



# Traumatic Brain Injury Program Annual Report

Division of Family Health and Wellness

July 2016 - June 2017



# 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. The program has achieved many accomplishments since its inception. This report contains specific information concerning the progress made from July 2016 through June 2017 in each of the major components of the Traumatic Brain Injury Program.

In Tennessee, approximately 8,000 people per year are injured and admitted to the hospital with traumatic brain injury, the majority of whom are Tennessee residents. In 2016, 5,586 Tennesseans were hospitalized due to a TBI-related cause, for a rate of 84 traumatic brain injuries per 100,000 people. An additional 55,515 emergency department visits were related to a TBI during the fiscal year of 2015. Survivors may experience impairments that affect their physical, cognitive and behavioral functioning, which in turn impact their ability to return to home, school and work. Whether the injury is the result of a motor vehicle accident, fall, assault, or sports activity, these survivors and families experience emotional and economic stress. The focus of the TBI Program is to improve access to services for survivors of TBI and their families.

## ***Key Findings***

### **Traumatic Brain Injury Advisory Council**

The nine-member Governor-appointed Advisory Council has met quarterly since 1994 and is composed of individuals dedicated to improving the lives of TBI survivors across Tennessee. Their guidance and recommendations have been invaluable to the development of the TBI program. In FY17, the Advisory Council investigated options to utilize available resources in the TBI trust fund for the benefit of TBI survivors. The Council proposed a five- year plan to use these funds to directly assist persons with TBI and their families by developing 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.

### **Federal Grant**

Beginning in 2000, the Traumatic Brain Injury Program was awarded a grant from the U.S. Health Resources and Services Administration (HRSA). The TBI Program used the funding to develop an education and training program for school personnel. Entitled Project BRAIN, the overall goal of the grant project is to improve educational outcomes for children with brain injuries in Tennessee. Since the original grant award in 2000, the TBI Program has received a total of \$3,091,000 in federal funding, and an additional \$1,055,000 from the Department of Education to support the program.

## **Case Management**

Service Coordinators are established in eight locations and cover all 95 counties, providing case management services to TBI survivors and their families. Services for children and adults include: providing information, making referrals to services and agencies, assisting consumers in applying for and accessing services, advocacy, support group development, and developing new programs and activities. The role of the Service Coordinator is to assess an individual survivor and to coordinate available resources within the community. During FY17, the eight service coordinators served an average case load of 58 survivors. They collectively provided information on TBI to over 12,800 callers.

## **Directory of Programs and Services**

A comprehensive resource directory, *Traumatic Brain Injury Services Directory and Resource Information Guide* has been distributed statewide to health care facilities and TBI professionals and has served to increase awareness of the TBI program. The directory is also available on the program web site: [TBI Resource Directory](#)

## **Traumatic Brain Injury Registry**

Hospitals are mandated to provide brain injury incidence information to the Department of Health and all hospitals are in compliance. Data is available starting from the first quarter of 1996. Analysis of these data allows staff to determine where and how injuries are occurring, what age groups are affected, and what prevention programs may be needed. During 2016, the number of persons in Tennessee admitted to the hospital with at least one brain injury diagnostic code was 7,471. All Tennessee residents listed on the registry receive a letter and program brochure to inform them of the services available through the TBI program.

## **TBI Clearinghouse of Information**

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 brochure has been broadly distributed. The Program also has a web page on the Department of Health website: <http://tn.gov/health/topic/tbi>

## **Education and Prevention**

The TBI program collaborates each year with the Brain Injury Association of Tennessee to present a statewide conference. The TBI Coordinator also participates on the Department of Health's Injury Control and Prevention committee.

## **Traumatic Brain Injury Trust Fund**

The fund has been established by the Department's Bureau of Administrative Services, and revenues have been deposited into the fund as they have been received from the Department of Safety.

## **Grant Program**

The TBI Program is authorized to award grants for home and community-based programs that address the needs of TBI survivors in Tennessee. The majority of the program's \$1 million in revenues is awarded in grants. In FY17, services provided through grants included:

- Eight TBI service coordinators served an average case load of 58 survivors whom they assisted with accessing local resources and programs.
- The TBI service coordinators collectively made 115 educational presentations to a total of 3,755 persons. They also provided 41 exhibits on brain injury that were seen by 18,428 participants.
- The three Project BRAIN Resource Specialists provided 46 trainings to 1,414 school and health professionals. BRAIN staff also provided 11 concussion trainings to 502 participants.
- Supportive living services were available to nine survivors living in two affordable and accessible apartment facilities in Memphis.
- Personal care services were available to 14 residents of Crumley House Brain Injury Rehabilitation Center.
- Fifty-five adult and youth survivors of brain injury attended camp sessions.
- The Brain Injury Association of Tennessee Executive Director provided support to survivors and families statewide.
- Project BRAIN transition liaisons in three children's hospitals provided 31 trainings to 159 healthcare professionals and have assisted over 1,800 families in their transition from hospital to home to school.

### **Youth Sport-Related Injuries**

In April 2013, the Tennessee General Assembly passed legislation aimed at reducing youth sports concussion and increasing awareness of traumatic brain injury. The required educational materials are free of charge and available from the Tennessee Department of Health website: <http://tn.gov/health/article/tbi-concussion>

### **Conclusion**

Although much has been accomplished, injuries persist. Work must continue to address the needs of all survivors in the state. The TBI Advisory Council extends their gratitude to the General Assembly for the opportunity to improve the lives of TBI survivors statewide.

# Traumatic Brain Injury Program

## Annual Report

*July 2016 – June 2017*

### **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 injured and admitted to the hospital with traumatic brain injury, the majority of whom are Tennessee residents. In 2016, 5,586 Tennesseans were hospitalized due to a TBI-related cause, for a rate of 84 TBIs per 100,000 people. An additional 55,515 emergency department visits were related to a TBI during the fiscal year of 2015. 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 motor vehicle accident, fall, assault, or sports activity, these survivors and families experience emotional and economic stress. The focus of the TBI Program is to improve services for survivors of TBI and their families.

*In Tennessee,  
almost 8,000  
people per year  
are hospitalized  
for a TBI.*

This report contains specific information concerning progress made from July 2016 through June 2017 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 Control and Prevention section. Currently, staff consists of a Program Director and an Epidemiologist that oversees the TBI registry.

The enabling legislation calls 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, Human Services, and Intellectual and Developmental Disabilities. An additional member represents health care professionals. Five of the nine members represent the category of TBI survivor, family member or primary care giver. The Council was organized in 1994 and has met quarterly since that time.

During 2016-2017, the TBI Advisory Council was comprised of the following members:

<b>Council member</b>	<b>Representation category</b>
Lana Bennett	Survivor, Family member, Primary Care Giver
Avis Easley	Departments of Mental Health/Intellectual Disabilities
Alicia Fitts	Survivor, Family member, Primary Care Giver
Alison Gauld	Department of Education
Mark Heydt, Chair	Health Care Professional
Rhonda Hicks	Survivor, Family member, Primary Care Giver
JoAnne Morris	Department of Human Services
Brian Potter	Survivor, Family member, Primary Care Giver
Michelle Stanton	Survivor, Family member, Primary Care Giver



TBI Advisory Council members, 2017.

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 composed 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 investigated options to utilize available resources in the TBI trust fund for the benefit of TBI survivors. The Council proposed a five- year plan to use these funds to directly assist persons with TBI and their families by developing 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. This plan for the Targeted TBI Family Support Program will address identified needs in the TBI

community, satisfy the mission of the Department, and fulfill the intent of the enabling legislation to improve the quality of life for persons with brain injury in Tennessee.

***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. The TennCare administration has indicated that the state 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 a grant from the U.S. Health Resources and Services Administration (HRSA). In 2015, the federal entity responsible for the TBI federal grant moved from HRSA to the Administration for Community Living (ACL). The original three-year grant had as its focus the provision of education and training for educators, families and health professionals who support students with TBI. The grant project, entitled Project BRAIN, has the overall goal of improving educational outcomes for children with brain injuries in Tennessee. In June 2014, the TBI Program was

awarded a new four-year, \$250,000 per year grant to continue and expand the work of Project BRAIN. Since the original grant award in 2000, the TBI Program has received a total of \$3,091,000 in federal funding and \$1,055,000 from the Department of Education to support the program.



Project BRAIN Staff



Erlanger BITL training hospital staff

**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 collaborates 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.

Project BRAIN has expanded its services by funding a hospital to home to school transition liaison program in three children's hospitals across the state. The Brain Injury Transition Liaisons (BITLs) are located in Monroe Carell Jr.

Children's Hospital at Vanderbilt in Nashville, Le Bonheur Children's Hospital in Memphis, and Children's Hospital at Erlanger in Chattanooga.

A BITL contacts families after they leave the hospital emergency department if their child has been treated for TBI. When families consent to receive follow-up calls, they can also be supported by the Department of Education. During FY16, the BITLs served over 1,800 families.

Project BRAIN has grown tremendously since its inception in 2000. Schools, families, and children across the state have benefitted from improved communication and support. This year, an additional staff person was added to support both the transition liaisons and the resource specialists.

### *Success Story*

*A young man with a severe brain injury had been studying pre-med at the university where he was an academic stand-out. The service coordinator assisted him in obtaining the necessary documentation to retain his scholarship while taking a reduced load. He has the determination to succeed and now wants to be a neuro-surgeon.*

**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 serving an average case load of 58 survivors and families. During FY17, the service coordinators collectively provided information on TBI to over 12,800 callers.



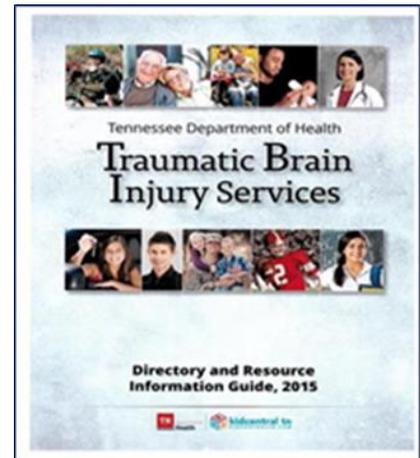
TBI Program Service Coordinators, 2017.

