

2017 Trauma System Report to the Legislature

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Minnesota Department of Health
Statewide Trauma System
P.O. Box 64882, St. Paul, MN 55164-0882
(651) 201-3838
(<http://www.health.state.mn.us/traumasystem>)



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Executive Summary

Injury is the third leading cause of death in Minnesota, following cancer and heart disease, respectively. It is the leading cause of death for those between ages one and 45 years of age. In 2015, more than 3,500 Minnesotans died from injury. Thousands more Minnesota citizens are seriously injured, requiring costly healthcare resources. Most often, the victims of injury are able to recover fully, returning to their families and resuming their places in the community. But some victims' recovery is prolonged and marked by an extended hospitalization and a protracted rehabilitation. These often under-appreciated facts characterize a major public health concern for the citizens of Minnesota as well as people across the globe.

The Statewide Trauma System exists to reduce death and disability from traumatic injuries across the state. Minnesota's trauma system was established in 2005 and has as its ultimate goal improving trauma patients' outcomes by developing a network of hospitals committed to optimizing the care provided to trauma patients. Currently, 122 of Minnesota's 129 eligible hospitals are designated as trauma hospitals. (To be eligible for designation, hospitals must have an emergency room.) Each have met rigorous criteria that ensures coordinated around-the-clock resuscitation and stabilization of trauma patients, and post-event critical review of the care provided as part of a comprehensive performance improvement process.

By designating hospitals as trauma hospitals and working collaboratively with like-minded partners in the emergency medical services (EMS), injury prevention and rehabilitation industries, the statewide trauma system strives to relegate the tragedies associated with traumatic injury to rare and unusual occurrences, rather than the daily heartbreak that they are for so many Minnesotans today.

The Trauma Registry

One essential method to achieve the trauma system's goals is through the collection and analysis of trauma care data. The purpose of this report is to establish a baseline of trauma epidemiology from which to develop clinical and system quality improvement, injury prevention, treatment and rehabilitation programs (M.S. 144.6071, Subd. 1 and 7).

Key Findings

- Almost every Minnesotan (99 percent) lives within 60 minutes of a designated trauma hospital.
- Falls were the leading cause of death for ages 65 and older. Vehicle-related injuries were the leading cause of death for ages 15-64. Submersion, suffocation and foreign bodies collectively were the leading causes of pediatric death.
- Elderly patients were disproportionately represented in the trauma registry data.
- Thirty-eight percent of cases involved activation of the "trauma team."

- Almost half of the trauma team activations reported occurred in Level 3 and 4 trauma hospitals.
- When patients were transferred from the emergency department of a Level 3 or 4 trauma hospital, the average length of stay in the emergency department decreased when the trauma team was activated versus when it was not.
- Only seven percent of major trauma cases transferred to a Level 1 or 2 trauma hospital were subsequently discharged from the emergency department of that hospital.

Achievements

Much of the work undertaken in the last year has been targeted at prioritizing and addressing the development goals. Progress has been made in the last year toward the pursuit of quality data from which to make sound policy decisions.

- The data set has been reduced in size to lessen the reporting burden on participating hospitals.
- The data set has been refined to ensure that the data originates from the source most likely to be accurate.
- The trauma case definition (i.e., inclusion criteria) has been refined to preclude the need for hospital to report minor injuries.
- The trauma case definition has been modified to capture all trauma cases involving a hospital admission, not just those admitted for more than 48 hours, an important consideration when describing the cost of traumatic injury.

Looking Ahead

As the trauma system data continues to mature, the ability to use it to measure progress will likewise improve, driving the trauma system and its stakeholders to improve trauma care and meet the ultimate goals of reducing costs in both dollars and life lost.

To achieve these outcomes, the trauma system continues to focus on three important development goals:

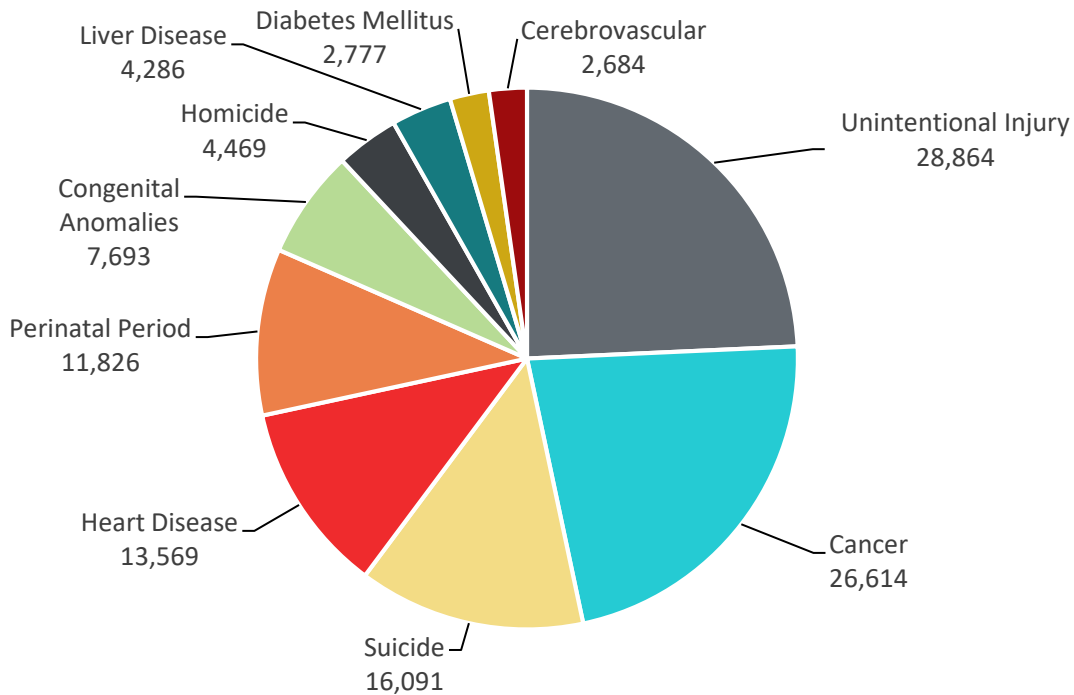
- Develop methodologies to:
 - account for and eliminate double-counting of trauma cases
 - ensure all required cases are reported
 - measure compliance with EMS transport requirements
 - validate the accuracy of the data
- Ensure disparate registry vendors accurately map and submit required data elements
- Collect data from Level 2 trauma hospitals in North Dakota, South Dakota and Wisconsin that treat major trauma patients injured in Minnesota.

