



Traumatic Brain Injury Program Annual Report

Division of Family Health and Wellness
July 2017 - June 2018



Department of
Health



Executive Summary

In 1993, the Tennessee General Assembly passed legislation establishing the Traumatic Brain Injury (TBI) Program within the Department of Health. The TBI Program staff, with guidance from a nine-member, Governor-appointed Advisory Council, is charged with expanding and revising existing state plans and services for persons with traumatic brain injuries. This report contains specific information concerning the progress made from July 2017 through June 2018 in each of the major components of the Traumatic Brain Injury Program.

In Tennessee, approximately 7,000 people per year are reported to the TBI Registry with a traumatic brain injury-related hospitalization or death. Of that number, approximately 5,000 are Tennessee residents, the remaining number being residents of other states that are admitted to Tennessee hospitals. Survivors of TBI may experience impairments that affect their physical, cognitive and behavioral functioning, which in turn impacts their ability to return to home, school and work. Whether the injury is the result of a fall, motor vehicle accident, assault, or sports activity, these survivors and families may experience emotional and economic stress. The focus of the TBI Program is to improve services for survivors of TBI and their families.

Key Accomplishments

- In FY17, the targeted TBI Family Support Program was implemented to directly assist persons with TBI. During the first year in FY18, there were 114 participants in the program.
- In June 2018, the TDH TBI Program was awarded a new three-year grant by the Administration for Community Living.
- Service coordinators provided case management services to TBI survivors and their families; each served an average case load of 57 survivors. They collectively provided information on TBI to over 13,500 callers.
- In FY18, services provided through TBI program funded grants included:
 - The TBI service coordinators collectively made 98 educational presentations to a total of 3,169 persons and provided 34 exhibits that were seen by 12,840 attendants.
 - The three Project BRAIN Resource Specialists provided 47 trainings to 1,473 school and health professionals.
 - Supportive living services were available to eight survivors living in two affordable and accessible apartment facilities in Memphis.
 - Personal care services were available to 24 residents of Crumley House Brain Injury Rehabilitation Center.
 - Fifty-eight adult and youth survivors of brain injury attended camp sessions.
 - Project BRAIN transition liaisons in three children's hospitals provided 7 trainings to 82 healthcare professionals and have assisted over 1,700 families in their transition from hospital to home to school.

Conclusion

Although much has been accomplished, injuries persist. Work must continue to prevent TBI and address the needs of all survivors in the state. The TBI Advisory Council is grateful for the opportunity to improve the lives of TBI survivors statewide.

Traumatic Brain Injury Program

Annual Report

July 2017 – June 2018

Introduction

In 1993, in response to testimony presented by brain injury survivors from across the state, the Tennessee General Assembly established the Traumatic Brain Injury (TBI) Program within the Department of Health to address the special needs of survivors and their families.

In Tennessee, approximately 8,000 people per year are reported to the TBI Registry with a traumatic brain injury-related hospitalization or death. Of that number, approximately 6,000 are Tennessee residents, the remaining number being residents of other states that are admitted to Tennessee hospitals. An additional 17,827 emergency department visits of Tennessee residents were related to a TBI during calendar year 2016. Survivors may experience impairments that affect their physical, cognitive and behavioral functioning, which in turn impacts their ability to return to home, school and work. Whether the injury is the result of a fall, motor vehicle accident, assault, or sports activity, these survivors and families may experience emotional and economic stress. The focus of the TBI Program is to improve services for survivors of TBI and their families.

This report contains specific information concerning progress made from July 2017 through June 2018 in each of the major components of the TBI Program, as well as pertinent historical information. The TBI Program is housed in the Department of Health, Division of Family Health and Wellness, Injury Prevention and Detection section. Currently, staff consists of a Program Director and an Epidemiologist that oversees the TBI registry.

The enabling legislation called for the establishment of a state TBI registry and a TBI trust fund, and it describes the duties of the Coordinator. Each of these areas is addressed by first citing the Tennessee Code Annotated (T.C.A.) followed by a description of activities and progress.

T.C.A 68-55-102 & 103. Advisory Council Established – Duties

The TBI Advisory Council was organized in accordance with the legislation to provide advice and guidance to the TBI Program staff. The nine-member Council is appointed by the Governor and includes representatives from the Departments of Education, Mental Health and Substance

Abuse Services and Intellectual and Developmental Disabilities, and Human Services. An additional member represents health care professionals. Five of the nine members represent the category of TBI survivor, family member or primary caregiver. The Council was organized in 1994 and has met quarterly since that time. During 2017-2018, the TBI Advisory Council was comprised of the following members:

Council member	Representation category
Lana Bennett	Survivor, Family member, Primary Care Giver
Avis Easley	Departments of Mental Health and Substance Abuse & Development Disabilities
Alicia Fitts	Survivor, Family member, Primary Care Giver
Alison Gauld	Department of Education
Mark Heydt, Chair	Health Care Professional
Rhonda Hicks	Department of Human Services, Vocational Rehab
JoAnne Morris	Survivor, Family member, Primary Care Giver
Brian Potter	Survivor, Family member, Primary Care Giver
Michelle Stanton	Survivor, Family member, Primary Care Giver

The duties of the council are to advise the TBI coordinator, make recommendations, and perform other duties as necessary for the implementation of a state-wide plan to assist persons with TBI and their families. The Advisory Council is comprised of individuals dedicated to improving the lives of TBI survivors in Tennessee. Their advice and recommendations have been invaluable to the development of the TBI program.

In FY17, the TBI Advisory Council was approved to utilize available resources in the TBI trust fund for the benefit of TBI survivors. The Council developed a five-year plan to use these funds to directly assist persons with TBI and their families by implementing a Targeted TBI Family Support Program, modeled on the existing state Family Support Program in the Department of Intellectual and Developmental Disabilities. The program is designed to assist individuals with disability due to brain injury, allowing them along with their families to remain together in their homes and communities. Services are flexible and responsive to families and their needs. During the first year in FY18, there were 114 participants in the program.

T.C.A. 68-55-201. TBI Coordinator to be designated.

The commissioner shall create a full-time position within the department and designate a person as the TBI coordinator to supervise and coordinate the development, implementation and enhancement of a registry and services system for persons with TBIs and provide sufficient staff to accomplish the effect and intent of this chapter. The TBI coordinator shall, to the fullest extent possible, utilize the services of the advisory council in fulfilling the duties and responsibilities required by this chapter.

The current full-time TBI coordinator (program director) has been in place since 1994, supervising and directing the program as described in this report. The TBI registry was established in 1994 along with the service system for persons with TBI. Staff includes the program director and the epidemiologist that oversees the TBI registry. The program director consults with Advisory Council members at least quarterly to secure their advice and guidance.

T.C.A. 68-55-202. Duties.

(a) The TBI coordinator shall:

(1) Aggressively seek and obtain funding, on an ongoing basis, from all available sources, including but not limited to Medicaid waivers and for expansion of the Medicaid program, private and federal funds needed to implement new state plans and services, and to expand and revise existing state plans and services for persons with traumatic brain injuries, including case management;

The TBI Coordinator continuously seeks additional funding from all available sources.

Medicaid Waiver: The TBI community continues to promote the idea of a TBI-specific Medicaid waiver which some states have implemented. TennCare has existing home and community-based waivers to serve the elderly and disabled for which survivors of brain injury may be eligible.

Federal Grant award: Since 2000, the TDH Traumatic Brain Injury Program has been the recipient of grants from the U.S. Health Resources and Services Administration (HRSA) that focused on providing education and training for school personnel and health professionals who support students with TBI. Project BRAIN had the overall goal of improving educational outcomes for children with brain injuries in Tennessee. Families were supported by Brain Injury Transition Liaisons housed in three children's hospitals. FY18 was the final year of the latest four-year grant. Between 2000 and 2018, Project BRAIN staff provided training on pediatric brain injury to 21,000 professionals, supported over 8,350 families, assisted 1,522 schools, responded to over 5,000 requests for technical assistance, and trained 1,436 hospital and community healthcare providers. Schools, families, and children across the state have benefitted from the work of this grant program. In June 2018, the TDH TBI Program was awarded a new three-year grant by the Administration for Community Living to build on the foundation established by Project BRAIN. The new grant program, Brain Links, will focus on educating the workforce that serves TBI survivors across the lifespan.

Expansion of services: The expansion of services for TBI survivors is accomplished through the grants program as outlined in Section 68-55-402 below. In addition, program staff collaborate with other relevant agencies such as the Tennessee Disability Coalition, the Brain Injury Association of Tennessee, and the Epilepsy Foundation, to improve services for all persons with

disabilities in the state.

Case management: There are currently eight Service Coordinators assisting TBI survivors and their families in all 95 counties through contract arrangements with non-profit agencies. Each agency has established a Brain Injury Support Center in its service area for the purpose of providing service coordination for children and adults with TBI. These services include: providing information, referring consumers to appropriate services and agencies, assisting consumers in applying for and accessing services, advocacy, support group development, and the development of new programs and activities. The service coordinators also have a pivotal role in connecting survivors to the new TBI Targeted Family Support Program.

The role of the Service Coordinator is to work with the individual survivor to assess needs and coordinate resources within the community on behalf of the client. The eight service coordinators are each serving an average case load of 57 survivors and families. During FY18, the service coordinators collectively provided information on TBI to over 13,500 callers.

(2) Seek funding, on an ongoing basis, and, in conjunction with other state agencies, prepare, coordinate, and advocate for state appropriations needed to fund and to develop services to implement the state plan:

The TBI Program Director and the Advisory Council seek funding on an ongoing basis. The Council includes representatives from the other state departments that also serve persons with brain injury -- Education, Mental Health and Substance Abuse Services, Human Services, and Intellectual and Developmental Disabilities -- and provides an opportunity for cooperation and collaboration. The Department of Education is a long-term partner on Project BRAIN, promoting the program to schools and providing substantial financial support.