***(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, 2015* has been distributed statewide to health care facilities and TBI professionals and has served to increase awareness of the TBI program. The directory is also available on the program web site: <http://tn.gov/health/topic/tbi>. In addition, all TBI service coordinators develop resource files for their local service areas. The directory is updated regularly and a new edition is planned for 2018.



TBI Service Directory, 2015

***(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 most recent federal grant award that resulted in Project BRAIN. According to the registry, in 2012- there were 1,071 children and youth ages 3-21 in Tennessee who were admitted to the hospital as a result of a TBI. That same year, the Department of Education classified 307 students in the category of TBI. The discrepancy in the number of children identified through the TBI Registry in

comparison to the number of children classified by DOE indicated a need for correct identification of students with TBI. Project BRAIN is designed to address that need by increasing 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. In 2017, 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 now available on the department website. The document is a resource for educators, coaches, health care providers, families and athletes.

The TBI Coordinator serves on the Department’s Council on Injury Prevention and Control, 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.



Service Coordinator prevention activity

***(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 brochure has been broadly distributed. The Program also has a web page on the Department of Health website: <http://tn.gov/health/topic/tbi>

***(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 are identified and addressed at the annual statewide conference. 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 2017, the TBI program collaborated with the Brain Injury Association of Tennessee and Disability Rights Tennessee to plan and present an annual statewide conference. The 28<sup>th</sup> Annual TBI Survivor, Family and Caregiver Event was attended by 86 people. Keynote speaker, Cheryl Kerr, captivated the audience with her story of survival and her subsequent work to change the law in Texas so that law enforcement and first responders receive training on brain injury. Other 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 cost is very much appreciated by survivors and families.



**Officer Grant presenting to the conference audience**

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 FY17, the TBI service coordinators collectively made 115 educational presentations to a total of 3,755 health care professionals and community members. They also

provided 41 exhibits on brain injury that were seen by 18,428 participants. The Project BRAIN staff provided 46 trainings to 1,414 school-related professionals. In addition, the brain injury transition liaisons provided 31 presentations to 159 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;***



Project BRAIN at Kids Central Event

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. 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.

Project BRAIN seeks to link hospital and community health providers with school



Project BRAIN concussion training

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 provides 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 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. 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. 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 FY17, 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.



2017 TBI Epidemiologist

***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. According to 2016 provisional data, the number of persons in Tennessee admitted to the hospital with at least one head injury diagnostic code was 7,471 while at least 843 were recorded as deceased (not mutually exclusive). Accidental falls were the leading cause of inclusion in the registry (hospitalization or death) at 40% of all causes. A summary of registry data for 2016 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 despite a cumbersome reporting process.

In February of 2017, the TBI program and the state Information Technology Services Division began work on a new submission platform that will improve reporting efficiency, timeliness, and data quality. Rollout was planned in early September 2017, with the first full TBI data collection cycle in the fourth quarter (October- December). 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 FY17, 4,457 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, 2016 was \$1,443,000. Funds are used to cover staff positions and to fund grants. In FY17, The TBI Advisory Council investigated options to utilize available resources in the TBI trust fund for the benefit of TBI survivors. The Council proposed a five- year plan to use these funds to directly assist persons with TBI and their families by developing a Targeted TBI Family Support Program, modeled on the existing state Family Support Program in the Department of Intellectual and Developmental Disabilities. The plan was approved by the Department and the contract went into effect July 1, 2017.

***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

***Success Story***

***A gentleman with a brain injury who had been chronically homeless was assisted by his service coordinator to apply for benefits through SOAR, the SSI/SSDI Outreach, Access, and Recovery program. The successful application provided him with enough funding to purchase a car and provide deposit money for housing.***

injured children.

- Centerstone Community Mental Health Centers, Inc. provided intensive in-home counseling and behavioral intervention for TBI students in 24 counties in middle Tennessee.

In FY17, through competitively awarded grants the following services were provided:

- Tennessee Community Resource Agency provided personal care services for nine 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 fourteen TBI survivors.
- Easter Seals Tennessee provided camp and recreational opportunities for 55 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:
  - Fort Sanders Regional Medical Center
  - Brain Injury Association of Tennessee
  - Regional One Health in Memphis
  - Epilepsy Foundation of Middle Tennessee
  - Crumley House Brain Injury Rehab Center
  - Chattanooga Area Brain Injury Association
  - Jackson Madison County General Hospital District

### ***Part 5 Youth Sport-Related Injuries [Effective January 1, 2014.]***

#### ***Tenn. Code Ann. § 68-55-501 to 503 (2013)***

In April 2013, Tennessee became the 44<sup>th</sup> 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: <http://health.tn.gov/TBI/concussion.htm>.

Project BRAIN has developed concussion-specific training for coaches and athletes. During FY17, staff provided 11 trainings to 502 participants.

In 2017, 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 now available on the department website. The document is a resource for educators, coaches, health care providers, families and athletes.

### ***Conclusion***

The TBI Program is authorized to award grants for home and community-based programs to address the needs of TBI survivors in Tennessee. The majority of the program’s \$1 million in revenues is awarded in grants. In FY17, services provided through grants included:

- The eight TBI service coordinators served an average case load of 58 survivors whom they assisted in accessing local resources and programs.
- The TBI service coordinators collectively made 115 educational presentations to a total of 3,755 persons. They also provided 41 exhibits on brain injury that were seen by 18,428 participants.
- The three Project BRAIN Resource Specialists provided 46 trainings to 1,414 school and health professionals. BRAIN staff also provided 11 concussion trainings to 502 participants.
- Supportive living services were available to nine survivors living in two affordable and accessible apartment facilities in Memphis. In addition, personal care services were available to 14 residents of Crumley House Brain Injury Rehab Center.
- Fifty-five adult and youth survivors of brain injury attended camp sessions.
- The Brain Injury Association of Tennessee Executive Director provided support to survivors and families statewide.
- Project BRAIN transition liaisons in three children’s hospitals provided 31 trainings to 159 healthcare professionals and have assisted over 1,800 families in their transition from hospital to home to school.

### ***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 has the potential to improve the safety of sports statewide, and extends their gratitude for the opportunity to work to improve the lives of TBI survivors throughout Tennessee.

# Traumatic Brain Injury Annual Surveillance Report 2016

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Division of Family Health and Wellness

July 2017



# 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 ( $\leq 20$ ) 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 55-68-203 mandates that the Department of Health develop and maintain a registry of these survivors. Data collection began in 1996, just three years after the law passed, ultimately producing an annual report summarizing the prevalence of traumatic brain injury, or TBI, across the state. Since inception, the Registry has collected data on over 150,000 patients and has connected countless Tennessean 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**

- A total of 11,334 unique patients were reported to the TBI Registry during the 2016 calendar year. Of these, 7,458 presented with a TBI-related hospitalization (length of stay  $\geq$  24 hours) and 843 were deceased.
- 54% of all TBIs were in the senior population (over 55 years).
- Overall, 58% of TBI patients were males. The number of male TBI patients exceeded females in each age group except in patients over 75 years.
- Falls were the leading cause of TBI in Tennessee, followed by motor vehicle accidents.
- Over 10% of concussion-related hospitalizations in 2016 were sports-related, but overall, sports-related concussions are likely underestimated.
- The age-adjusted TBI hospitalization rate for Tennesseans in 2016 was 84.17 per 100,000, while the age-adjusted death rate was 9.11 per 100,000 residents.

# 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 brain<sup>1</sup>”. 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 over 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 actually admitted to the hospital receive survivor letters from the Program. Required data fields include various 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.

The data within this report serves to analyze 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 2016.

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<sup>1</sup> Basic Information about Traumatic Brain Injury and Concussion. (2016, January 22) 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, making 2016 the first full year of data submission in this format. 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 definition, 2016<sup>2</sup>.

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 (7<sup>th</sup> 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.

<sup>2</sup> 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

From January 1<sup>st</sup> to December 31<sup>st</sup>, 2016, there were 11,334 unique patient encounters reported to the Tennessee TBI Registry. A total of 10,013 patients were found with the appropriate TBI-related codes as outlined in Table 1. Of these, 7,471 patients were hospitalized and 843 were deceased either during their hospitalization, emergency treatment, or transport to the facility. The remaining 2,392 were treated in an emergency/observational capacity and released. Patients classified as emergency visits are not included in this analysis since they are not required to be reported, as outlined in the legislative rules of the Registry.

*On average, around  
**8,000** TBI-related  
hospitalizations occur  
in Tennessee annually.*

Of the 7,621 hospitalizations and deaths required to be reported to the Registry, 90% (N=6,821) of TBI patients were alive at discharge (Table 2). 48% (N=3,691) of TBI-related patients hospitalized were released with self-care instructions, indicating a modest level of independence and less disability. Still, 38% (N=2,879) of TBI patients required further, potentially more extensive treatment post-hospitalization. As noted in Table 2, although a patient is alive at discharge, some may have death dates recorded due to deaths at the residential or rehabilitation facility shared with the original reporting hospital and/or due to misclassification.