These improvements will ensure a robust dataset from which clinical and system quality improvement, injury prevention, treatment and rehabilitation programs can be assessed, analyzed and reported. The State Trauma Advisory Council and other regional and local industry leaders can use this data to drive their state, regional and local performance improvement and injury prevention initiatives. Ultimately, data-driven best practices will lead to uniform trauma management practices across the system.

Minnesota’s Statewide Trauma System

Minnesota established its statewide trauma system in 2005 to ensure that people who experience major trauma are promptly transported and treated at trauma hospitals appropriate to the severity of their injuries. Major trauma is defined by Minnesota Statutes 144.602, Subdivision 3 as “sudden severe injury or damage to the body caused by an external force that results in potentially life-threatening injuries or that could result in the following disabilities: (1) impairment of cognitive or mental abilities; (2) impairment of physical functioning; or (3) disturbance of behavioral or emotional functioning.” Injury was the third leading cause of death in Minnesota in 2015, and the leading cause of death of citizens from ages one to 44.¹ More years of potential life before age 65 are lost due to unintentional injury than any other cause. Yet, it remains one of the most underappreciated of all major public health problems.

Years of Potential Life Lost in Minnesota, 2015
Top 10 Causes



Source: Centers for Disease Control

¹ Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. (2005) [cited February 7, 2017]. Available from URL: www.cdc.gov/injury/wisqars

Before the statewide trauma system was established, pockets of coordinated trauma care existed only in the more-densely populated areas of the state. But much of rural Minnesota lacked a coordinated system of trauma care. At that time, there were only six verified trauma hospitals in a state of over 5 million people. Now, after ten years of development, there are 122 designated trauma hospitals in the state, some with *two* levels of designation (both adult and pediatric). These hospitals are networked together, all committed to providing trauma care in a systematic fashion and working together for the betterment of their trauma patients.

This system approach to trauma care is the most effective means of reducing death and disability resulting from severe injury. For the severely injured person, the time between sustaining an injury and receiving definitive care is the most important predictor of survival. A trauma system ensures that the necessary infrastructure is in place to deliver the right patient to the right hospital and that emergency medical services and hospital resources are effectively coordinated to optimize the delivery of trauma care to achieve the best possible outcomes. Trauma systems further reduce death and disability by identifying the causes of injury, promoting prevention initiatives and ensuring that the resources required for optimal trauma care are available when and where they are needed.

Governance

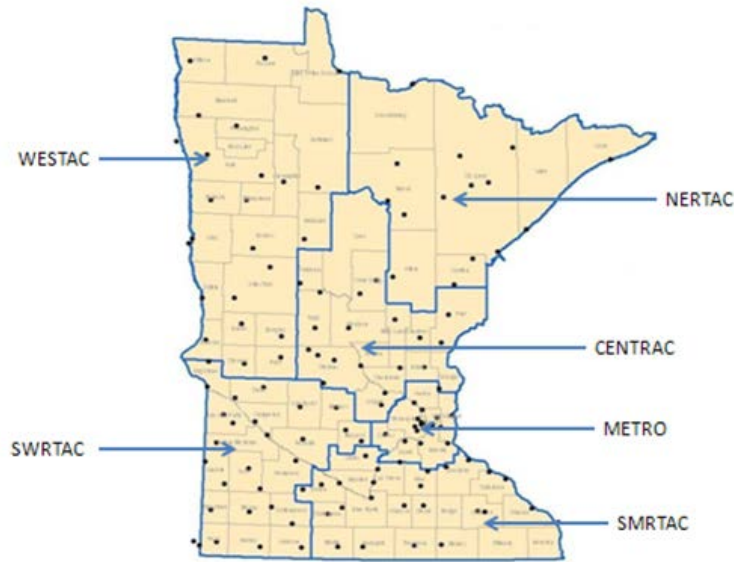
Minnesota Statutes Section 144.608 established the State Trauma Advisory Council (STAC). This multidisciplinary committee of health care and community professionals is appointed by the commissioner of health to advise, consult with and make recommendations to the commissioner on the development, maintenance and improvement of the statewide trauma system. (See [Appendix A](#) for a listing of current STAC members.)

