagnostic codes listed in the Data Notes & Definitions section is included in addition to:
- Patient transferred from one acute care hospital to another acute care hospital or
- Patient directly admitted to the hospital or
- Patients who were in-patient admission and/or observed suppressed.
- **Exclusions:** Emergency department discharges of out-of-state residents admitted to an identified Michigan trauma level hospital. Visits for a subsequent encounter and sequela, along with patients who died before discharge are not included. Patients who were seen in an emergency department and subsequently admitted to the hospital are not included. Patients who died before discharge are not included.
- **Suppression:** Counts <6 and rates based on counts <6 have been suppressed.
- **Population data for calculation of rates:** National Center for Health Statistics. Vintage 2019 postcensal estimates of the resident population of the United States (April 1, 2010, July 1, 2010-July 1, 2019), by year, county, single-year of age (0, 1, 2, .., 85 years and over), bridged race, Hispanic origin, and sex. Prepared under a collaborative arrangement with the U.S. Census Bureau. Available from: /nchs/nvss/bridged_race.htm as of July 9, 2020, following release by the U.S. Census Bureau of the unbridged Vintage 2019 postcensal estimates by 5-year age group on June 25, 2020.

- **Limitations:** The MODB is an event-level dataset, therefore it is possible the same individual will be represented multiple times if they were admitted and discharged more than once a calendar year.
- **Hospitals not reporting:** The MODB has three hospitals that did not report in 2018 or 2019: University of Michigan Health System (Washtenaw County), C.S. Mott Children's Hospital (Washtenaw County), and Sheridan Community Hospital (Montcalm County)
- Spectrum Health Kelsey Hospital (Montcalm County) - did not report 2019)

Emergency Department Data Source

4. 2018 - 2019 Michigan Outpatient Database, Michigan Health, and Hospital Association

    - **Inclusions:** Michigan Residents who are discharged from the emergency department or held on observation status.
    - All initial encounters of Michigan residents at identified MHA trauma level hospitals that met the National Trauma Data Standard (NTDS) Patient Inclusion Criteria.
    - Trauma patient sustains a traumatic injury within 14 days of initial hospital encounter.

State of Michigan Trauma Registry

5. ImageTrend®, Inc. provides the data collection software which hosts the State of Michigan Trauma Registry. https://www.mi-emsis.org/patientregistry/.

The National Trauma Data Standard (NTDS) elements are the minimum data set required to be entered into the Registry. The following are the links to the data dictionaries and inclusion criteria.

- 2021 National Trauma Data Standard Data Dictionary
- 2020 National Trauma Data Standard Data Dictionary

Appendix C

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