**Table 2.** Reported discharge status of 7,621 TBI patients, Tennessee 2016.

Patient Status	N	%
Alive at Discharge*	6,821	89.6
Discharged with self-care or non-skilled assistance (routine discharges)	3,691	48.4
Discharged to a residential, rehabilitation, or other long term care facility (includes hospice home care)	2,879	37.8
Other Discharges (includes unknown and left without medical care)	252	3.3

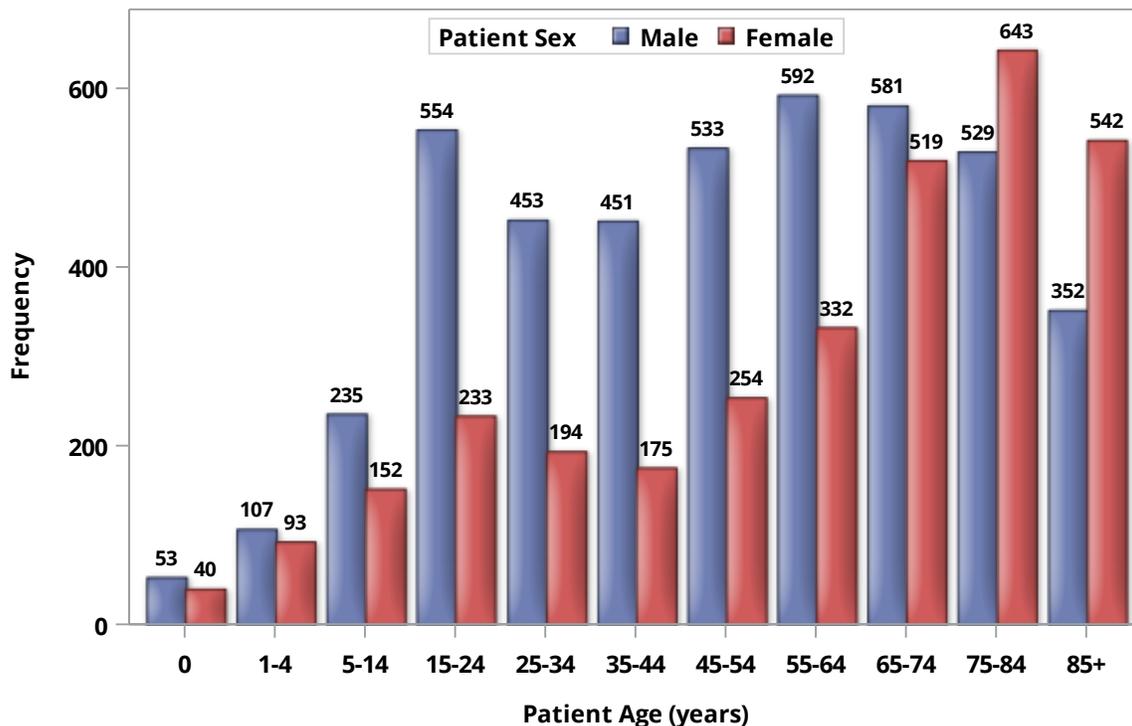
*\*Although alive at discharge, 43 of these patients have death dates due to facility follow-up and/or misclassification*

## Demographics

Although men were more likely to be discharged routinely (62%, N=2,278), they were also more likely to be discharged as deceased due to TBI-related causes (65%, N=372).

*Until recently, males sustained more TBIs in every age group.*

The majority of traumatic brain injury-related hospitalizations and deaths occur in the senior population; 54% (N=4,092) of patients with a reported TBI were over 55 years of age. More males (58%, N=4,440) sustained traumatic brain injuries than females, and this difference is seen within most age groups. However, within the age groups over 75 years, the trend changes and women sustain more TBIs than males (Figure 1). Females ages 75 to 84 comprised the largest proportion of TBI hospitalizations and deaths at just over 8% (N=643), followed by just under 8% (N=592) of men ages 55 to 64. Males ages 15 to 64 were over twice as likely to be hospitalized or expire due to a TBI-related cause as women of the same age groups.

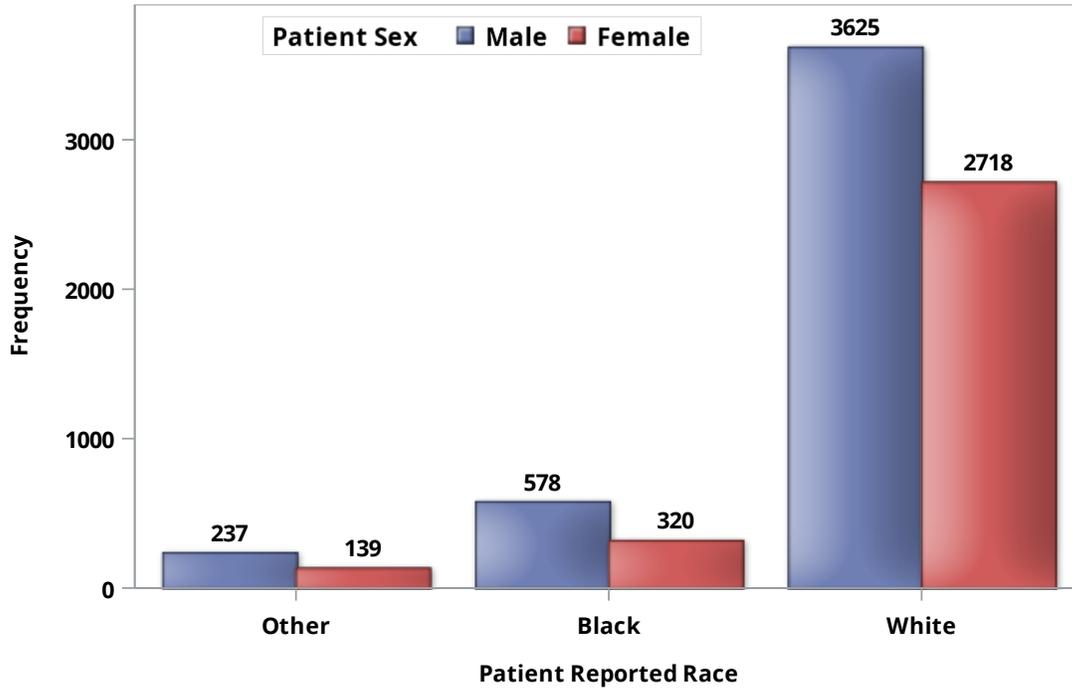


Traumatic Brain Injury Registry 2016 Final Data

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

**Figure 1.** Number of TBI-Related Patients by Age Group and Sex, 2016.

Over 83% (N=6,346) of reported TBI patients were white, while only 12% (N=899) were black, and 5% (N=376) were all other races. Although white men are only slightly more likely to sustain a TBI, men of all other races were almost twice as likely (63%, N=815) to sustain a TBI as women of other races (Figure 2).



*Traumatic Brain Injury Registry 2016 Final Data*

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

**Figure 2.** Traumatic brain injury hospitalizations and deaths by sex and race, 2016.

## Head Injury Diagnoses

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, over 90% (N=6,919) of patients were diagnosed with at least one of these traumatic brain injuries. In contrast, although they are the second most common TBI diagnosis, skull fractures were diagnosed in only 25% (N=1924) of hospitalizations and deaths.

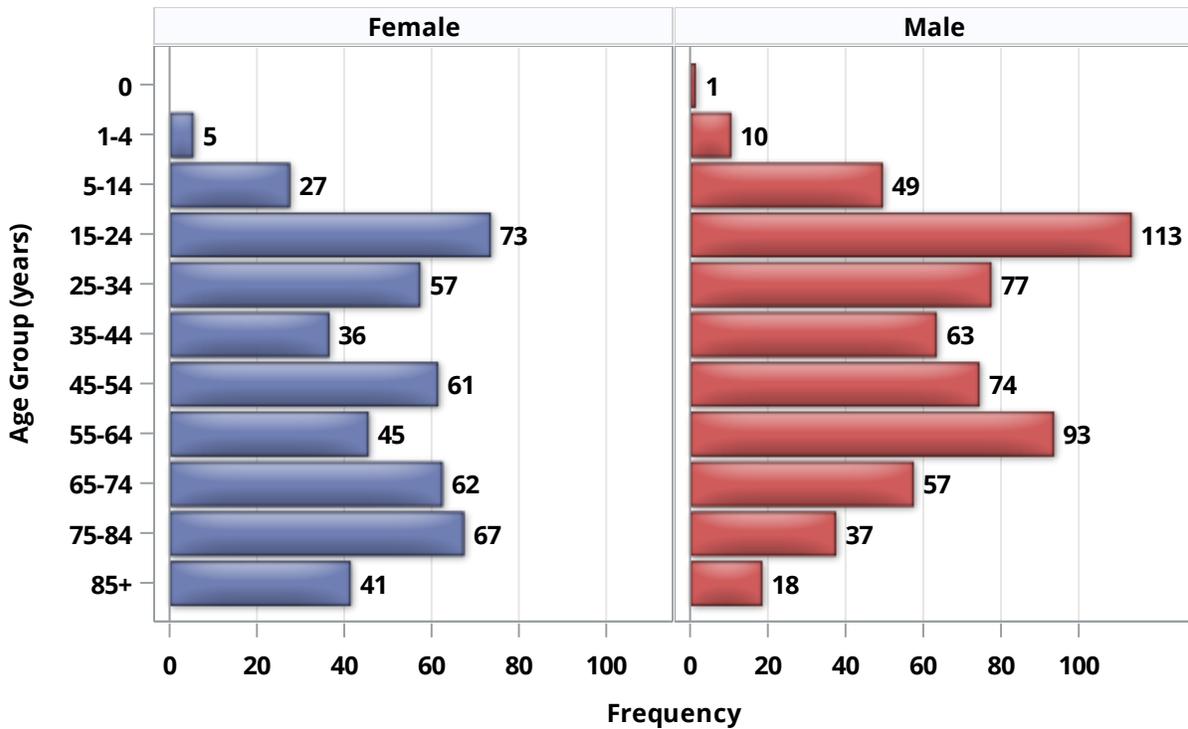
The causes of each of these injury diagnoses are quite different, due to the mechanisms at play. The most common cause of intracranial injuries is an accidental fall (42%, N=2,875), while the most common cause of a skull fracture is a transportation accident (37%, N=702) (Table 3).