The STAC's vision for the trauma system is that all Minnesota hospitals will participate in a fully funded trauma system that:

- Is of the highest quality.
- Is seamless across the continuum of care (prevention, care delivery, rehabilitation).
- Is safe, timely, efficient, patient-centered, and patient-driven.
- Uses outcome data and continuous clinical quality improvement to evolve.
- Allows many trauma patients to be treated in their own communities.
- Eliminates all delays in transfers to definitive care.
- Is embraced and valued by citizens and policymakers.
- Is fully integrated into the disaster preparedness and public health systems.

To accommodate specific regional needs within the trauma system, the Commissioner of Health, in consultation with the Emergency Medical Services Regulatory Board (EMSRB), has appointed six regional trauma advisory committees (RTACs) to advise, consult with and make recommendation to the STAC. Regional trauma advisory committees assess the regional performance of the trauma system and support the performance improvement activities of their member hospitals. See [Appendix B](#) for a listing of the counties included in each RTAC.

MINNESOTA'S REGIONAL TRAUMA ADVISORY COMMITTEES



Trauma Hospitals

The statewide trauma system designates six levels of trauma hospitals. These designations distinguish the availability of resources required to resuscitate and care for an injured patient; Level 1s have more resources than Level 4s. Designation levels do not imply a ranking of the quality of care provided at these hospitals. (See [Appendix C](#) for listing of Minnesota's designated hospitals in 2015.)

Each designated trauma hospital has committed to establish and maintain a trauma program within the hospital, which includes the appointment of a program manager and a physician medical director. Clinical staff must satisfy basic trauma training requirements. Each hospital has established a trauma team that can be rapidly assembled to provide for the initial evaluation and resuscitation of major trauma patients. Minimal levels of clinical resources are continuously maintained and each hospital commits to perpetual clinical performance improvement. This performance improvement process is a defining characteristic of a designated trauma hospital. And hospitals commit to collecting and submitting trauma-related data via the state trauma registry.

In Minnesota, Level 1 and 2 trauma hospitals voluntarily undergo a verification process by the American College of Surgeons to substantiate the presence of the required resources. Most Level 3 and all Level 4 trauma hospitals voluntarily undergo a verification process administered

by the Minnesota Department of Health. (Level 3 hospitals may elect to verify via the American College of Surgeons; however, most use the state pathway.) Once a hospital's resources are verified, the commissioner of health designates the facility as a trauma hospital. The facility must repeat the verification process every three years. Following is an explanation of each designation level.

Level 1 trauma hospital

Can provide definitive care for virtually any trauma patient. Injured patients have access to the most comprehensive resources for treatment of their injury. Many specialized services are available 24 hours a day, including anesthesiology, critical care, emergency medicine, internal medicine, neurosurgery, oral and maxillofacial surgery, orthopedic surgery, plastic surgery and radiology. Emergency physician and general surgeons are immediately available to the trauma patient while other specialties may be on call off site. The Level 1 trauma hospitals provide training for resident physicians and conduct trauma-related research. They must meet minimum trauma patient volume requirements in order to maintain their status. Level 1 trauma hospitals often receive severely injured patients transferred from Level 3 and 4 trauma hospitals.

Level 1 pediatric trauma hospital

Has similar resource requirements as Level 1 trauma hospitals above but must admit a minimum number of pediatric (<15 years of age) trauma patients annually and dedicate pediatric-specific clinical and administrative resources.

Level 2 trauma hospital

Provides definitive care for many complex and severely injured patients. Like the Level 1 trauma hospital, the emergency physician and general surgeon are immediately available to the trauma patient. But while many specialized services are available, fewer are required than for Level 1 facilities. Level 2 trauma hospitals are not required to provide residency training programs or to conduct trauma-related research. Level 2 trauma hospitals also receive severely injured patients transferred from Level 3 and 4 trauma hospitals.

Level 2 pediatric trauma hospital

Has similar resource requirements as Level 2 trauma hospitals above but must admit a minimum number of pediatric (<15 years of age) trauma patients annually. Level 2 pediatric trauma hospitals also have dedicated pediatric-specific clinical and administrative resources.

Level 3 trauma hospital

Can provide initial resuscitation and stabilization of the trauma patient. A general surgeon is available within 30 minutes to assist with the resuscitation and to provide surgical interventions. Moderately injured patients can be admitted and followed by the general surgeon. Patients with complex and multi-system injuries are typically transferred to a Level 1 or 2 trauma hospital.

Level 4 trauma hospital

Provides initial resuscitation to the severely injured patient. Surgical services are not required, so trauma patients requiring admission or more comprehensive evaluation are typically transferred to a Level 1 or 2 trauma hospital.

Key Trauma System Metrics

As the trauma system data continues to mature, additional data will improve performance measurement and better describe the cost of trauma in terms of both dollars and life lost. Some figures that begin to characterize these measures are included in this report. For instance, patients' length of stay in the hospital, discharge disposition and injury severity can serve as crude proxies of the financial cost of hospitalized injury.