(3) Identify available programs and services and compile a comprehensive directory of identified programs and services:

A comprehensive resource directory, *Traumatic Brain Injury Services Directory and Resource Information Guide, 2018* was updated in 2017, distributed statewide and has served to increase awareness of the TBI program. The directory is also available on the program web site: <https://tinyurl.com/y9xhuvf5>. In addition, all TBI service coordinators develop resource files for their local service areas.

(4) Provide technical assistance and define gaps in service delivery and spearhead the development of those services needed for a comprehensive system of service delivery;

The TBI office provides technical assistance as requested by consumers, families, and

providers. Examples include providing information on services and programs, referrals to rehabilitation programs, and making connections to support groups. The TBI office also conducts annual technical assistance site visits with all TBI contractors.

The Service Coordination project described above [TCA 68-55-202 (a)(1)] is designed to assist survivors and their families overcome the gaps in services within their communities.

(5) Implement, oversee and receive surveillance data from the Tennessee Brain Trauma Registry to use in developing and revising the state plan to meet the changing needs of this population:

The TBI registry data has been a valuable tool in documenting the need for TBI services and in program planning. Data from the TBI registry enabled successful application for the federal grant award that resulted in Project BRAIN and the new grant for Brain Links. Project BRAIN was designed to increase the numbers of students identified as having traumatic brain injury.

Registry data on sports concussions highlighted a problem in the state and, as a result, Tennessee became the 44th state to pass a sports concussion law designed to reduce youth sports concussions and increase awareness of traumatic brain injury. The Department of Health collaborated with Vanderbilt Medical Center and other professionals to develop *Return to Learn/Return to Play: Concussion Management Guidelines* which is available on the department website. The document is a resource for educators, coaches, health care providers, families and athletes. In FY18, 1,800 copies of the *Guidelines* were printed and distributed statewide.

The TBI Program Director serves on the Commissioner's Council on Injury Prevention, which is funded by a grant from the CDC. The TBI registry data is one of the data sources being used to identify areas of need.

(6) Evaluate surveillance data regarding the quality of services provided and outcome and impact on the quality of life of this population, including reintegration and productivity in the community;

As noted in TCA 68-55-202(a)(5) above, surveillance data is limited since the type of information being collected in the registry does not include the quality of services provided. However, the TBI program at the Tennessee Rehabilitation Center does provide reports on the outcome and impact of the quality of life of this population, particularly in community reintegration and productivity.

(7) Promote research on the causes, effects, prevention, treatment and rehabilitation of head trauma injuries;

The development of the state registry and the resulting availability of statistics are directed toward encouraging research on the causes, effects and treatment of brain trauma injuries. As information on TBI is collected by the central office and the service coordinators, areas for research on causes, effects, and prevention can be identified.

(8) Serve as a clearinghouse for the collection and dissemination of information collected on available programs and services. A statewide, toll-free telephone line shall be established and operated during normal business hours for the express purpose of providing such information to callers.

The TBI clearinghouse, accessible via a toll-free number, has been operational since 1994. Information is routinely updated on available programs and services across the state. A TBI Program brochure has been broadly distributed. The Program also has a web page on the Department of Health website:

<https://www.tn.gov/health/health-program-areas/fhw/vipp/tbi.html>

(b) Utilizing the services and expertise of the advisory council to the greatest extent possible and in cooperation with the advisory council, the TBI coordinator shall:

(1) Develop a coordinated case management system, a short-term state plan, a long-term state plan, affordable and accessible home and community based services, and criteria to identify training needs and priorities for all persons serving TBI clients;

The case management system known as Service Coordination and described in TCA 68-55-202 (a)(1) covers all 95 counties in the state. The Advisory Council and TBI coordinator have developed short-term and long-term goals and objectives for the program following the mandates in the legislation. Efforts to provide affordable and accessible home and community-based services are on-going through the TennCare Choices program. Currently, the TBI Program has a contract to provide personal care services on a limited basis in select facilities in Memphis and Johnson City. Training needs of persons serving TBI clients will be identified and addressed in the new federal grant, Brain Links. The TBI service coordinators also provide training to health care professionals in their respective communities.

(2) Establish and provide for the centralized organization of a statewide family clearinghouse of information, including availability of services, education and referral to survivors, professionals, and family members during the early stages of injury in the acute hospital setting.

Through the development of the TBI Resource Directory and in establishing the TBI registry, contacts have been made in the hospitals where acute care is provided. The service coordinators have also developed referral relationships with their local hospitals. Copies of the updated Resource Directory are distributed to facilities statewide. The improved system of reporting to the registry and letters being sent to survivors, coupled with service coordinators in place across the state, makes information and assistance available to survivors and family members in the early stages of injury and across the lifespan.

(3) Assure statewide compliance with licensure, if any, and performance standards through regular service monitoring, site visitation, and self-appraisal;

(4) If licensure is required, monitor and update licensure requirements specific to this population;

The Department of Health oversees certification and licensure of health care facilities in Tennessee. The TBI Program coordinator works with appropriate staff to ensure licensure compliance and to monitor and update licensure requirements specific to this population, as needed.

(5) Seek funding and other resources to assure that state personnel working with this disability group are properly trained and provided, at least annually, an opportunity to attend formal or informal education programs through colleges, workshops, seminars, or conferences;

In 2018, the TBI Program collaborated with the Brain Injury Association of Tennessee and Disability Rights Tennessee to plan and present an annual statewide conference. The *29th Annual TBI Survivor, Family and Caregiver Event* was attended by 90 people. Speakers addressed advocacy issues and law enforcement. The final panel presentation included speakers who provided eloquent and moving stories of their experiences as a survivor, a family member, and as a caregiver. Being able to offer the event day at no charge to participants is very much appreciated by survivors and families.

The TBI Program Director regularly provides educational presentations on brain injury to the Commissioner's Council on Injury Prevention which is attended by several state personnel that serve the TBI community. The TBI staff and service coordinators, as well as the Project BRAIN staff, regularly present at seminars and workshops, enhancing the ability of state personnel to meet the needs of survivors. During FY18, the TBI service coordinators collectively made 98 educational presentations to a total of 3,169 health care professionals and community members. They also provided 34 exhibits on brain injury that were seen by 12,840 participants.

The Project BRAIN staff provided 47 trainings to 1,473 school-related professionals. In addition, the brain injury transition liaisons provided 7 trainings to 82 health care professionals.

(6) Ensure updates and compliance standards from the National Head Injury Foundation's quality standards committee are made available to professionals and providers, on a timely basis, to help educate providers and professionals regarding the latest technology available to this disability group;

In addition to regularly scheduled trainings and the annual conference, the TBI program has developed a TBI Community Listserv to provide information on the latest technology available for the TBI community.

(7) Oversee efforts to better educate the general public concerning the need for head injury prevention programs and the need for early intervention, including but not limited to, developing plans and programs for affordable post-acute rehabilitation services, long-term care programs, respite services, and day treatment programs to deal with those who have lifelong disabilities, as well as developing plans and programs to deal effectively with TBI students in the educational system;

The TBI Program collaborates with the Brain Injury Association of Tennessee to present an annual conference focusing on current topics, including prevention and the need for early intervention. In addition, the TBI Service Coordinators provide prevention programs in their respective service areas. The TBI Program Director regularly provides educational presentations on brain injury to the Commissioner's Council on Injury Prevention. Project BRAIN is specifically designed to effectively assist TBI students in the educational system. Information on post-acute rehabilitation services, respite services, and day programs are included in the TBI Clearinghouse and the TBI Resource Directory. In the last year of the federal grant, Project BRAIN sought to link hospital and community health providers with school professionals in order to identify and address the needs of students with brain injuries. A specially designed TBI curriculum, *Brain Injury 101*, is used to train educators, health professionals, and families. Project BRAIN provided training in any school system in the state, upon request.

(8) Work with vocational rehabilitation and other state agencies to offer incentives and to obtain cooperation of private industries to initiate on-the-job training and supported employment for TBI persons;

The TBI program staff work with Vocational Rehabilitation counselors located throughout the state, helping to promote incentives and encourage private industry to initiate on-the-job training and supported employment opportunities for persons with traumatic brain injury. For example, the TBI staff maintains a close working relationship with Vocational Rehabilitation counselors and the TBI Program at the Tennessee Rehabilitation Center in Smyrna. The comprehensive program there provides job skills training and placement for approximately 45

students each year. A representative of the Vocational Rehabilitation program serves on the TBI Advisory Council, which furthers collaborative opportunities. TBI staff is available to provide technical assistance, as requested.

(9) Assist in obtaining grant funding and provide technical assistance for the Tennessee Head Injury Association (THIA) to develop policies and procedures to maximize self-determination and self-advocacy of a person suffering a TBI.

The TBI Program has established an excellent working relationship with the staff and board of the Brain Injury Association of Tennessee (BIAT) (formerly Tennessee Head Injury Association). In FY18, the TBI Program continued to support BIAT's work with survivors and their families. A grant from the TBI Program funded a full-time executive director who serves as an advocate to improve funding for services benefiting TBI survivors. In addition, the Nashville Area Service coordinator is housed at BIAT, an efficient and direct connection for BIAT callers. The TBI Service Coordinators facilitate brain injury support groups across the state. The monthly meetings of the support groups provide a way to meet the educational, social, and emotional needs of survivors and families.