**Table 3.** Head Injury Types as reported to the Traumatic Brain Injury Registry, 2016.

<b>TBI Diagnosis</b>	<b>Total</b> N(%)	<b>Accidental</b> <b>Falls</b> N(%)	<b>Transport</b> N(%)	<b>Assault</b> N(%)	<b>Struck</b> <b>By/</b> <b>Against</b> N(%)	<b>Suicide</b> N(%)	<b>All</b> <b>Other</b> <b>Causes</b> N(%)
Skull Fractures (S02.0, S02.1-, S02.8, S02.91)	1924 (100)	530 (28)	702 (37)	124 (6)	60 (3)	61 (3)	445 (23)
Optic Injuries (S04.01-, S04.02-, S04.03-)	16 (100)	2 (13)	6 (38)	1 (6)	2 (13)	1 (6)	4 (25)
Intracranial Injuries (S06-)	6919 (100)	2875 (42)	2073 (30)	200 (3)	133 (2)	67 (1)	1546 (22)
Crushing Injuries (S07-)	10 (100)	2 (20)	8 (80)	0 (0)	0 (0)	0 (0)	0 (0)
Shaken Infant Syndrome (T74.4)	6 (100)	0 (0)	0 (0)	3 (50)	0 (0)	0 (0)	3 (50)

The least common diagnosis is shaken infant syndrome. This could be due either to a low incidence or the underreporting of child abuse within the state.

In ICD-10 coding, concussions are intracranial injuries with the first 4 digits of “S06.0.” Although concussions are the least severe intracranial injuries, they can still produce lasting effects in those who sustain them. In 2016, 14% (N=1,063) of TBI patients hospitalized or deceased were diagnosed with a concussion. Again, most concussion patients were males (55%, N=588) and 18% (N=188) were between the ages of 15 and 24 (Figure 3).



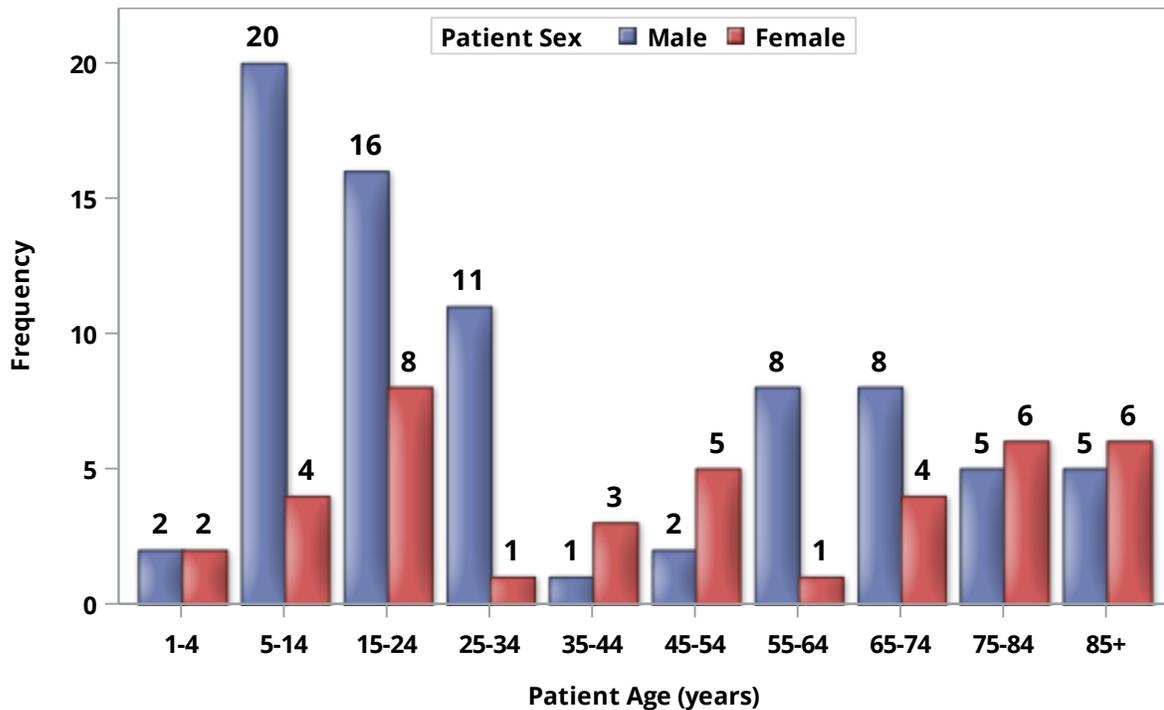
*Traumatic Brain Injury Registry 2016 Final Data*  
*Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program*

**Figure 3.** TBI registry patients with concussion diagnoses by age and sex, 2016.

A recent study shows that almost 82% of pediatric concussion patients had their first visit within primary care and only 12% were seen in the emergency department<sup>3</sup>. Since this analysis is limited to inpatient hospitalizations and deaths and does not capture cases seen elsewhere (i.e. emergency department, primary care), it likely provides a substantial underestimation of the burden of concussion within the state.

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

In 2013, Tennessee General Assembly passed a sports concussion law aimed at increasing awareness of traumatic brain injuries and reducing youth sports concussions. Examining the incidence of sports concussion-related hospitalizations helps evaluate the impact of the law. In 2016, 11% (N=118) of the 1,063 patients that were hospitalized with a concussion were coded with a sports-related external cause. The majority of the patients hospitalized with sports-related concussions (41%, N=48) were youths between the ages of 5 and 24 (Figure 4).



Traumatic Brain Injury Registry 2016 Final Data

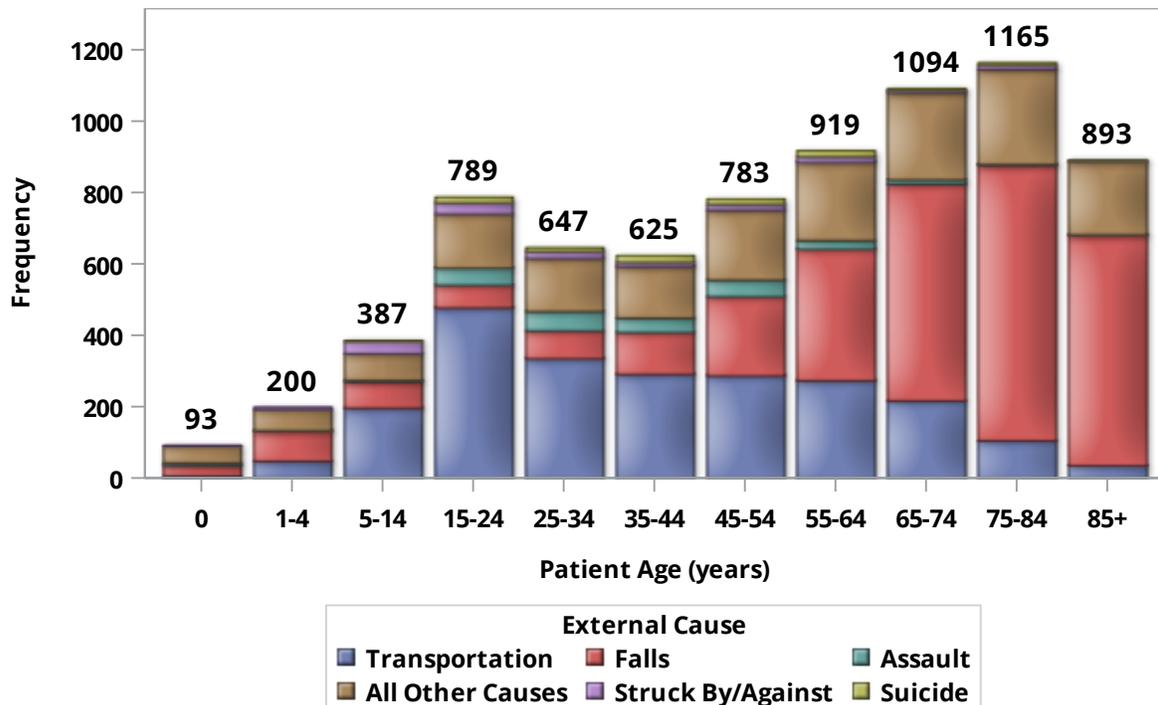
Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program

**Figure 4.** Sports-related concussion hospitalizations by age and sex, 2016.

## 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 2016, 82% of hospitalizations and deaths had at least one associated and appropriate external cause code.

Since the TBI Registry began collecting data in 1996, the two leading causes of traumatic brain injuries in Tennessee have been accidental falls and motor vehicle traffic accidents. Falls surpassed motor vehicle accidents as the most frequent cause of TBI in 2008, likely due to the increase of fall-related TBI in seniors<sup>4</sup>. In 2016, accidental falls remained the leading cause of TBI-related hospitalizations and deaths, accounting for 40% (N=3,055) of patients.



Traumatic Brain Injury Registry 2016 Provisional Data

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

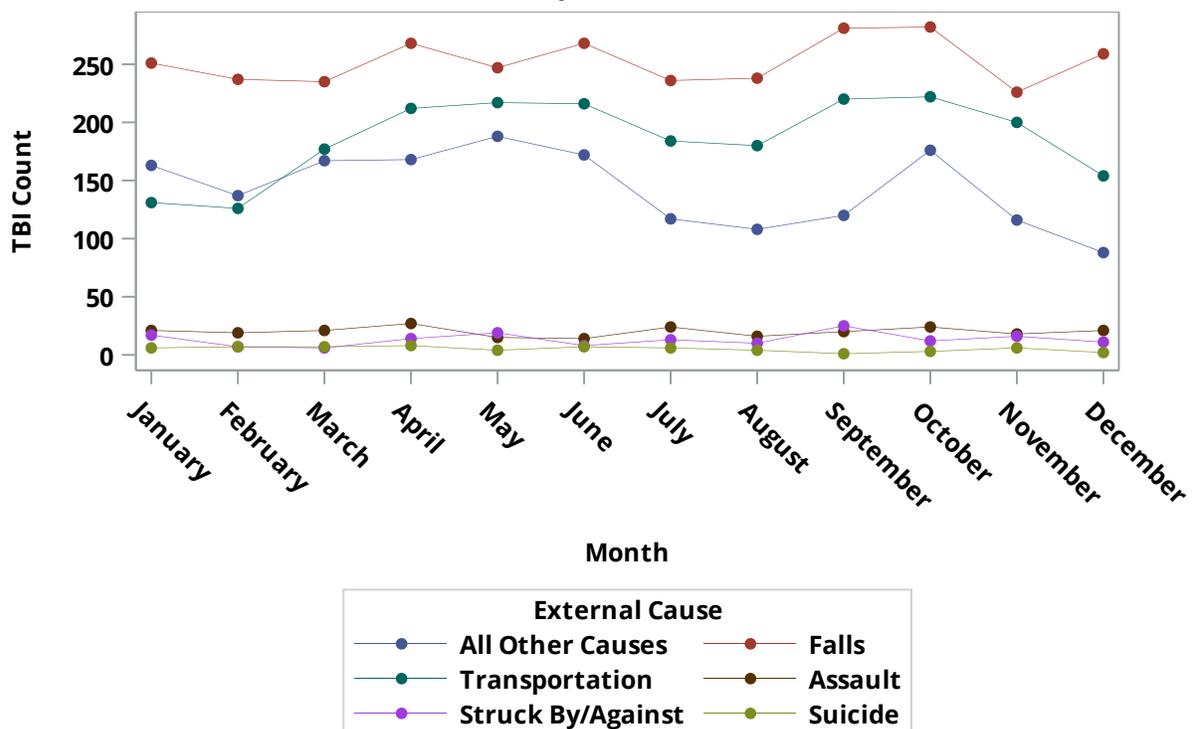
**Figure 5.** External causes of traumatic brain injury hospitalizations and deaths by age group, 2016.