A goal of the system is to use the trauma data to formulate best practices for patient care. For instance:

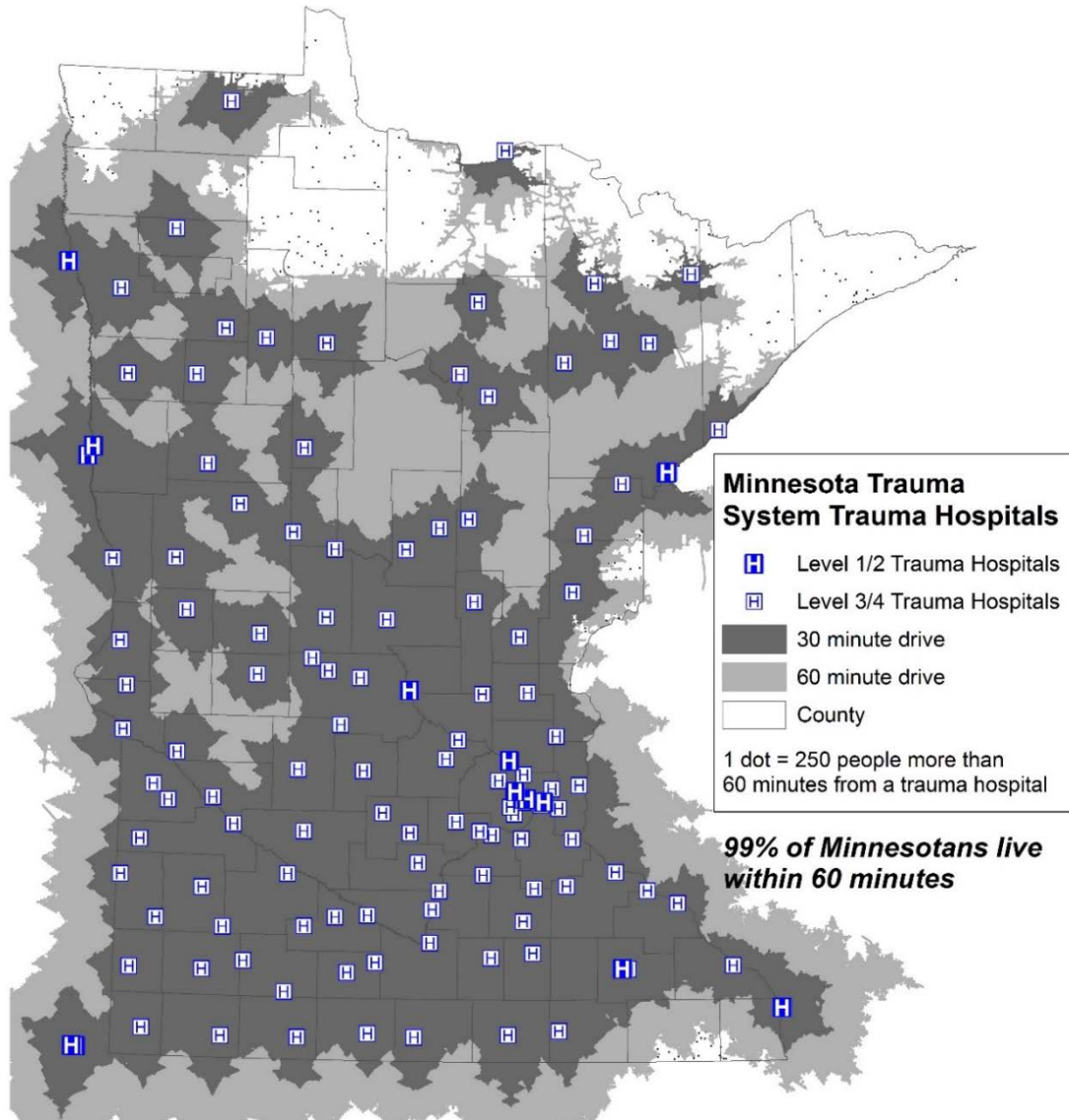
- When is it advantageous to transport a trauma patient via helicopter?
- When should a trauma patient be transported directly to a tertiary hospital rather than stopping at a local hospital first?
- When should a local hospital perform imaging studies before transferring trauma patients to a tertiary hospital?

The trauma system also seeks to use the data to measure its own performance. Important principles of trauma care include:

- Minimizing patients' time out of definitive care through prompt referral to tertiary hospitals.
- Eliminating multiple transfers of patients who are initially transferred to a hospital that is not equipped to manage the patients' injuries definitively.
- Minimizing the transfer of low-acuity patients that can be safely cared for at the local hospital.
- Minimizing the number of trauma patients that die at a Level 3 or 4 trauma hospital.
- Maximizing the number of seriously injured pediatric patients that are treated at a designated pediatric trauma hospital.
- Maximizing the number of trauma patients that are transported by emergency medical services to designated trauma hospitals.