T.C.A. 68-55-203. Brain Trauma Registry

The commissioner shall establish and maintain a central registry of persons who sustain traumatic brain injury. The purpose of the registry is to: (1) collect information to facilitate the development of injury prevention, treatment and rehabilitation programs; and (2) ensure the provision to persons with traumatic brain injury of information regarding appropriate public or private agencies that provide rehabilitation services so that injured person may obtain needed services to alleviate injuries and avoid secondary problems.

The TBI registry is a mechanism for collecting data on brain injury in the state. In calendar year 2017, 7,402 patients were reported to the TBI registry with at least one brain injury diagnosis; 6,680 of these patients were hospitalized and discharged alive while the remaining 722 patients died as a result of their injuries. Accidental falls were the leading cause of injury amongst patients included in the Registry at 32% of all causes. The *Traumatic Brain Injury Annual Surveillance Report* is included as Attachment 1.

The TBI registry is supported by an Epidemiologist housed in the Family Health and Wellness Division. Data collection officially began with patients discharged during 1996. Reporting hospitals submit data on inpatients or any deceased patients with TBI-specific ICD-10 diagnosis codes; patients seen in emergency rooms who were sent home the same day are not included in the registry. Hospitals are required to report within six weeks of the end of the quarter. All hospitals in the state are currently in compliance with this legislation.

In September 2017, the TBI Registry rolled out a new submission platform that improved reporting efficiency, timeliness, and data quality. Data collected from the registry enables staff to pinpoint the population being affected by brain injury and are used for injury prevention and health care planning.

The registry also serves to connect brain injury survivors with needed services. All Tennessee residents listed on the registry receive a letter and program brochure to inform them of the services available through the TBI program. In FY18, 3,107 letters were mailed. For many, the letter is the first link to information regarding needed rehabilitation services and programs.

T.C.A. 68-55-401. Traumatic Brain Injury Fund.

There is hereby established a general fund reserve to be allocated by the General Appropriations Act which shall be known as the "traumatic brain injury fund" hereafter referred to as the fund. Money from the fund may be expended to fund the registry, the TBI coordinator position, and additional staff requirements and other expenditures and grants under the provisions of this chapter.

The fund has been established in the Department of Health and revenues have been deposited into the fund as they have been received. The Fund Balance as of June 30, 2018 was \$1,174,000. Funds are used to cover staff positions and to fund grants. In FY17, the TBI Advisory Council was approved to utilize available resources in the TBI trust fund for the benefit of TBI survivors. The Council developed a five-year plan to use these funds to directly assist persons with TBI and their families by implementing a Targeted TBI Family Support Program, modeled on the existing state Family Support Program in the Department of Intellectual and Developmental Disabilities. During FY18, the first year of the program, there were 114 participants in the program.

T.C.A. 68-55-402. Grant Programs.

From the revenues deposited in the traumatic brain injury fund, the Department of Health is authorized to provide grants to county and municipal governments and/or not for profit organizations for home and community based programs to serve the needs of TBI persons and their families. The department is authorized to establish such grant programs and to develop criteria for eligible applicants.

In accordance with the legislation, the TBI Program has awarded numerous grants for a variety of projects since 1995. Examples include:

- Crumley House Brain Injury Rehabilitation Program in Johnson City expanded their day program to provide recreation, transportation, and respite care to TBI survivors and their families.
- Mid-South Head Injury Association in Memphis and Brain Injury Association of Tennessee developed a comprehensive proposal to build affordable, accessible, supportive housing for forty-eight TBI survivors in Memphis and Nashville using HUD Section 811 grant dollars.

- The Division of Rehabilitation Services created a specialized program for TBI persons at the Tennessee Rehabilitation Center (TRC) in Smyrna.
- The Tennessee Emergency Services for Children project improved the capability of 54 rural hospitals in the early management of acutely injured children.

In FY18, through competitively awarded grants the following services were provided:

- Tennessee Community Resource Agency provided personal care services for eight individuals with TBI who live in two accessible, affordable apartment buildings in Memphis.
- Crumley House Brain Injury Rehabilitation Center offered respite and personal care assistance to twenty-four TBI survivors.
- Arc of Davidson County and Greater Nashville provided TBI Family Support Program services to 114 participants.
- Easter Seals Tennessee provided camp and recreational opportunities for 58 adults and youth with TBI.
- The Brain Injury Association of Tennessee employed a full-time executive director.
- The Tennessee Disability Coalition managed and implemented Project BRAIN.
- Grants for service coordination were awarded to:
 - Brain Injury Association of Tennessee
 - Chattanooga Area Brain Injury Association
 - Crumley House Brain Injury Rehab Center
 - Epilepsy Foundation of Middle and West Tennessee
 - Fort Sanders Regional Medical Center
 - Jackson Madison County General Hospital District
 - Regional One Health

Part 5 T.C.A. 68-55-501 to 503 Youth Sport-Related Injuries

In April 2013, Tennessee became the 44th state to pass legislation aimed at reducing youth sports concussion and increasing awareness of traumatic brain injury. Both public and private school sports and recreational leagues for children under age 18 that require a fee are affected by the new law. The law covers all sports. The TBI Program staff led the effort to convene an interdisciplinary team of experts to review materials and make recommendations. The required educational materials are free of charge and readily available from the Tennessee Department of Health website:

<https://www.tn.gov/health/health-program-areas/fhw/vipp/tbi/tennessee-concussion.html>

Project BRAIN developed concussion-specific training for coaches and athletes. During FY18,

staff provided 2 concussion-specific trainings to 70 participants. The Department of Health collaborated with Vanderbilt Medical Center and other professionals to develop *Return to Learn/Return to Play: Concussion Management Guidelines* which has been printed and distributed and is available on the department website. The document is a resource for educators, coaches, health care providers, families and athletes.

Conclusion and Recommendations

Although much has been accomplished, injuries persist. Work must continue to address the needs of all survivors in the state, particularly in the areas of day programs, housing, long-term care, and rehabilitation. The Council respectfully recommends that the legislature continue to support making home and community-based services available as an alternative to institutional care. The TBI Advisory Council commends the legislature for the passage of the sports concussion law which will improve the safety of sports statewide, and for maintaining the universal motorcycle helmet law that has resulted in lives saved and injuries avoided. The Council extends their gratitude for the opportunity to work to improve the lives of TBI survivors throughout Tennessee.

Traumatic Brain Injury Annual Surveillance Report 2017

Division of Family Health and Wellness

January 2019



A Note to the Reader

Readers should interpret all findings with caution. In some cases, and particularly when examining county-level data, the counts provided in this report are small (≤ 20) and therefore, rates and other calculations may be statistically unreliable.

We encourage caution in interpreting results and comparing differences across counties. If you have questions about particular data points or need assistance interpreting the data, please contact:

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Executive Summary

In 1993, the Tennessee General Assembly established the Tennessee Traumatic Brain Injury Program and Registry to address the growing needs of brain injury survivors within the state. Tennessee Code Annotated 68-55-203 mandates that the Department of Health develop and maintain a registry of these patients. Data collection began in 1996, just three years after the law passed, ultimately producing an annual report summarizing the characteristics of patients submitted to the Registry. Since inception, the Registry has collected data on over 150,000 patients and has connected Tennessee TBI survivors with vital resources for their recovery. Data from the Registry has also been advantageous in detecting populations at risk for and prevalent mechanisms of TBI in order to enhance and tailor prevention efforts. The findings in this report serve to continue and enhance these efforts.

Key Findings

- During the 2017 calendar year, a total of 7,402 TBI patients met criteria for required report to the Registry. Of these, 6,680 presented with a nonfatal TBI-related hospitalization (length of stay \geq 24 hours) and 722 were deceased.
- A considerable percentage of TBI patients reported to the Registry required extended care following their injury: 29% were discharged from the hospital to rehabilitation, skilled nursing, or other long-term care facilities.
- 57% of TBI patients reported to the Registry were older adults over 54 years of age. Females ages 75 to 84 comprised the largest proportion of reported TBI patients.
- Overall, 58% of TBI patients were males. The number of male TBI patients exceeded females in every age group except in patients aged 1-4 years and patients over 75 years. The gender difference varied within racial groups: 55% of white TBI patients were male compared to 69% of black TBI patients.
- Intracranial injuries were by far the most common type of TBI diagnosed, present in 91% of reported patients (sometimes in conjunction with other TBI diagnoses).
- Falls were the leading cause of TBI injury, followed by motor vehicle accidents. Wider gender disparities existed amongst injuries caused by motor vehicle traffic crashes, assault, and intentional self-harm, where males made up 61%, 82%, and 80% of TBI patients respectively.
- The age-adjusted rate of TBI-related hospitalization among Tennesseans in 2017 was 74.1 per 100,000. Three counties (Meigs, Grundy and Sequatchie) had age-adjusted rates of TBI hospitalization that were over two times the state rate.

Traumatic Brain Injury in Tennessee

Introduction

Traumatic brain injuries (TBIs) are acquired injuries, caused by a “bump, blow, or jolt to the head, or a penetrating head injury that disrupts the normal function of the brain¹”. Because of their nature, TBIs are a major cause of death and disability, making these injuries a significant public health problem across the United States. In order to address the unique needs of Tennesseans who have sustained a TBI, the Tennessee General Assembly established the Tennessee Traumatic Brain Injury Program and Registry in 1993.

The Tennessee Traumatic Brain Injury Registry began collecting brain injury data in 1996 with the core purpose of connecting TBI survivors, via a survivor letter, with resources available to them during the course of their recovery. All non-federal reporting hospitals (n=130) are mandated to submit any traumatic brain injury-related hospitalization (patients with a length of stay of at least 24 hours) or death (patients who expire at or before reaching the facility) to the Registry.