<sup>4</sup> Traumatic Brain Injury Registry, historical data, 1996 through 2015.

Falls were the leading cause of TBI-related hospitalization and death in children under 5 (39%, N=115) and adults over the age of 65 (64%, N=2,022). However, transportation accidents accounted for 30% (N=2,302) of TBI-related hospitalizations and deaths overall and were the leading cause of hospitalization and death in patients ages 5 to 64 (45%, N=1,878) (Figure 5).

Males were more likely to be hospitalized by a motor vehicle-related (64%, n=1,096) or assault-related TBI (79%, n=254) than women. Slightly more women (52%, n=1,801) sustained TBIs from falls than men, particularly in the age groups over 75.

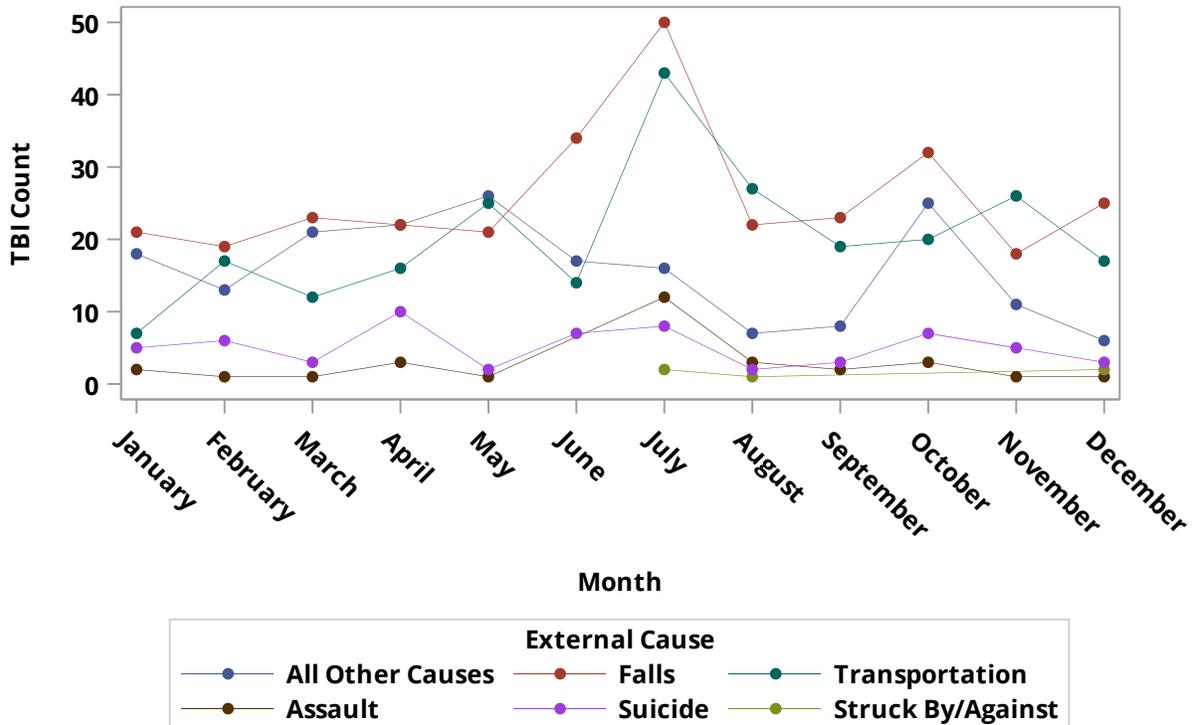
Traumatic brain injury-related hospitalizations due to all causes seem to increase in the spring and fall. Motor vehicle traffic accident-related TBI hospitalizations increased slightly in April through June and again in September through November, while fall-related TBI hospitalizations peaked in September and October (Figure 6).



Traumatic Brain Injury Registry 2016 Final Data  
 Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program

**Figure 6.** Traumatic brain injury causes of hospitalization and death by month of patient discharge, 2016.

In contrast, TBI-related deaths reported to the Registry peak in the summer, specifically in July (Figure 7). It is important to note that the deaths reported to the Registry are those that happen during hospitalization or before arrival at reporting hospitals. Therefore, they do not represent all TBI-related deaths in Tennessee, and temporal death patterns could be slightly different when including all TBI-related deaths.



Traumatic Brain Injury Registry 2016 Final Data  
 Source: Tennessee Department of Health, Division of Family Health and Wellness, Traumatic Brain Injury Program

**Figure 7.** Traumatic brain injury death causes by month of patient discharge or death, 2016.

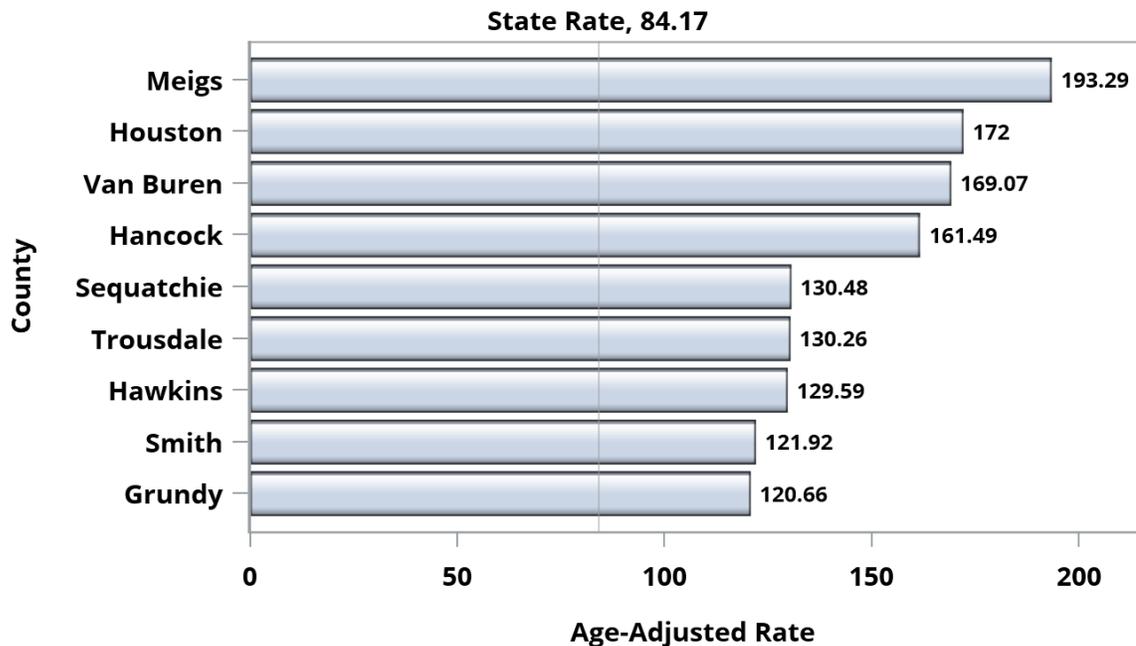
## Rates

Unlike earlier calculations that included all TBI patients reported to and matching the legislative rules of the Registry, the following rates are calculated using only Tennessee resident patients.

## Hospitalization Rates

Hospitalization rates are calculated using all patients that were reported as a hospitalization (length of stay  $\geq 24$  hours) to the Registry. 522 patients that died during their hospitalization are also counted in the death rate calculations.

In 2016, 5,586 Tennesseans were hospitalized with a TBI. The statewide age-adjusted rate of traumatic brain injury hospitalizations was 84.17 cases per 100,000 population (95% CI = 81.96, 86.38). The TBI-related hospitalization rates of the residents in Meigs, Houston, and Van Buren Counties were twice as high as the state rate (Figure 8). A full list of county-level hospitalization rates by county of patient residence can be found in Appendix A.