Distribution of Trauma Hospitals

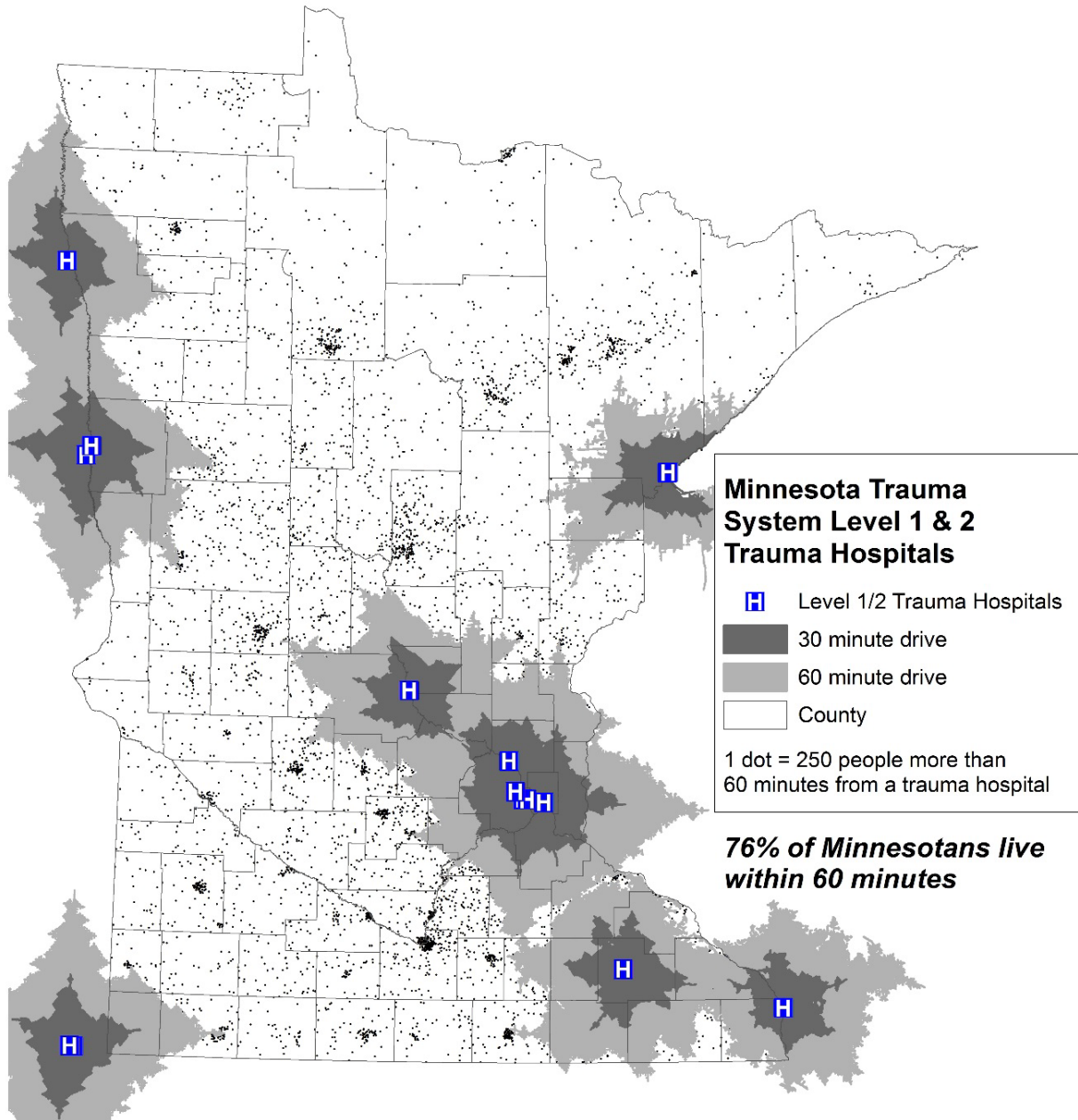
Drive Time to Designated Trauma Hospitals and Minnesota Population Distribution in 2015²



Almost every Minnesotan lives within 60 minutes of a designated trauma hospital.

² Data Sources: Minnesota Department of Health, as of January 2016; 2010 US Census Redistricting Data P.L. 94-171. Map by MDH Cardiovascular Health Unit, January 2016.