All patients meeting these criteria are to be reported to the Registry, regardless of residence, although only Tennessee residents admitted to the hospital receive survivor letters from the Program. Required data fields include demographic, injury, and facility information. Patient inclusion for the annual report is determined by date of discharge. Short-stay TBI-related emergency department visits are increasingly submitted, but are not compulsory and are thus not included in the analyses presented in this report.

The data within this report describe the causes of TBIs in Tennessee and support the planning and implementation of initiatives to reduce these injuries throughout the state. Information presented in this surveillance summary is based on final data collected by the Tennessee TBI Registry for the calendar year of 2017.

¹ Basic Information about Traumatic Brain Injury and Concussion. (2019, January 20) Retrieved from: <http://www.cdc.gov/traumaticbraininjury/basics.html>

Note on Coding Terminology

Data submission in International Classification of Diseases Tenth Revision, Clinical Module (ICD-10-CM) format began on October 1, 2015. ICD-10-CM coding is intended to enhance the quality of healthcare data in the United States, in turn improving epidemiological research. In particular, ICD-10-CM codes provide significantly more detail on the clinical event. Brain injury codes benefit from the higher level of detail, especially in respect to severity and laterality. Table 1 provides the proposed ICD-10-CM surveillance definition for traumatic brain injury, as designated by the Centers for Disease Control and Prevention.

Table 1. ICD-10-CM Code Ranges for TBI Surveillance, CDC definition².

ICD-10-CM Code	Description
S02.0, S02.1-	Fracture of skull
S02.8, S02.91	Fracture of other specified skull and facial bones; Unspecified fracture of skull
S04.02, S04.03-, S04.04-	Injury of optic chiasm; injury of optic tract and pathways; injury of visual cortex
S06-	Intracranial injury
S07.1	Crushing injury of skull
T74.4	Shaken infant syndrome

"-" indicates any 4th, 5th or 6th character

7th character of A or B for S02.0, S02.1-, S02.8 and S02.91

7th character of A for S04.02, S04.03-, S04.04-, S06-, S07.1 and T74.4

It is important to note that these definitions only collect initial encounters (7th character of 'A' and/or 'B' depending on the ICD-10 code), allowing for a better estimation of prevalence. However, this makes any readmission analyses difficult. While outside of the scope of this report, an analysis of readmissions due to TBI would be helpful in estimating burden.

ICD-10-CM is new for collecting clinical morbidity-related data, therefore we do not yet have standards for measurement of sensitivity and specificity of these codes. Thus, this proposed definition may be altered as more data become available.

² Hedegaard, H; Taylor, C. A surveillance case definition for Traumatic Brain Injury using ICD-10-CM. National Association of State Head Injury Administrators. Webinar, September 17, 2015.

General

As stated in the Introduction, hospitals are mandated to report all TBI-related hospitalizations and deaths that occur at or during transport to the hospital. TBI-related deaths that occur outside the purview of the hospital (e.g., fatal shootings of the head that are declared dead at the scene) are not included in the Registry.

In 2017, 7,402 patients were reported to the Registry with a traumatic brain injury

During calendar year 2017, a total of 7,402 patients met the criteria for mandated report to the Registry. Of these 7,402 patients, 7,277 were hospitalized and the remaining 125 were deaths that occurred in the emergency department. A portion of the hospitalized patients also died as a result of their injuries: of the 7,277 inpatient hospitalizations, 597 expired—leading to a total 722 deaths reported to the Registry for 2017. The remaining 6,680 inpatient hospitalizations were discharged alive, most commonly in routine discharges to home but a considerable percentage to long-term care facilities (Table 2).

Table 2. Reported discharge status of 7,402 TBI patients meeting criteria for required report to the Registry, Tennessee 2017.

Patient Status	N	%
Alive at discharge	6680	90
Routine discharge to home	3683	50
Discharge to home under care of organized home health service organization	509	7
Discharged to another hospital for further care	204	3
Discharged to rehabilitation, skilled nursing, or other long-term care facility (includes hospice home care)	2167	29
Other (includes left against medical advice and discharged to jail, prison, or other detention facilities)	117	2

Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.

Demographics

The majority of traumatic brain injuries reported to the Registry occurred in the older adult population: 57% (N=4,219) of patients were over 54 years of age. More males (58%, N=4,294) sustained traumatic brain injuries than females, and this difference was seen within most age groups. However, within the two oldest age groups, the trend changed and women sustained more TBIs than

males (Figure 1). Females ages 75 to 84 comprised the largest proportion of reported TBI patients at just over 9% (N=684), followed by males ages 65-74 at approximately 8% (N=623). Excluding the senior population, the gender difference became more stark; amongst TBI patients less than 65 years of age (N=4,046), 67% (N=2,728) were male.

57% of reported TBI patients were older adults over 54 years of age

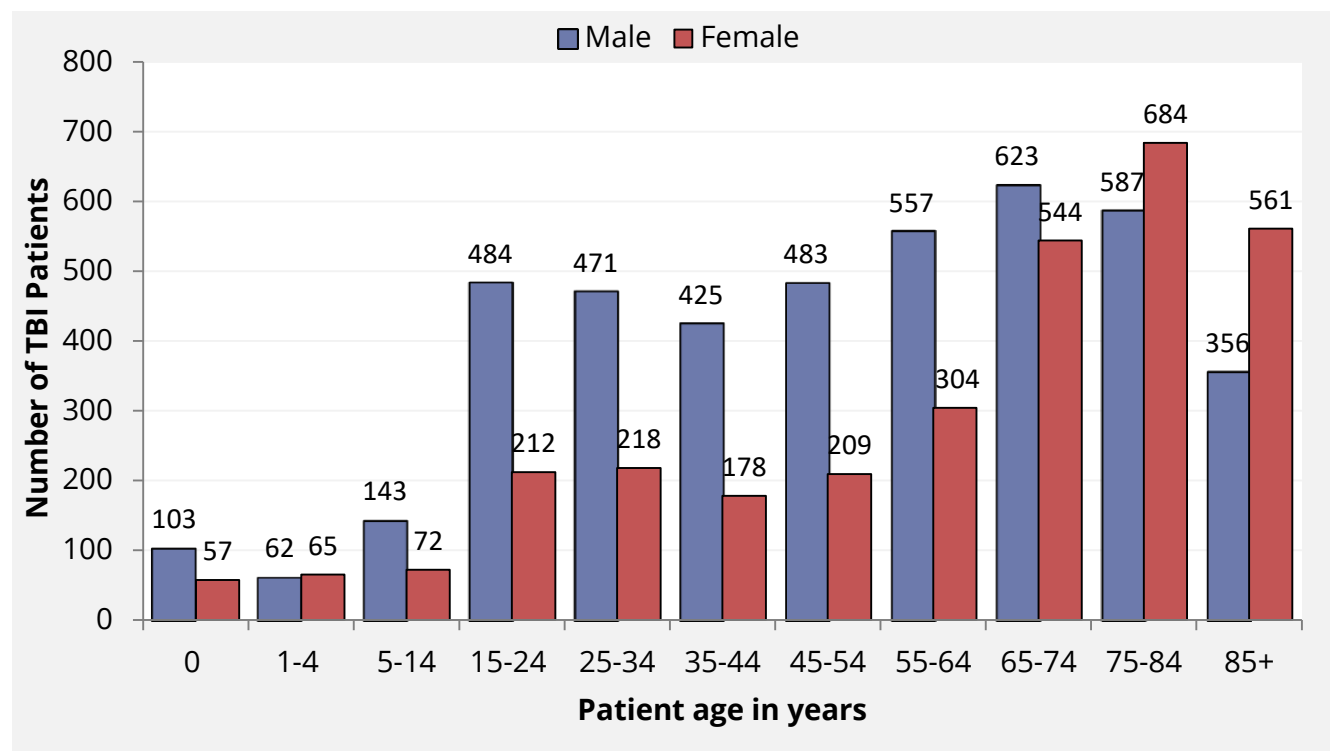


Figure 1. Number of TBI-related hospitalizations and deaths reported to the Registry by age group and sex, 2017. Note that patients with unknown sex are not shown in the above figure. *Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.*

Approximately 80% (N=5,913) of reported TBI patients were white, while 15% (N=1131) were black, 3% (N=206) were another race, and the remaining 2% (N=152) were an unknown race. The gender difference noted amongst all TBI patients varied depending on race; 55% of white TBI patients were male compared to 69% of black TBI patients (Figure 2).