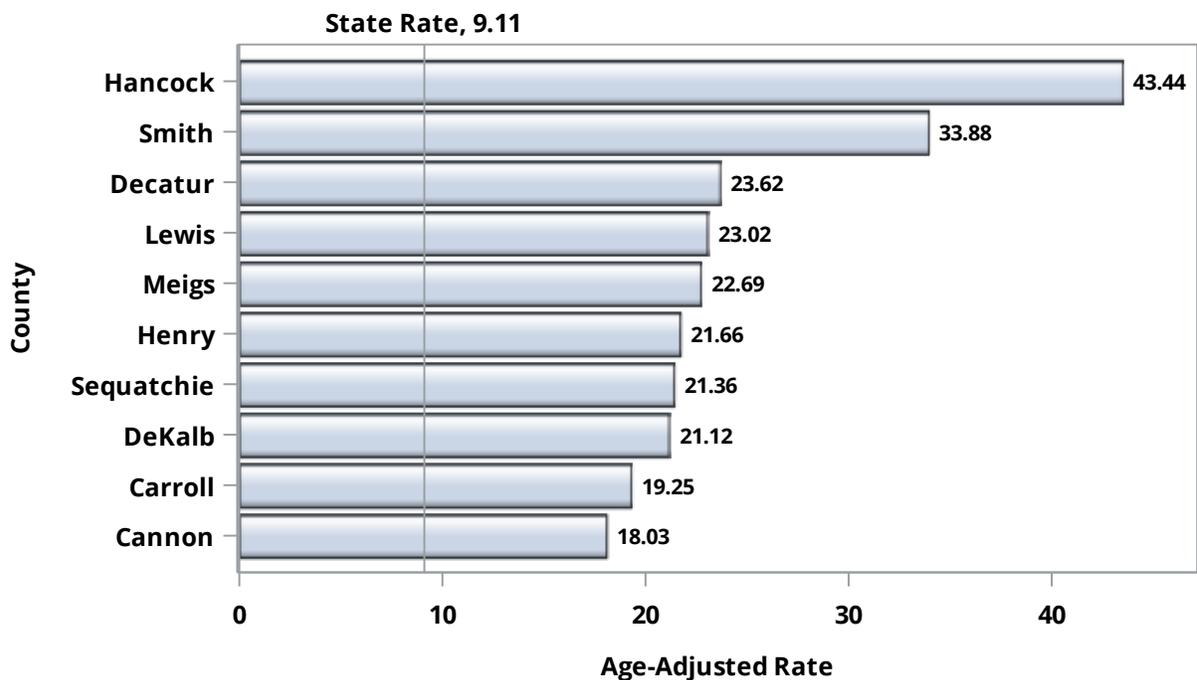
*Traumatic Brain Injury Registry 2016 Final Data  
Rates based on 2016 County-Level Population Estimates provided by the Census Bureau  
Source: Tennessee Department of Health, Division of Family Health and Wellness*

**Figure 8.** Top Ten County-Level Age-Adjusted TBI Hospitalization Rates per 100,000 Tennesseans, 2016.

## Mortality Rates

Again, we must emphasize that the deaths captured by the Registry are those that happen during hospitalization or before arrival at reporting hospitals. Therefore, they do not represent all TBI-related deaths in Tennessee; for comparison, a total of 1,348 Tennesseans sustained fatal brain injuries in 2015<sup>5</sup>. As mentioned previously, 522 patients died from their injuries during their hospitalization and are included in both rate calculations.

For the 638 Tennesseans who sustained a fatal TBI, the age-adjusted TBI mortality rate in 2016 was 9.11 TBI-related deaths per 100,000 population (95% CI = 8.41, 9.82). Nine counties had rates more than twice that of the state (Figure 9), although many counties had death counts under 20, which may cause the county-level age-adjusted rate to be statistically unstable. A full list of county level mortality rates can be found in Appendix B.



*Traumatic Brain Injury Registry 2016 Final Data  
Rates based on 2016 County-Level Population Estimates provided by the Census Bureau  
Source: Tennessee Department of Health, Division of Family Health and Wellness*

**Figure 9.** Top ten county-level age-adjusted TBI mortality rates per 100,000 Tennesseans, 2016.

<sup>5</sup> Data prepared for CDC Injury Indicator/Special Emphasis reports, 2015. Data Source: Tennessee Department of Health, Division of Policy, Planning, and Analysis, Vital Statistics

## ***Additional Information***

### **State of Patient Residence**

Almost 75% (N=5,702) of reported TBI hospitalizations and fatal injuries involved a Tennessee resident, while just over 25% (N=1,919) involved non-residents, primarily from the states bordering Tennessee (Table 4).

***Table 4. State of Residence of 7,621 TBI patients, 2016.***

<b>Patient State of Residence</b>	<b>N</b>	<b>%</b>
Tennessee	5702	74.8
Alabama	123	1.6
Arkansas	180	2.4
Georgia	321	4.2
Kentucky	350	4.6
Mississippi	296	3.9
Missouri	24	0.3
North Carolina	62	0.8
Virginia	335	4.4
Other US States	228	3.0

### **State of Injury**

The location of the incident resulting in the injury was unknown for almost one third (31%, N=2,333) of patients. Overall, more than half (57%, N=4,307) occurred in Tennessee, while another 12% (N=967) occurred in the states bordering Tennessee (Table 5).

***Table 5. State of Injury of 7,621 TBI patients, 2016.***

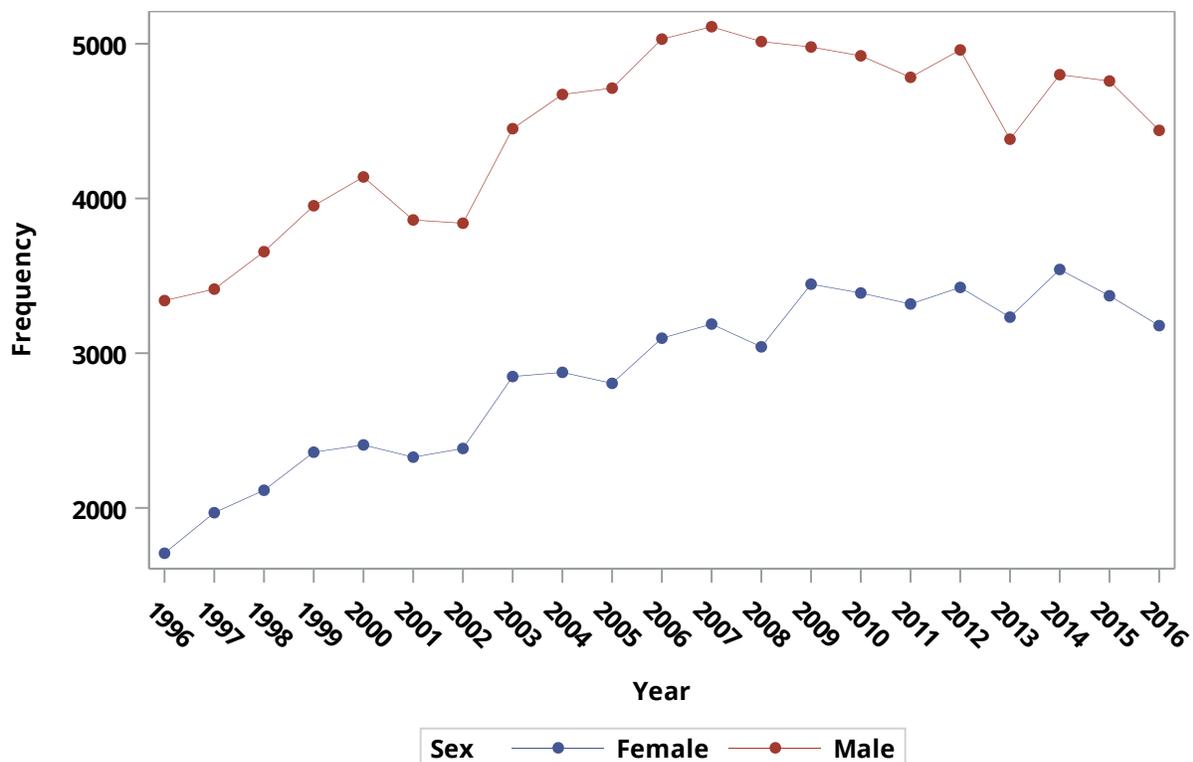
<b>Patient State of Residence</b>	<b>N</b>	<b>%</b>
Tennessee	4307	56.5
Alabama	71	0.9
Arkansas	62	0.8
Georgia	191	2.5
Kentucky	264	3.5
Mississippi	131	1.7
Missouri	6	0.1
North Carolina	33	0.4
Virginia	209	2.7
Other US States	14	0.2
Unknown	2333	30.6

## Length of Stay

The average length of stay for a TBI-related hospitalization in 2016 was 6.4 days, remaining steady from 2015<sup>6</sup>.

## Historical Trends

Males of all ages consistently sustain more traumatic brain injuries than females. Since the Registry's inception in 1996, the frequency of males hospitalized or deceased with any brain injury had been 54% higher than that of females on average (Figure 10). However, the difference has narrowed to only 33% in 2016.



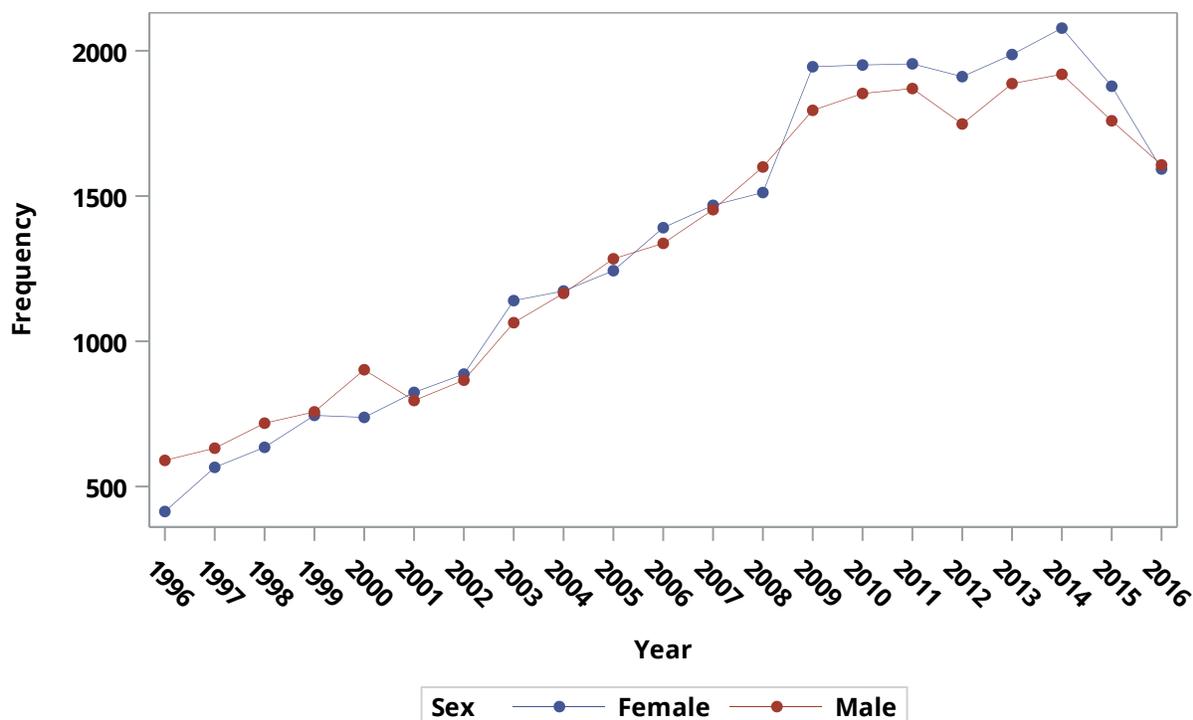
Traumatic Brain Injury Registry Provisional Data

Source: Tennessee Department of Health, Division of Family Health and Wellness

**Figure 10.** Annual trend of traumatic brain injury-related hospitalizations and deaths by sex, 1996-2016.

<sup>6</sup> Traumatic Brain Injury Surveillance Annual Report, 2015. Tennessee Department of Health, Nashville, TN.