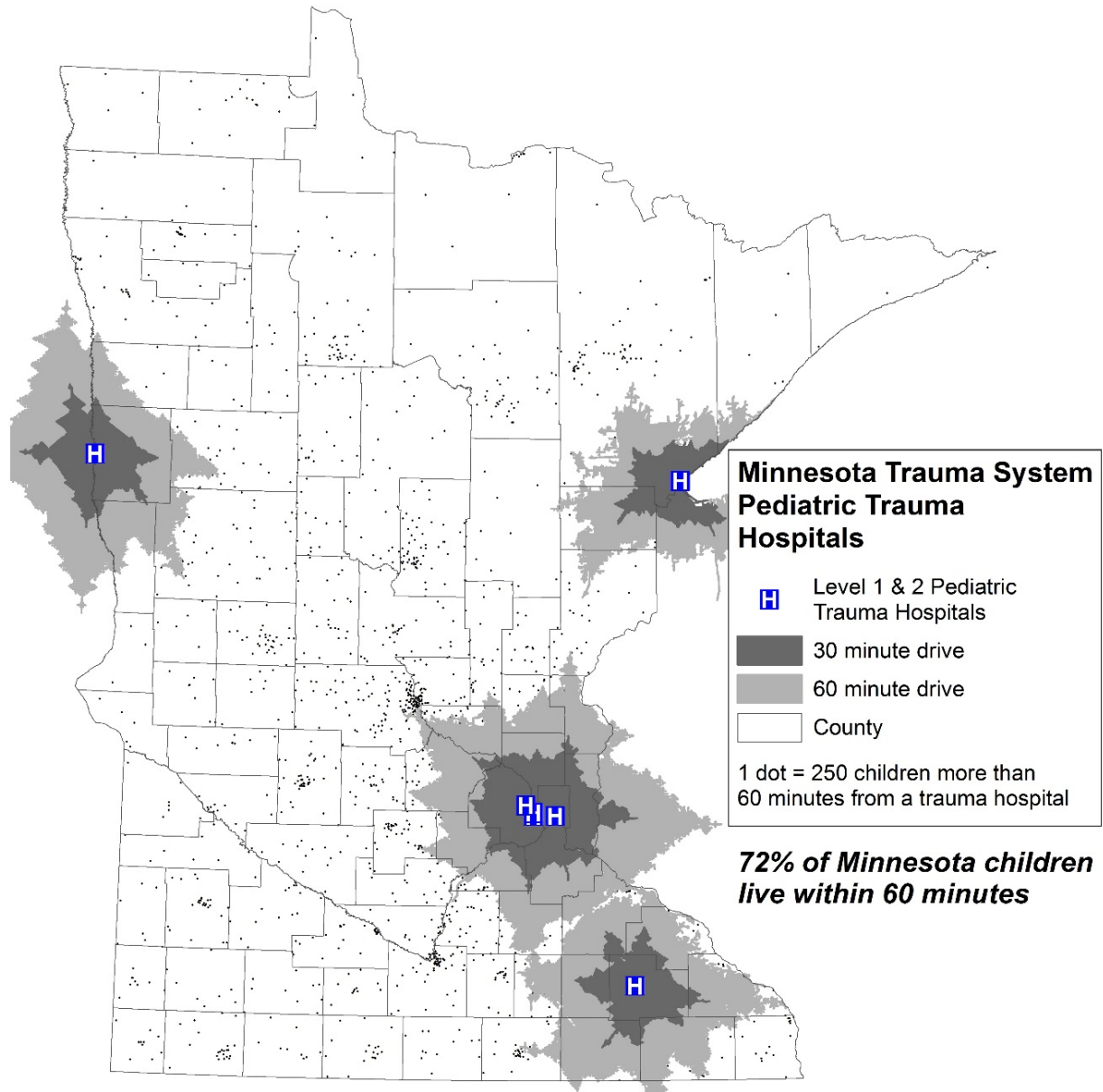
Drive Time to Designated Level 1 & 2 Trauma Hospitals and Minnesota Population Distribution³



Most Minnesotans live within 60 minutes of a Level 1 or 2 trauma hospital.

³ Data Sources: Minnesota Department of Health, as of January 2016; 2010 US Census Redistricting Data P.L. 94-171. Map by MDH Cardiovascular Health Unit, January 2016.

Drive Time to Designated Pediatric Trauma Hospitals and Minnesota Population Distribution⁴



The majority of children (less than 18 years old) live within 60 minutes of a designated Level 1 or 2 pediatric trauma hospital.

⁴ Data Sources: Minnesota Department of Health, as of January 2016; 2010 US Census Redistricting Data P.L. 94-171. Map by MDH Cardiovascular Health Unit, January 2016.

2015 Major Trauma Statistics

One essential method to achieve the trauma system's goals is through the collection and analysis of trauma care data. This section of the report describes a baseline of trauma data from which to develop clinical and system quality improvement, injury prevention, treatment and rehabilitation programs (M.S. 144.6071, Subd. 1 and 7).

Trauma data in this report includes all incidents reported by designated trauma hospitals that occurred during calendar year 2015 and met the MNTrauma inclusion criteria ([Appendix D](#)). Generally, the inclusion criteria describe cases in which the patients' primary diagnosis was a traumatic injury and the trauma team was activated or the patient was admitted, transferred or died.

This report includes only cases that: 1) arrived at a designated trauma hospital in Minnesota; 2) met the trauma registry inclusion criteria; and 3) were reported by the treating hospital. Patients who died from a traumatic injury but were not transported to a hospital are not included in these data.