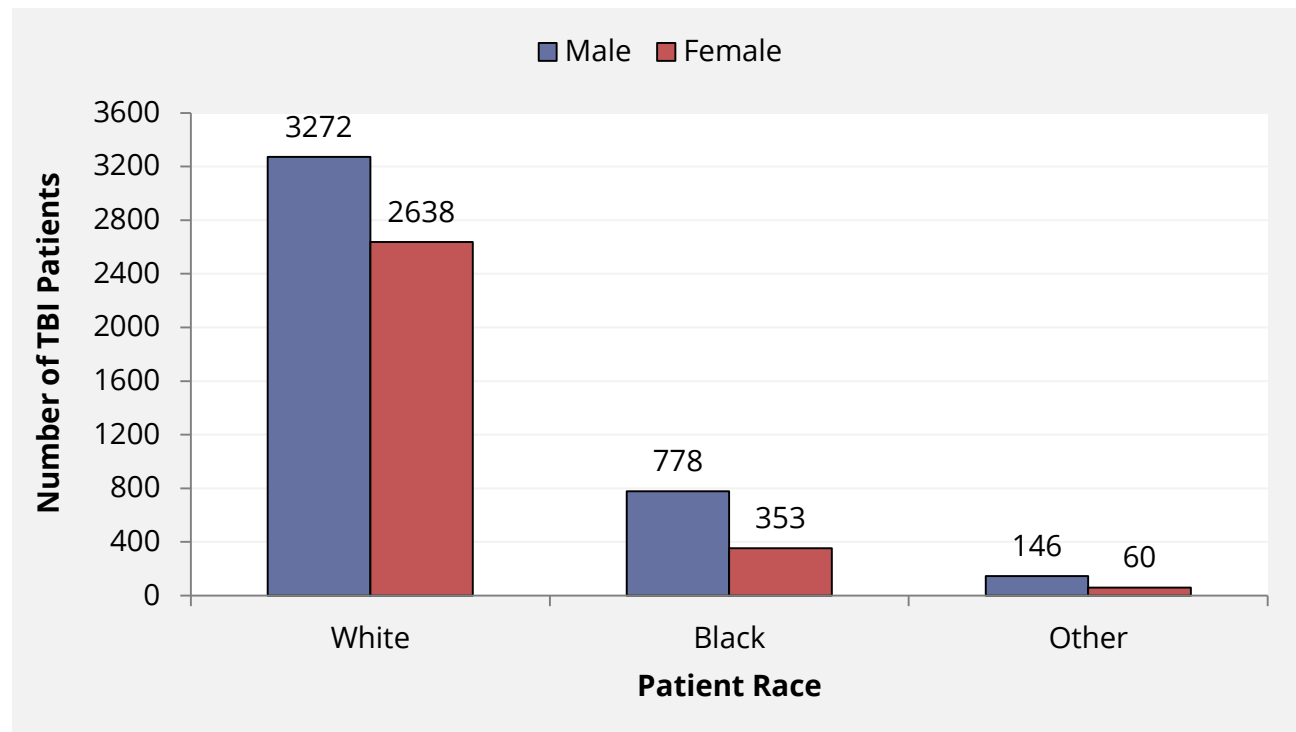


Figure 2. Number of TBI-related hospitalizations and deaths reported to the Registry by race and sex, 2017. Note that patients with unknown sex are not shown in the above figure. *Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.*

Brain Injury Diagnoses

Every patient reported to the Registry had at least one traumatic brain injury diagnosis, and many patients had multiple types of TBI. By far, the most common traumatic brain injuries reported were categorized as intracranial injuries. Although this may not be the primary TBI diagnosis in each case, 91% (N=6,745) of patients were diagnosed with at least one intracranial injury. Skull fractures were the second most common type of TBI, diagnosed in 25% (N=1,817) of patients reported to the Registry.

The types of TBI varied in terms of most common causes. The most common cause of intracranial injuries was accidental falls, while the most common cause of skull fractures was motor vehicle traffic accidents (Table 3).

Table 3. Types of TBI by cause of injury for TBI-related hospitalizations and deaths reported to the Registry, 2017.

TBI Diagnosis	Total N	Accidental Falls N(%)	Motor Vehicle Traffic N(%)	Assault N(%)	Struck By/ Against N(%)	Self- Harm N(%)	Other/ Unknown Cause N(%)
Skull Fractures (S02.0, S02.1-, S02.8, S02.91)	1817	446 (25)	484 (27)	173 (10)	36 (2)	68 (4)	610 (34)
Optic Injuries (S04.01-, S04.02-, S04.03-)	22	1 (5)	6 (27)	1 (5)	0 (0)	2 (9)	12 (55)
Intracranial Injuries (S06-)	6745	2251 (33)	1839 (27)	238 (4)	107 (2)	83 (1)	2227 (33)
Crushing Injuries (S07-)	7	0 (0)	3 (43)	0 (0)	1 (14)	0 (0)	3 (43)

Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.

The final type of TBI, shaken infant syndrome (often referred to as shaken baby syndrome), is not included in Table 3 as the cause is inherent to the diagnosis. In 2017, there were a total of 52 patients reported to the Registry with an injury resulting from child abuse with 16 of them reported as having shaken infant syndrome.

In ICD-10-CM, concussions are intracranial injuries with the first 4 digits of “S06.0.” Although concussions are the least severe intracranial injuries, they can produce lasting effects in those who sustain them. In 2017, 16% (N=1,172) of TBI patients reported to the Registry were diagnosed with a concussion, either as the sole TBI diagnosis or in conjunction with another type of TBI. The slight majority of concussion patients were male (52%, N=611) and 45% (N=525) of all concussion patients were 65 years of age or older (Figure 3).

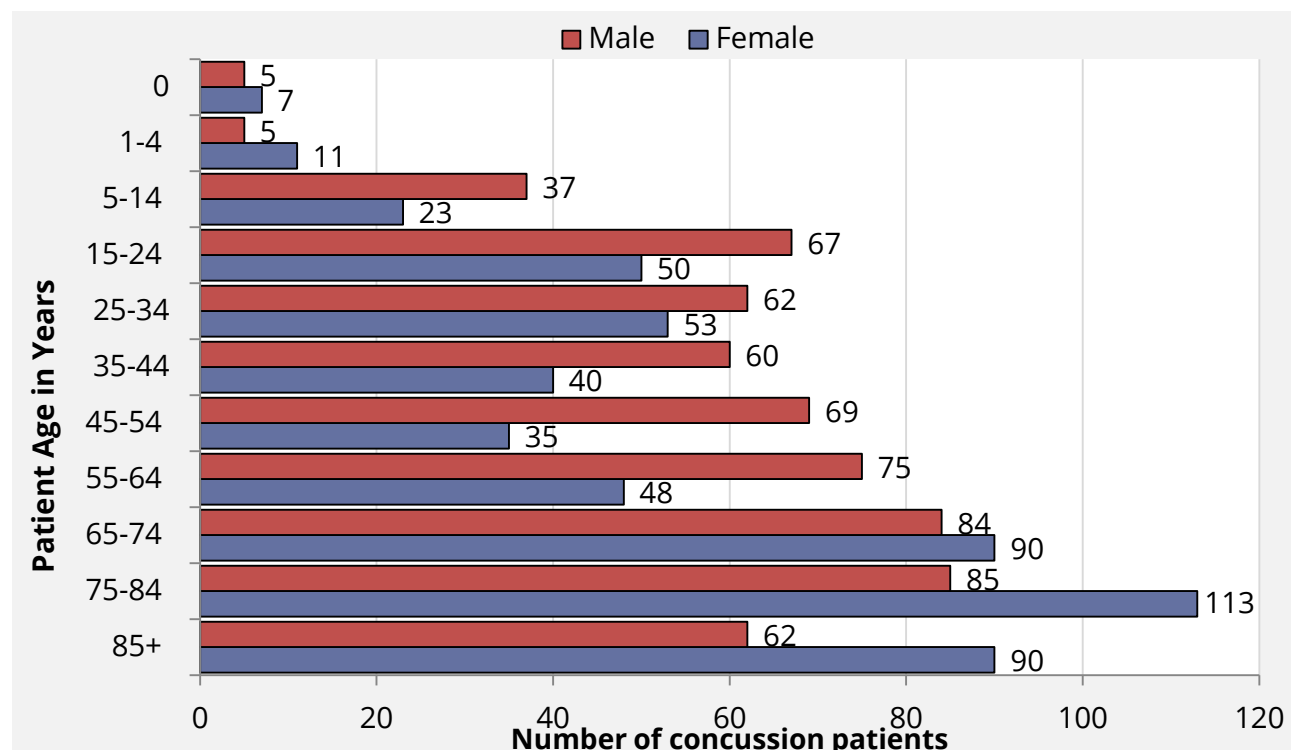


Figure 3. Number of TBI-related hospitalizations and deaths reported to the Registry with concussion diagnoses by race and sex, 2017. *Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.*

A 2016 study demonstrated that 82% of pediatric concussion patients first sought care within primary care and only 12% were seen in the emergency department³. Since this analysis is limited to inpatient hospitalizations and deaths and does not capture cases seen elsewhere (i.e. emergency department, primary care), it undoubtedly provides a substantial underestimation of the full burden of concussion within the state.

³ Arbogast, KB et al. Point of Health Care Entry for Youth with Concussion within a Large Pediatric Care Network. *JAMA Pediatr.* 2016 Jul 5.

External Causes

External cause codes describe the mechanism by which the traumatic brain injury occurred. Although this is not a required field, as often the mechanisms are unknown or unclear, it is highly encouraged that this field is captured. For 2017, 74% of patients reported to the Registry had at least one valid external cause code.

Since the Registry began collecting data in 1996, the leading causes of TBI in Tennessee have been accidental falls and motor vehicle accidents. Falls surpassed motor vehicle accidents as the most frequent cause of TBI in 2007, likely due to the increase of fall-related TBI in seniors⁴. In 2017, accidental falls remained the leading cause of injury amongst patients reported to the Registry, accounting for 32% (N=2,402) of patients.