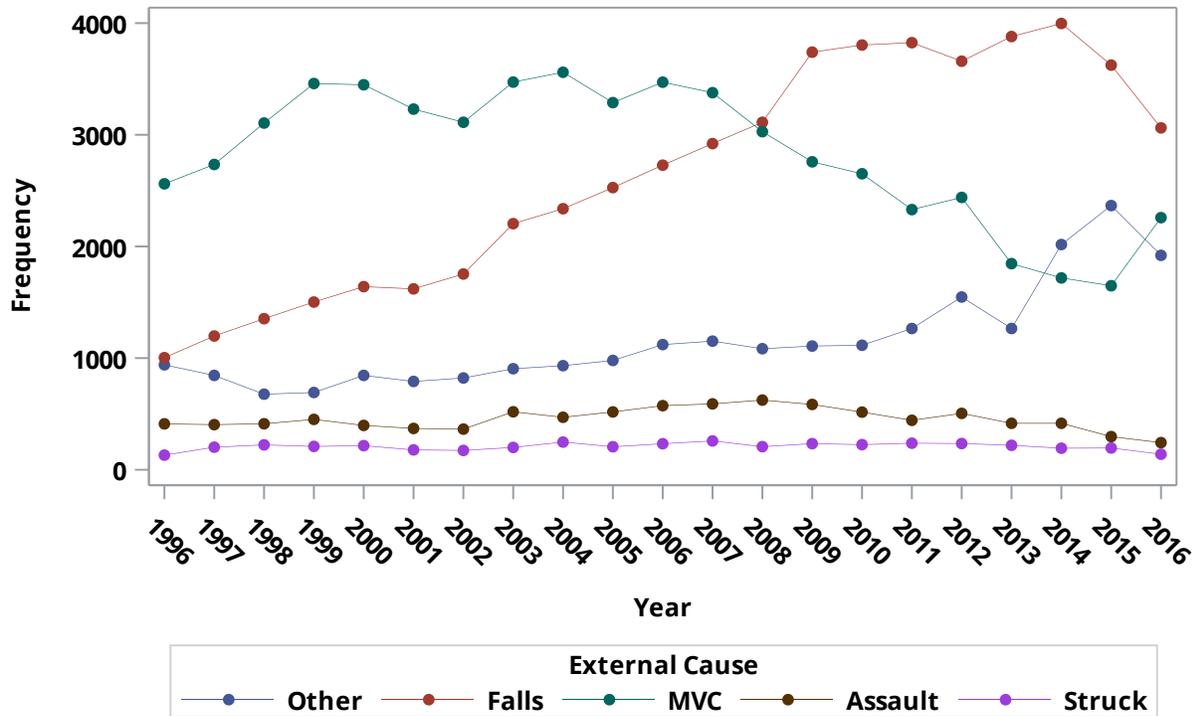
This narrowing of the difference between sexes may be in part due to the increase of fall-related TBI in females, especially those in the age groups above 75 years. Figure 11 shows this pattern over time; females have sustained more fall-related TBIs than males since 2009. Although falls seem to have declined since 2014, this is likely due to the change in coding from ICD-9 to ICD-10 during 2015.



*Traumatic Brain Injury Registry Provisional Data*  
 Source: Tennessee Department of Health, Division of Family Health and Wellness

**Figure 11.** Annual trend of fall-related traumatic brain injury hospitalizations and deaths by sex, 1996-2016.

Figure 12 provides a snapshot of the patterns of all mechanisms of injury since 1996. Falls have continuously increased since 1996, surpassing transport accidents in 2008 to become the leading cause of TBI in Tennessee. Changes that appear to happen in 2015 and 2016 may be due to changes in coding and reporting. For example, transport accidents seem to have increased from 2015 to 2016 after a steady decline since 2007. Although this could represent a true increase, more data and further investigation is needed to confidently determine the cause.



Traumatic Brain Injury Registry Provisional Data  
 Source: Tennessee Department of Health, Division of Family Health and Wellness

**Figure 12.** Annual trend of TBI-related hospitalizations and deaths by cause, 1996-2016.

### Limitations

Although measures were taken to reduce the effect of coding errors, TBI cases may still be misclassified. For instance, the TDH Child Fatality Review program identified two deaths due to pediatric abusive head trauma in 2016 that were not coded as such in the TBI database.

There are multiple methodologies available to analyze registry data. The program chose to evaluate demographics for all TBI cases (both hospitalizations and deaths) for conciseness, while separating deaths and hospitalizations for rate calculations. Additional demographic analyses are available upon request.

Some hospitals submit data on TBI-related emergency department visits and inpatient observations lasting less than 24 hours. However, these are not required to be reported to the registry. It is unknown if patients treated in these situations, who sustain assumingly less severe brain injuries, may also require the services provided through the TBI program due to lasting effects.

## ***Conclusion***

TBI still contributes to a significant proportion of death and disability in the State of Tennessee; the number of patients reported to the registry has steadily increased since 1996. Fortunately, T.C.A. 55-68-203 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 and long-term outcomes in TBI patients. However, these injuries still occur at alarming rates and often, patients are still 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/topic/tbi>. For additional information on the Traumatic Brain Injury Program, please call 1.800.882.0611.

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# Appendix A

**County-level age-adjusted hospitalization rates for 5,586 Tennesseans hospitalized during the calendar year of 2016.**

County	TBI-Related Hospitalization Count	2016 County Population	Age-Adjusted Hospitalization Rate	95% Confidence Intervals	Relative Rate*
Anderson	76	77995	81.51	63.19, 99.84	0.97
Bedford	39	53091	70.51	48.38, 92.64	0.84
Benton	17	16385	76.93	40.36, 113.5	0.91
Bledsoe	9	14987	59.57	20.65, 98.48	0.71
Blount	99	132789	60.11	48.27, 71.95	0.71
Bradley	104	110842	90.28	72.93, 107.64	1.07
Campbell	32	40205	68.05	44.47, 91.63	0.81
Cannon	19	14365	101.99	56.13, 147.85	1.21
Carroll	42	28816	108.56	75.73, 141.4	1.29
Carter	29	57517	46.27	29.43, 63.11	0.55
Cheatham	33	41007	85	56, 114	1.01
Chester	17	17861	79.88	41.91, 117.85	0.95
Claiborne	23	32175	74.7	44.17, 105.23	0.89
Clay	5	7926	42.25	5.22, 79.29	0.5
Cocke	39	36000	91.37	62.69, 120.04	1.09
Coffee	50	56959	78.05	56.41, 99.68	0.93
Crockett	16	15900	86.69	44.21, 129.17	1.03
Cumberland	73	60323	84.3	64.96, 103.64	1
Davidson	643	753451	92.6	85.45, 99.76	1.1
DeKalb	13	20790	107.23	48.94, 165.52	1.27
Decatur	24	12167	90.63	54.37, 126.89	1.08
Dickson	45	53925	79.21	56.07, 102.35	0.94
Dyer	30	39010	70.8	45.46, 96.14	0.84
Fayette	15	40577	32.7	16.15, 49.25	0.39
Fentress	17	18268	83.29	43.7, 122.89	0.99
Franklin	40	43001	86.11	59.43, 112.8	1.02
Gibson	36	50735	58.96	39.7, 78.22	0.7
Giles	13	29990	35.24	16.08, 54.39	0.42
Grainger	22	23847	91.39	53.2, 129.57	1.09
Greene	53	70504	66.33	48.47, 84.19	0.79
Grundy	18	13519	120.66	64.92, 176.4	1.43