Limitations of the Data

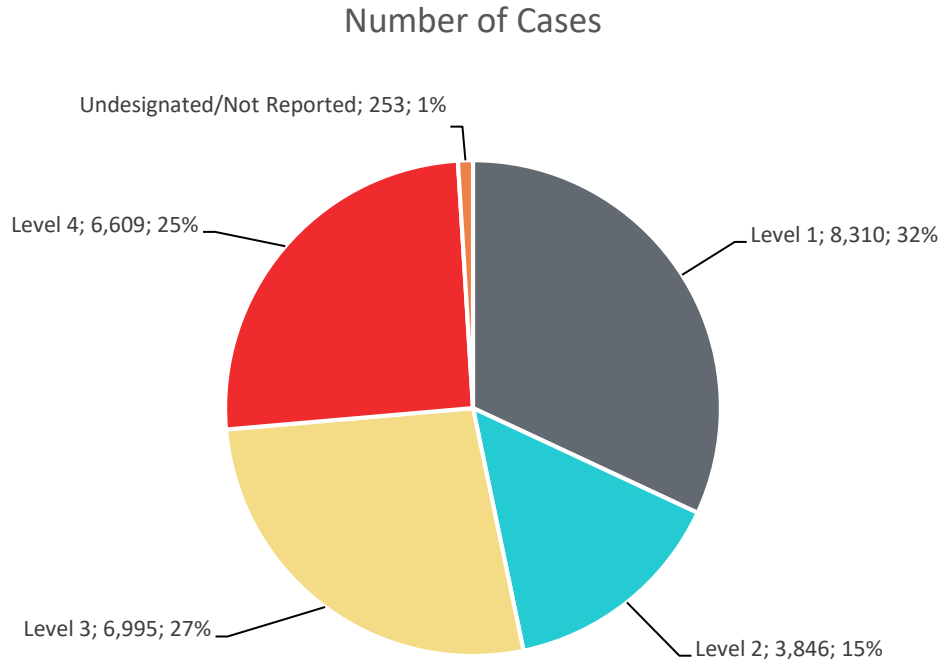
- Since Level 2 trauma hospitals exist just across the borders of Minnesota in North Dakota, South Dakota and Wisconsin, some patients injured in Minnesota are transported directly to those trauma hospitals. Those cases are recorded in the respective states' trauma system registries, and are not included in MNTrauma.
- Similarly, patients may be transferred to an out-of-state trauma hospital from one of Minnesota's Level 3 or 4 trauma hospitals. In such cases, the record from the Level 3 or 4 trauma hospital is included in this report, but the corresponding out-of-state hospital record is not included.
- Many of Minnesota's Level 1 and 2 trauma hospitals also receive trauma patients transferred from out-of-state hospitals. The records from those patients treated in Minnesota are included in this report, even though the patients were not injured in Minnesota.
- Cases treated initially in one Minnesota trauma hospital and then transferred to another Minnesota trauma hospital result in two distinct MNTrauma records: one from each facility that provided care. Thus, one patient could be counted twice in these data.
- Not all trauma cases that meet the registry inclusion criteria have been reported. But the exact number of missing cases is unknown.
- When cases are reported but required data fields are left blank, the record may be excluded from this report because the missing data precludes its identification as an included case.

- Injury severity scores⁵ (ISS) from Level 1 and 2 trauma hospitals are considered accurate; however, ISSs from Level 3s and 4s have not yet been validated. Therefore, only injury severity scores from records submitted by Level 1 and 2 trauma hospitals are reported in this document.
- Trauma registry records are created by either entering data directly into MNTrauma from a web-based interface, or importing data from an export file generated by a third-party vendor. The latter could result in the exclusion of some data because of importing errors or mapping inconsistencies.

⁵ The Injury Severity Score is a summary measure used to characterize the condition of patients with multiple injuries. The standard industry definition of major trauma is an ISS > 15, which makes it useful for comparison; however, the clinical significance of that definition is a question still being debated in the academic community.

Trauma Incidence by Patient Characteristics

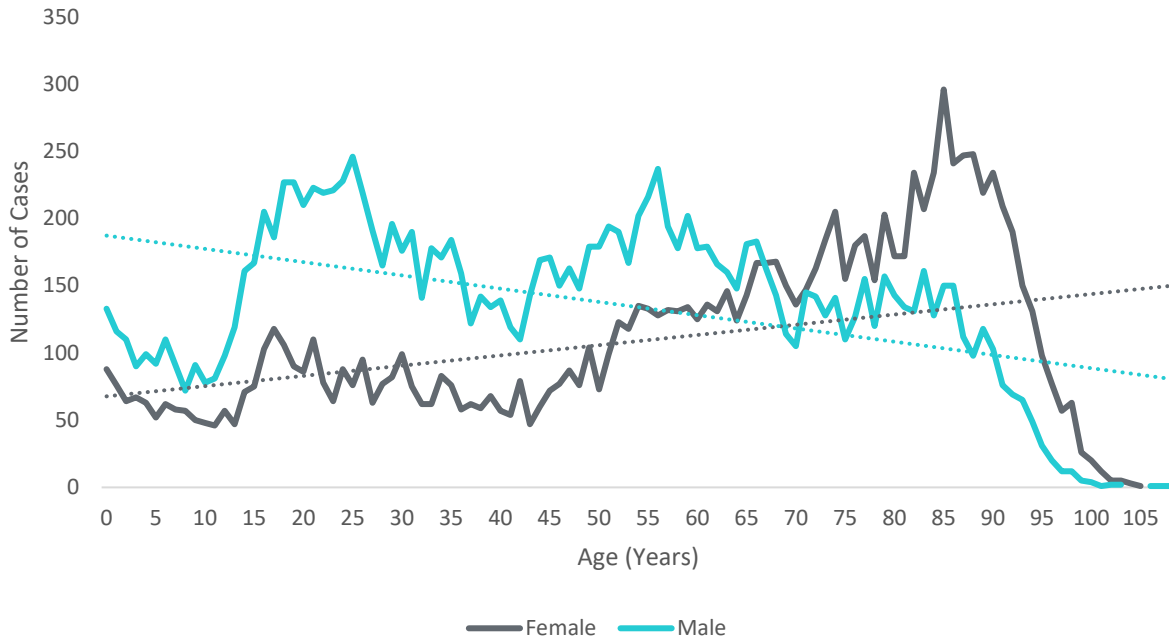
These data represent cases reported. See *Limitations of the Data*, above, for an explanation of how the limitations may affect the data in these reports.