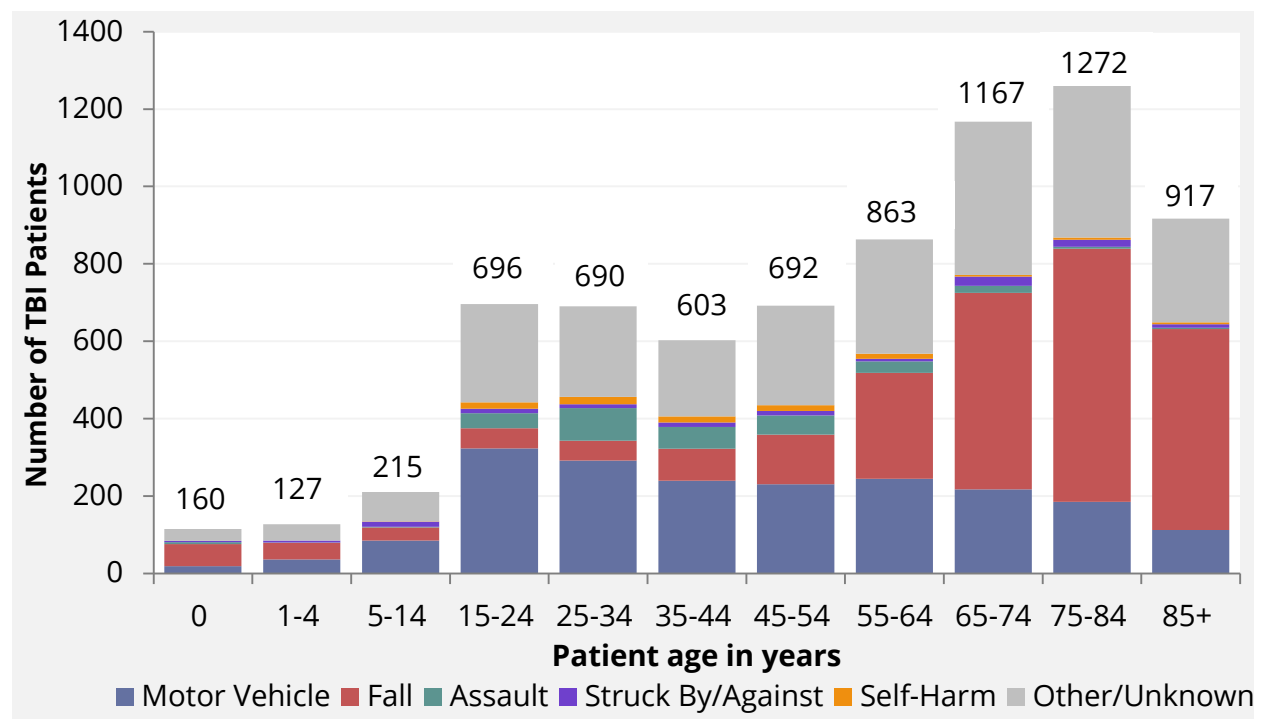


Figure 4. Number of TBI-related hospitalizations and deaths reported to the Registry by age and cause of injury, 2017. *Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.*

⁴ Traumatic Brain Injury Registry, historical data, 1996 through 2017.

Falls were the leading cause of TBI-related hospitalizations and deaths reported to the Registry in children under 5 (35%, N=100) and adults over the age of 64 (50%, N=1,682). However, motor vehicle traffic accidents accounted for 27% (N=1,985) of Registry patients overall and were the leading cause of injury in patients ages 5 to 64 (38%, N=1,416) (Figure 4).

Amongst male patients, motor vehicle traffic accidents were the leading cause of injury while falls were the leading cause for female patients. As stated earlier, males made up the majority (58%) of reported TBI patients overall, and this difference widened within particular causes of injury. For example, 61% of patients injured in motor vehicle traffic accidents were male. The male majority was larger still amongst TBI patients with injuries caused by assault and intentional self-harm, 82% and 80% respectively.

In 2017, seasonal differences existed in the dominant cause of injury amongst TBI patients reported to the registry. Motor vehicle traffic-related TBI cases increased sharply in the spring season, rising above fall-related cases to become the leading cause of injury for these three months. Falls were the most prevalent cause of injury for all other months, peaking in October (Figure 5).

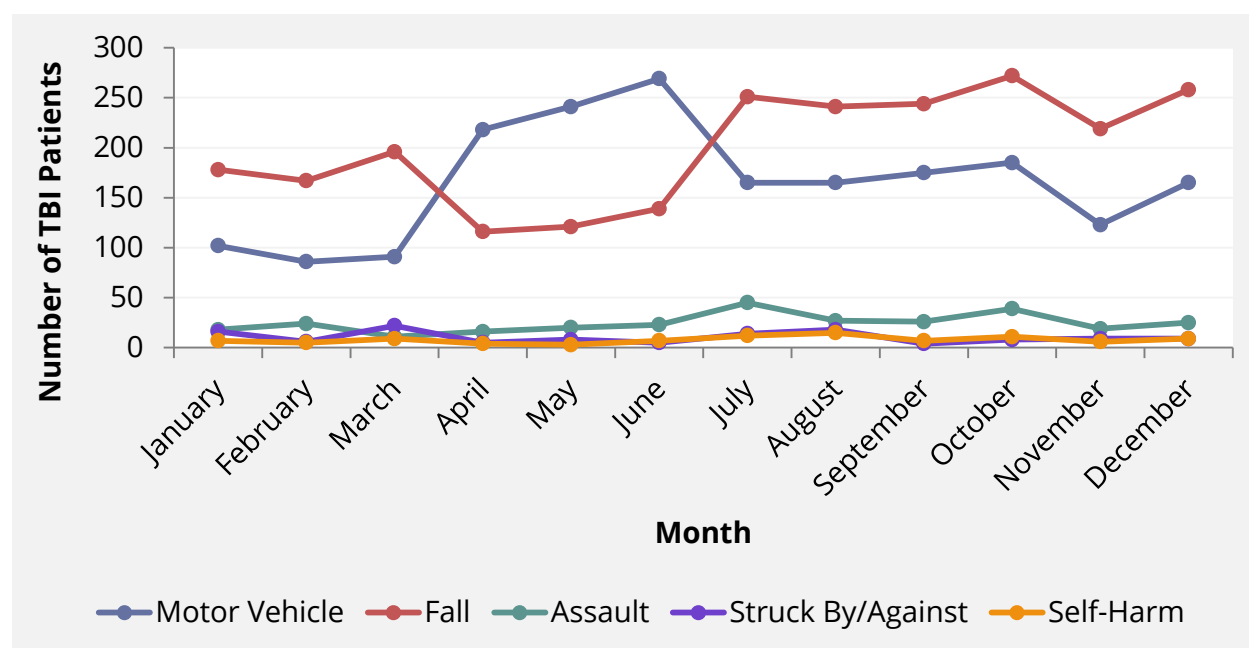


Figure 5. Number of TBI-related hospitalizations and deaths reported to the Registry by month of patient discharge, 2017. *Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.*

Falls were also the leading cause of injury amongst TBI-related deaths reported to the Registry at approximately 30% (N=216) of fatal cases, closely followed by motor vehicle traffic accidents which represented 27% (N=197) of fatal cases (Figure 6). It is important to reiterate that the deaths reported to the Registry are those that happen during hospitalization or during transport to reporting hospitals. Therefore, they do not represent all TBI-related deaths in Tennessee, and causal patterns could differ when examining all TBI-related deaths.

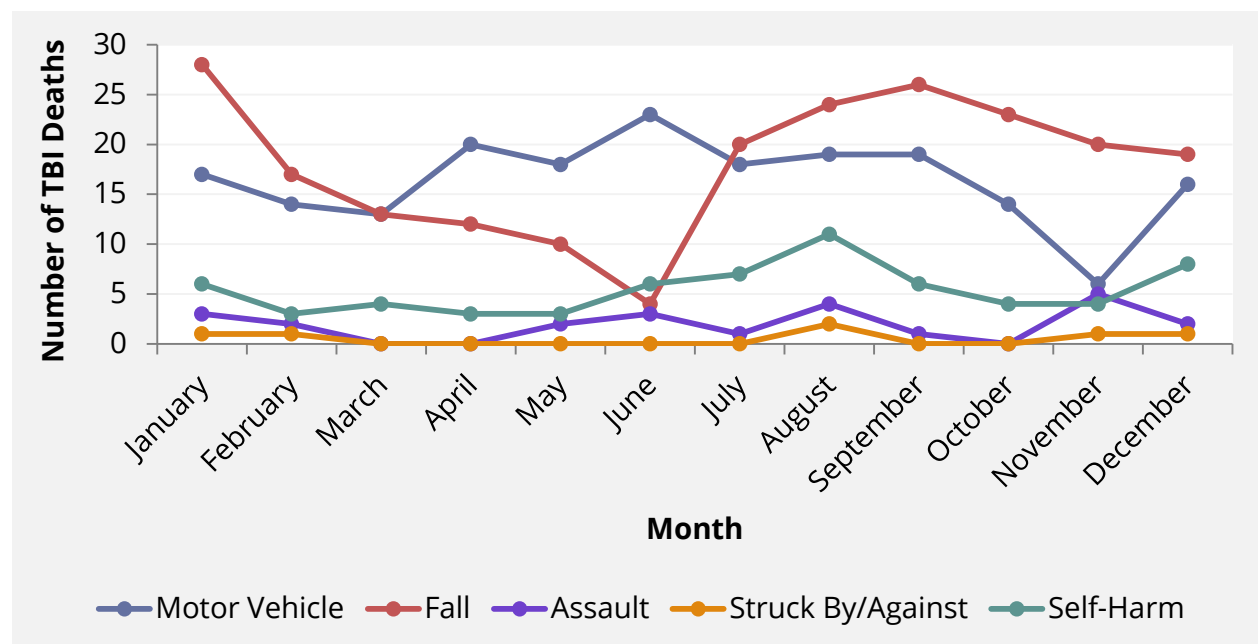


Figure 6. Number of TBI-related deaths reported to the Registry by month of patient discharge, 2017. *Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.*

Rates

Unlike earlier calculations that included all TBI patients reported to and meeting the legislative rules of the Registry, the following rates are calculated using only Tennessee resident patients. Only rates for TBI-related hospitalization (and not TBI-related mortality) are presented because not all cases of TBI-related death are reported to the Registry.