Hamblen	57	71151	75.23	55.7, 94.76	0.89
Hamilton	349	377138	87.63	78.44, 96.83	1.04
Hancock	13	6583	161.49	73.7, 249.28	1.92
Hardeman	27	25872	93.94	58.51, 129.38	1.12
Hardin	18	26234	65.15	35.05, 95.24	0.77
Hawkins	79	57371	129.59	101.01, 158.17	1.54
Haywood	17	18636	74.68	39.18, 110.18	0.89
Henderson	18	28426	57.63	31.01, 84.25	0.68
Henry	33	33071	92.37	60.86, 123.89	1.1
Hickman	29	24872	114.59	72.88, 156.29	1.36
Houston	18	8292	172	92.54, 251.46	2.04
Humphreys	24	18786	109.34	65.6, 153.09	1.3
Jackson	7	11764	48.85	12.66, 85.04	0.58
Jefferson	40	55374	63.72	43.97, 83.46	0.76
Johnson	12	18096	59.14	25.68, 92.61	0.7
Knox	338	474549	67.42	60.23, 74.6	0.8
Lake	3	7735	37.27	-4.91, 79.45	0.44
Lauderdale	22	27451	81.93	47.69, 116.16	0.97
Lawrence	40	44010	85.98	59.33, 112.63	1.02
Lewis	14	12183	114.77	54.65, 174.89	1.36
Lincoln	16	34757	36.98	18.86, 55.1	0.44
Loudon	55	55745	77.54	57.05, 98.04	0.92
Macon	26	24650	101.67	62.59, 140.76	1.21
Madison	77	101326	70.81	55, 86.63	0.84
Marion	18	28946	58.07	31.24, 84.9	0.69
Marshall	23	33521	66.36	39.24, 93.48	0.79
Maury	63	95071	65.45	49.29, 81.62	0.78
McMinn	49	54938	82	59.04, 104.96	0.97
McNairy	27	26478	87.7	54.62, 120.78	1.04
Meigs	25	12246	193.29	117.52, 269.06	2.3
Monroe	43	47917	83.92	58.83, 109	1
Montgomery	111	215245	61.71	50.23, 73.19	0.73
Moore	1	6429	8.53	-8.19, 25.25	0.1
Morgan	19	21812	88.28	48.58, 127.97	1.05
Obion	17	31847	46.92	24.61, 69.22	0.56
Overton	16	22351	67.67	34.51, 100.83	0.8
Perry	7	8155	64.95	16.83, 113.07	0.77
Pickett	5	5221	107.97	13.33, 202.61	1.28
Polk	19	17116	96.65	53.19, 140.12	1.15
Putnam	62	80628	72.19	54.22, 90.15	0.86
Rhea	37	33999	94.24	63.88, 124.61	1.12

Roane	58	53803	85.39	63.41, 107.36	1.01
Robertson	67	73664	91.9	69.9, 113.91	1.09
Rutherford	213	331604	74.24	64.27, 84.21	0.88
Scott	13	22120	52.88	24.13, 81.63	0.63
Sequatchie	23	15391	130.48	77.15, 183.8	1.55
Sevier	85	102077	77.66	61.15, 94.18	0.92
Shelby	617	992013	63.75	58.72, 68.78	0.76
Smith	23	19906	121.92	72.09, 171.74	1.45
Stewart	9	13546	50.81	17.62, 84.01	0.6
Sullivan	198	159453	110.19	94.84, 125.54	1.31
Sumner	219	188444	114.83	99.62, 130.04	1.36
Tipton	39	62929	61.42	42.14, 80.69	0.73
Trousdale	11	8517	130.26	53.28, 207.24	1.55
Unicoi	11	18553	58.16	23.79, 92.54	0.69
Union	16	19434	76.69	39.11, 114.27	0.91
Van Buren	10	5732	169.07	64.28, 273.87	2.01
Warren	32	44044	69	45.09, 92.9	0.82
Washington	84	131698	56.97	44.78, 69.15	0.68
Wayne	7	17059	33.2	8.6, 57.79	0.39
Weakley	15	34257	40.69	20.1, 61.28	0.48
White	36	27348	119.2	80.26, 158.13	1.42
Williamson	116	229294	53.05	43.4, 62.71	0.63
Wilson	119	138081	84.17	69.04, 99.29	1
<b>Tennessee</b>	<b>5586</b>	<b>6999886</b>	<b>84.17</b>	<b>81.96, 86.38</b>	<b>1</b>

\*-Relative rate as compared to the state age-adjusted rate.

# Appendix B

County-level age-adjusted mortality rates for 638 Tennesseans with fatal traumatic brain injury during the calendar year of 2016. Please interpret with caution.

County	TBI-Related Fatality Count	2016 County Population	Age-Adjusted Mortality Rate	95% Confidence Intervals	Relative Rate
Anderson	5	77995	4.99	0.62, 0.55	0.55
Bedford	5	53091	10.25	1.27, 1.13	1.13
Benton	2	16385	7	-2.7, 0.77	0.77
Bledsoe	2	14987	11.46	-4.42, 1.26	1.26
Blount	11	132789	7.15	2.92, 0.78	0.78
Bradley	4	110842	2.88	0.06, 0.32	0.32
Campbell	4	40205	8.44	0.17, 0.93	0.93
Cannon	3	14365	18.03	-2.37, 1.98	1.98
Carroll	7	28816	19.25	4.99, 2.11	2.11
Carter	3	57517	4.6	-0.61, 0.5	0.5
Cheatham	6	41007	15.15	3.03, 1.66	1.66
Chester	1	17861	3.78	-3.62, 0.41	0.41
Claiborne	2	32175	7.43	-2.87, 0.82	0.82
Clay	0	7926	0	0, 0	0
Cocke	1	36000	2.61	-2.51, 0.29	0.29
Coffee	7	56959	10.06	2.61, 1.1	1.1
Crockett	1	15900	5.71	-5.48, 0.63	0.63
Cumberland	11	60323	14.49	5.93, 1.59	1.59
Davidson	77	753451	11.06	8.59, 1.21	1.21
DeKalb	5	20790	21.12	2.61, 2.32	2.32
Decatur	3	12167	23.62	-3.11, 2.59	2.59
Dickson	10	53925	16.83	6.4, 1.85	1.85
Dyer	2	39010	5.14	-1.98, 0.56	0.56
Fayette	2	40577	4.29	-1.66, 0.47	0.47
Fentress	2	18268	6.88	-2.66, 0.76	0.76
Franklin	6	43001	13.05	2.61, 1.43	1.43
Gibson	6	50735	9.69	1.94, 1.06	1.06
Giles	2	29990	8.22	-3.17, 0.9	0.9
Grainger	2	23847	8.96	-3.46, 0.98	0.98
Greene	9	70504	9.74	3.38, 1.07	1.07
Grundy	0	13519	0	0, 0	0
Hamblen	4	71151	6.16	0.12, 0.68	0.68

Hamilton	29	377138	7.22	4.59, 0.79	0.79
Hancock	4	6583	43.44	0.87, 4.77	4.77
Hardeman	3	25872	10.77	-1.42, 1.18	1.18
Hardin	3	26234	9.32	-1.23, 1.02	1.02
Hawkins	9	57371	14.68	5.09, 1.61	1.61
Haywood	2	18636	8.21	-3.17, 0.9	0.9
Henderson	6	28426	17.87	3.57, 1.96	1.96
Henry	7	33071	21.66	5.61, 2.38	2.38
Hickman	2	24872	8.05	-3.11, 0.88	0.88
Houston	2	8292	15.57	-6.01, 1.71	1.71
Humphreys	3	18786	11.61	-1.53, 1.27	1.27
Jackson	1	11764	4.28	-4.11, 0.47	0.47
Jefferson	2	55374	2.86	-1.1, 0.31	0.31
Johnson	1	18096	4.06	-3.9, 0.45	0.45
Knox	37	474549	7.06	4.78, 0.77	0.77
Lake	0	7735	0	0, 0	0
Lauderdale	2	27451	6.71	-2.59, 0.74	0.74
Lawrence	7	44010	14.54	3.77, 1.6	1.6
Lewis	3	12183	23.02	-3.03, 2.53	2.53
Lincoln	1	34757	2.81	-2.7, 0.31	0.31
Loudon	1	55745	1.09	-1.05, 0.12	0.12
Macon	5	24650	17.2	2.12, 1.89	1.89
Madison	12	101326	10.67	4.63, 1.17	1.17
Marion	1	28946	1.96	-1.88, 0.22	0.22
Marshall	4	33521	9.23	0.18, 1.01	1.01
Maury	8	95071	9.34	2.87, 1.03	1.03
McMinn	5	54938	7.87	0.97, 0.86	0.86
McNairy	4	26478	13.18	0.26, 1.45	1.45
Meigs	3	12246	22.69	-2.99, 2.49	2.49
Monroe	4	47917	7.66	0.15, 0.84	0.84
Montgomery	20	215245	9.47	5.32, 1.04	1.04
Moore	0	6429	0	0, 0	0
Morgan	1	21812	5.61	-5.38, 0.62	0.62
Obion	2	31847	6.47	-2.5, 0.71	0.71
Overton	2	22351	8.13	-3.14, 0.89	0.89
Perry	1	8155	9.17	-8.8, 1.01	1.01
Pickett	0	5221	0	0, 0	0
Polk	1	17116	4.4	-4.22, 0.48	0.48
Putnam	10	80628	11.36	4.32, 1.25	1.25
Rhea	1	33999	2	-1.92, 0.22	0.22
Roane	6	53803	9.28	1.85, 1.02	1.02

Robertson	9	73664	12.59	4.36, 1.38	1.38
Rutherford	18	331604	6.15	3.31, 0.68	0.68
Scott	2	22120	6.08	-2.35, 0.67	0.67
Sequatchie	3	15391	21.36	-2.81, 2.34	2.34
Sevier	9	102077	6.62	2.3, 0.73	0.73
Shelby	63	992013	6.5	4.9, 0.71	0.71
Smith	6	19906	33.88	6.77, 3.72	3.72
Stewart	1	13546	5.79	-5.56, 0.64	0.64
Sullivan	19	159453	11.33	6.24, 1.24	1.24
Sumner	17	188444	8.59	4.51, 0.94	0.94
Tipton	2	62929	2.48	-0.96, 0.27	0.27
Trousdale	0	8517	0	0, 0	0
Unicoi	1	18553	6.71	-6.45, 0.74	0.74
Union	1	19434	4.86	-4.67, 0.53	0.53
Van Buren	0	5732	0	0, 0	0
Warren	9	44044	17.42	6.04, 1.91	1.91
Washington	14	131698	8.97	4.27, 0.98	0.98
Wayne	2	17059	10.62	-4.1, 1.17	1.17
Weakley	2	34257	6.34	-2.45, 0.7	0.7
White	3	27348	7.45	-0.98, 0.82	0.82
Williamson	21	229294	10.28	5.88, 1.13	1.13
Wilson	16	138081	11.8	6.02, 1.3	1.3
<b>Tennessee</b>	<b>638</b>	<b>6999886</b>	<b>9.11</b>	<b>8.41, 1</b>	<b>1</b>

\*-Relative rate as compared to the state age-adjusted rate.