Hospitalization Rates

Hospitalization rates are calculated using patients that were reported as a hospitalization (length of stay ≥ 24 hours) to the Registry.

In 2017, 5,365 Tennesseans were hospitalized with a TBI. The statewide age-adjusted rate of TBI-related hospitalization was 74.1 cases per 100,000 population. The TBI-related hospitalization rates for Meigs, Grundy, and Sequatchie counties were over twice as high as the state rate (Figure 7). These three counties also ranked in the top ten for 2016, with Meigs maintaining its place as the number one county overall. A full listing of hospitalization rates by county of patient residence can be found in the Appendix at the end of the report.

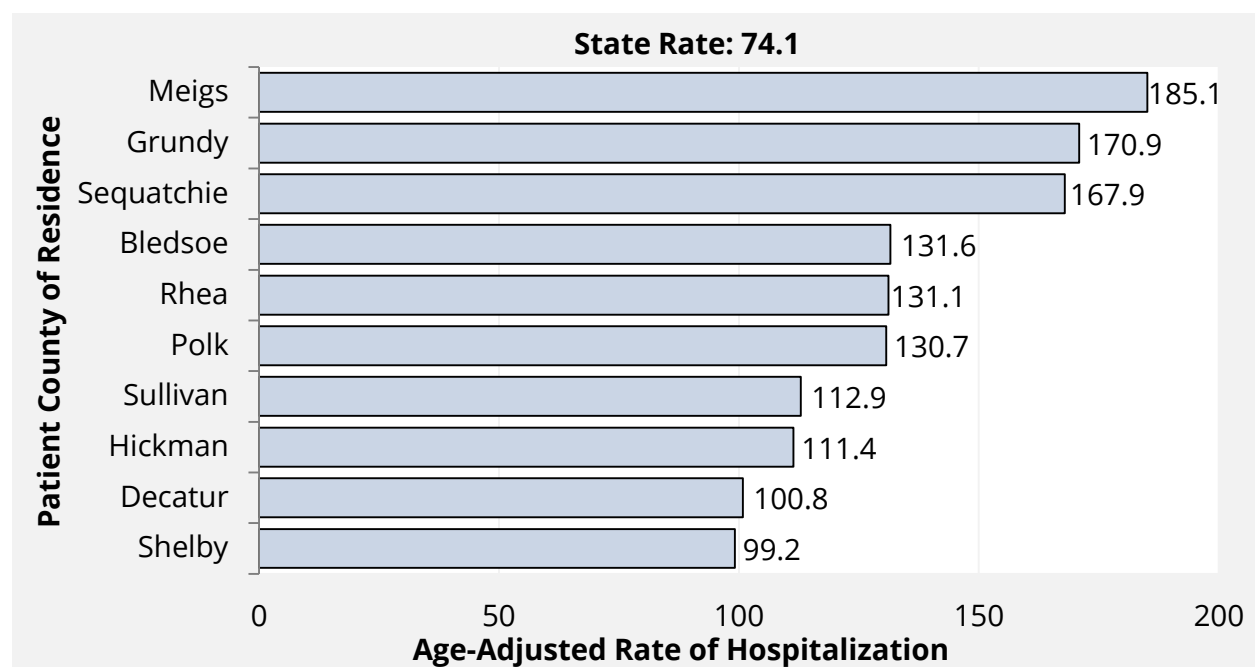


Figure 7. Top ten county-level age-adjusted rates of TBI-related hospitalization, 2017. *Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.*

Additional Information

State of Patient Residence

Approximately 74% (N=5,477) of reported TBI hospitalizations and deaths reported to the Registry involved a Tennessee resident, while just over 26% (N=1,923) involved non-residents, primarily from the states bordering Tennessee (Table 4).

Table 4. State of Residence of 7,402 TBI patients, 2017.

Patient State of Residence	N	%
Tennessee	5477	74.0
Mississippi	383	5.2
Georgia	378	5.1
Kentucky	256	3.5
Virginia	242	3.3
Arkansas	237	3.2
Alabama	140	1.9
North Carolina	77	1.0
Missouri	33	0.4
Other US States	177	2.4

State of Injury

The location of the incident resulting in the injury was unknown for 26% of patients. Overall, 61% (N=4,495) were reported to occur in Tennessee, while another 13% (N=963) occurred in the states bordering Tennessee (Table 5).

Table 5. State of Injury of 7,402 TBI patients, 2017.

Patient State of Residence	N	%
Tennessee	4495	60.7
Georgia	259	3.5
Virginia	194	2.6
Kentucky	168	2.3
Mississippi	134	1.8
Alabama	77	1.0
Arkansas	66	0.9
North Carolina	48	0.6
Missouri	7	0.1
Other US States	10	0.1
Unknown	1944	26.3

Length of Stay

The average length of stay for a TBI-related nonfatal hospitalization in 2017 was 6.4 days, remaining steady from 2016⁵.

Historical Trends

Rates presented here again include only Tennessee resident patients. All figures include dashed vertical lines to mark the transition of hospital data from ICD-9-CM to ICD-10-CM in the middle of 2015. Because of the substantial differences in the way data is captured in the two coding systems, trends should not be compared across the transition.

Male Tennesseans have consistently sustained more traumatic brain injuries than females. Since the Registry's inception in 1996, the rate of males reported to the registry with TBI-related hospitalization or death has been 58% higher than that of females on average (Figure 8). However, the difference has narrowed to only 38% in 2017.

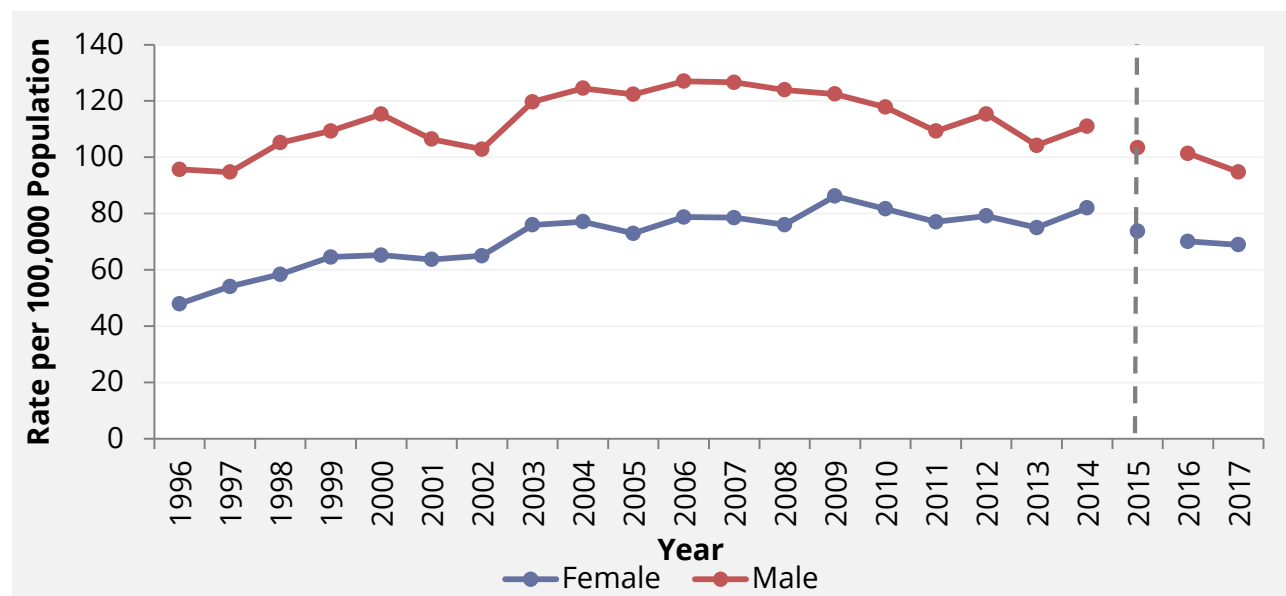


Figure 8. Rates of TBI-related hospitalization and death reported to the Registry by sex, 1996-2017. *Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.*

⁵ Traumatic Brain Injury Surveillance Annual Report, 2016. Tennessee Department of Health, Nashville, TN.

Figure 9 shows the pattern of fall-related TBI hospitalizations and deaths over time. Although falls seem to have declined since 2014, this is likely due to the change in coding system from ICD-9-CM to ICD-10-CM during 2015.

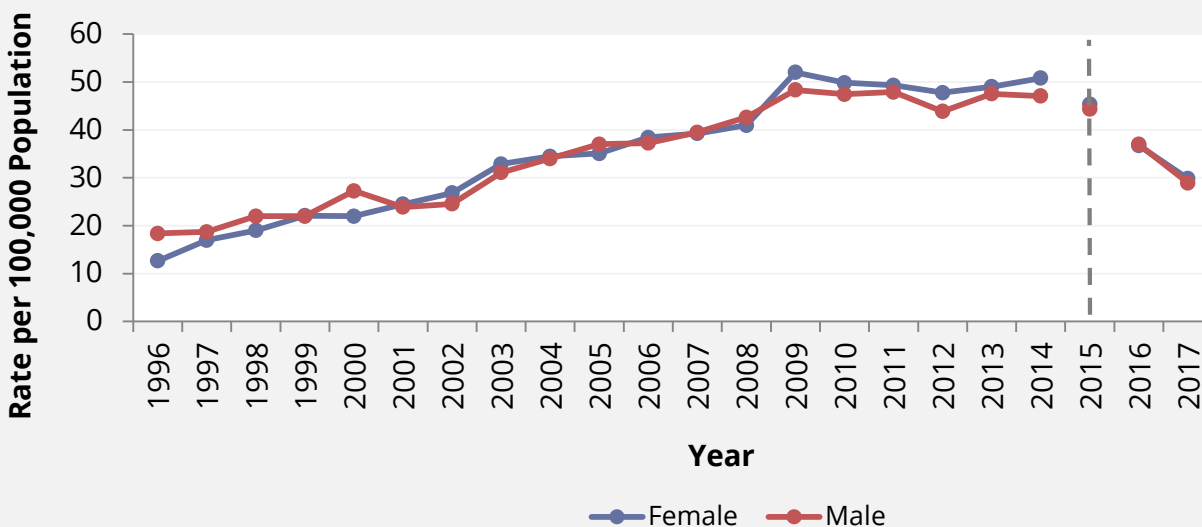


Figure 9. Rates of fall-related TBI-related hospitalization and death reported to the Registry by sex, 1996-2017. *Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.*

Figure 10 provides a snapshot of the patterns of all mechanisms of injury since 1996. Falls steadily increased from 1996 to 2007, surpassing transport accidents that year to become the leading cause of TBI in Tennessee.

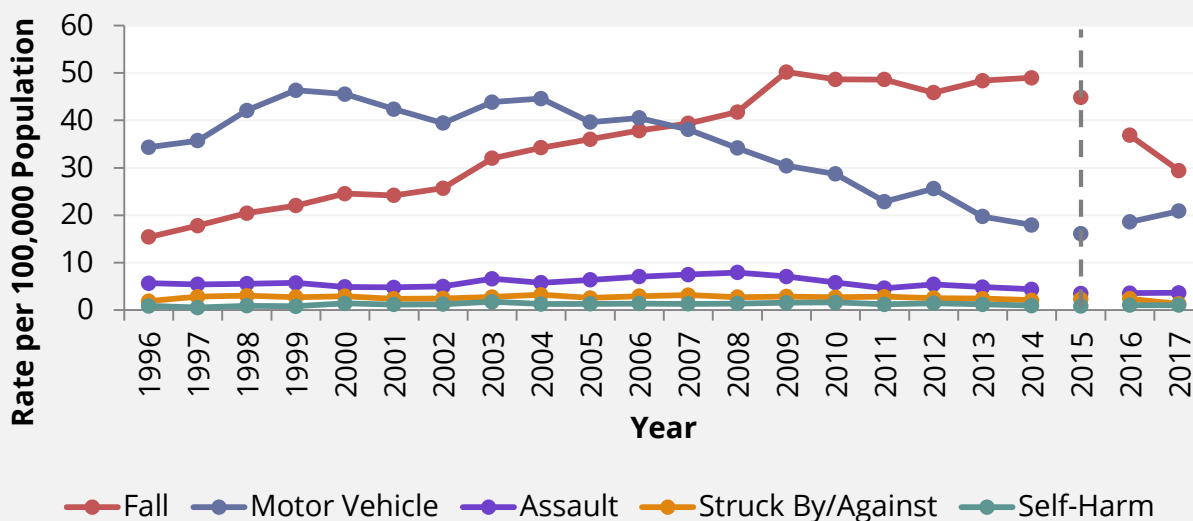


Figure 10. Rates of TBI-related hospitalization and death reported to the Registry by cause, 1996-2017. *Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.*

Limitations

As emphasized throughout this report, the analyses presented are for the TBI Registry-reported cases, which include all TBI-related hospitalizations and those TBI-related deaths which occurred at or during transport to the hospital. Many TBI-related fatal injury cases die outside of the hospital and are thus not reported to the Registry. For reference, based on Vital Statistics death data, in 2017 there were a total of 1,485 TBI-related deaths of Tennessee residents. In comparison, only 722 TBI-related deaths were reported to the Registry, 581 of which involved Tennessee residents. Because most TBI-related deaths are not submitted to the Registry, we have not presented TBI-related mortality rates for Tennessee overall or by county; this information would be better gleaned from the Vital Statistics death data than from our hospital-based reporting.

For conciseness, the program chooses to present the demographic characteristics for all TBI Registry cases (both hospitalizations and deaths) together, while separating hospitalizations for rate calculations. Additional demographic analyses are available upon request.

Increasingly, hospitals also submit data on TBI-related emergency department visits. However, these are not currently required to be reported to the Registry. It is unknown if patients treated in these situations, who presumably sustain less severe brain injuries, may also require the services provided through the TBI program due to lasting effects.

Conclusion

Traumatic brain injury contributes to a significant proportion of death and disability in the State of Tennessee. Fortunately, T.C.A. 68-55-203 has enabled the TBI Program to provide assistance to over 80,000 Tennessean survivors since this legislation came into effect. Continuous surveillance of TBI allows us for targeted interventions that may alleviate this burden.

Recent advancements in neurological science and clinical care allow for improved intervention to TBI patients. However, these injuries still occur at alarming rates, and patients are in need of long-term assistance. The findings in this report not only emphasize the continued need for these TBI patient resources in Tennessee, but also highlight the opportunity to enhance TBI prevention efforts across the state.

Acknowledgements

The Tennessee Department of Health would like to acknowledge all the reporting hospitals across Tennessee, especially the staff involved in reporting to the Registry.

Contacts

Additional TBI reports and fact sheets may be found at <https://www.tn.gov/health/health-program-areas/fhw/vipp/tbi.html> For additional information on the Traumatic Brain Injury Program, please call 1.800.882.0611.

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Appendix

County-level age-adjusted rates of TBI-related hospitalization for 5,365 Tennesseans hospitalized during calendar year 2017.

County	TBI-Related Hospitalization Count	2017 County Population	Age-Adjusted Rate of Hospitalization
Anderson	65	76,262	64.3
Bedford	20	48,117	40.6
Benton	18	15,991	84.9
Bledsoe	17	14,722	131.6
Blount	98	129,933	62.2
Bradley	98	105,563	87.3
Campbell	42	39,647	82.0
Cannon	11	14,222	64.2
Carroll	29	27,859	84.9
Carter	23	56,479	34.6
Cheatham	33	40,334	76.4
Chester	10	17,126	56.9
Claiborne	17	31,621	53.1
Clay	7	7,714	90.8
Cocke	35	35,556	91.5
Coffee	44	55,027	72.1
Crockett	9	14,476	48.5
Cumberland	53	59,074	62.2
Davidson	491	691,239	72.9
Decatur	20	11,751	100.8
DeKalb	14	19,836	63.0
Dickson	43	52,854	70.8
Dyer	36	37,460	92.8
Fayette	24	40,042	53.7
Fentress	15	18,129	58.2

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County	TBI-Related Hospitalization Count	2017 County Population	Age-Adjusted Rate of Hospitalization
Franklin	31	41,655	62.3
Gibson	38	49,110	66.8
Giles	13	29,401	38.1
Grainger	20	23,148	75.4
Greene	57	68,800	73.5
Grundy	24	13,370	170.9
Hamblen	54	64,267	71.8
Hamilton	376	361,613	93.4
Hancock	3	6,579	52.4
Hardeman	23	25,449	75.0
Hardin	23	25,846	85.8
Hawkins	58	56,463	92.9
Haywood	11	17,567	56.6
Henderson	18	27,751	61.7
Henry	19	32,454	45.9
Hickman	29	24,863	111.4
Houston	5	8,219	41.3
Humphreys	22	18,491	95.9
Jackson	8	11,683	60.1
Jefferson	54	53,810	85.3
Johnson	9	17,680	54.1
Knox	403	461,860	80.7
Lake	7	7,470	68.6
Lauderdale	22	25,271	88.8
Lawrence	20	43,399	43.2
Lewis	5	12,026	27.5
Lincoln	15	33,747	37.1
Loudon	56	52,158	81.5
McMinn	53	52,884	88.3
McNairy	13	26,009	44.2
Macon	25	24,074	97.2

Continued on next page

County	TBI-Related Hospitalization Count	2017 County Population	Age-Adjusted Rate of Hospitalization
Madison	55	97,646	52.3
Marion	20	28,429	70.6
Marshall	15	32,933	44.4
Maury	31	92,162	33.7
Meigs	24	12,064	185.1
Monroe	46	46,228	87.6
Montgomery	98	200,177	59.6
Moore	1	6,377	20.5
Morgan	11	21,630	48.9
Obion	11	30,376	35.2
Overton	20	22,003	72.3
Perry	2	7,984	30.1
Pickett	1	5,060	10.1
Polk	23	16,754	130.7
Putnam	53	77,676	65.2
Rhea	49	32,695	131.1
Roane	43	53,032	71.6
Robertson	50	70,177	71.6
Rutherford	176	317,165	65.4
Scott	10	21,985	41.2
Sequatchie	26	14,736	167.9
Sevier	79	97,629	75.4
Shelby	929	936,954	99.2
Smith	10	19,634	47.3
Stewart	7	13,347	36.3
Sullivan	208	157,161	112.9
Sumner	129	183,546	66.2
Tipton	44	61,374	72.5
Trousdale	8	10,077	75.5
Unicoi	13	17,753	66.5
Union	9	19,430	39.2

Continued on next page

County	TBI-Related Hospitalization Count	2017 County Population	Age-Adjusted Rate of Hospitalization
Van Buren	3	5,711	33.8
Warren	35	40,655	80.4
Washington	99	127,800	69.0
Wayne	10	16,563	42.5
Weakley	19	33,336	48.2
White	19	26,767	60.8
Williamson	82	226,249	39.4
Wilson	93	136,436	65.5
Tennessee	5,365	6,715,862	74.1

Note: Rates based on counts less than 20 are considered unstable and should be interpreted with caution. *Data Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program.*