Minnesota hospitals collectively reported 26,013 major trauma cases during calendar year 2015. This represents a one percent decrease over 2014. Level 4 trauma hospitals saw an increase in major trauma cases in 2015; all other levels saw a decrease.

Level 3 and 4 trauma hospitals, many of which are located in rural areas, initially cared for 53% of Minnesota's major trauma patients.

Age and Gender

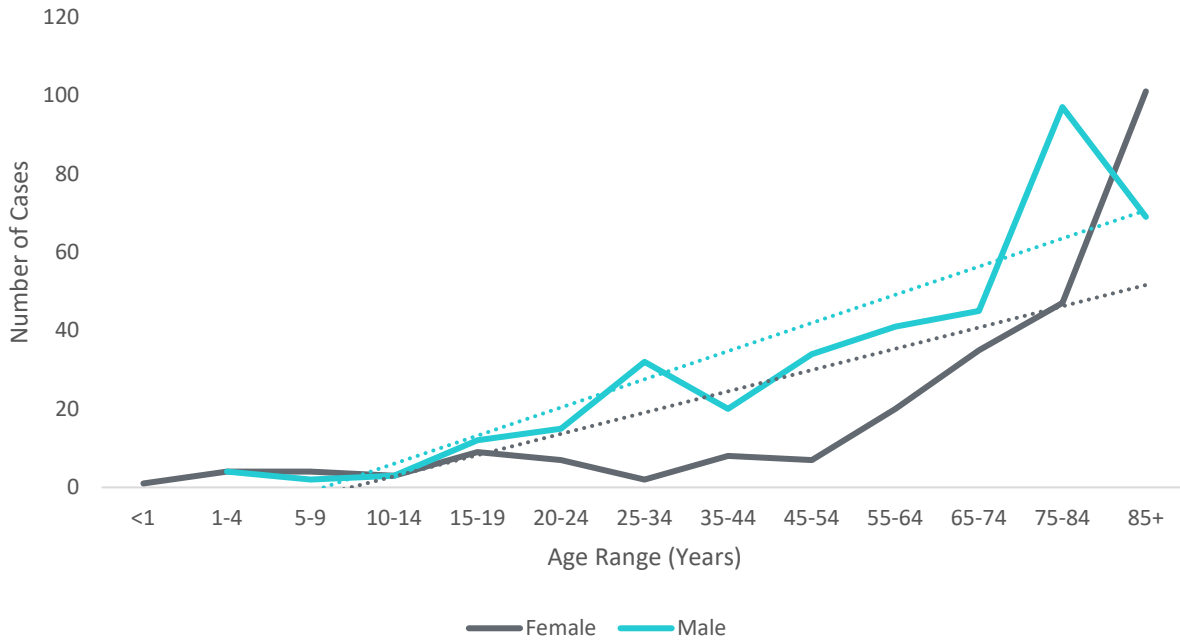


The number of cases generally increases as patient age increases. However, there is a noticeable increase in the number of major trauma cases between birth and age two, 14 and 36, 54 and 59, and again from 74 to 92 years of age.

There is a direct relationship between increasing age and comorbid conditions. Younger patients tend to have shorter hospital stays or may not require admission at all. As such, they may not be included in the trauma registry. As patients age, their comorbid conditions may cause a traumatic injury; or their injury could exacerbate an existing comorbid condition, resulting in complications and/or a longer hospitalization.

Fifty-four percent of the major trauma cases reported were males. Males dominated major trauma cases in the early years. But beginning around the age of 67, females comprised the majority of cases.

Mortality by Age and Gender



There were 662 cases in which the patient’s discharge disposition indicated death. Children (under age 15) accounted for three percent of traumatic fatalities treated in Minnesota’s trauma hospitals. Patients over the age of 75 accounted for 50 percent of the fatalities. The elderly are more likely to die from a traumatic injury than younger patients who experience the same injury.

Many patients that die from major trauma do not die in the hospital. Patients that died outside of the hospital (i.e., those that were not transported or died after discharge) are not counted in these numbers.

Cause of Injury

Falls represented the majority of trauma cases: fifty-four percent of the trauma registry cases in first three quarters of 2015. And while falls were the leading cause of injury in the pediatric and geriatric populations, vehicle-related injuries were the leading cause of injury in the middle adult age group. The geriatric population had the highest burden of trauma related to falls where 85 percent of the trauma registry cases in that age group were due to falls.

Vehicle-related injuries (motor vehicle crash, motor vehicle non-traffic crashes and other road vehicle crashes) accounted for the second most common cause of injury in first three quarters of 2015. These cases represented twenty-six percent of trauma cases in all age groups. The middle adult age group had the highest burden of trauma related to vehicle-related causes, with 38 percent of trauma registry records in this age group attributed to vehicle-related injury. Injuries due to motor vehicle accidents were only reported in the trauma registry if the patient was transported to a hospital. Because of this limitation in reporting, vehicle-related injuries and deaths are underrepresented and the actual number is considerably higher.

Most Common Causes of Injury for Hospitalized Major Trauma Cases January – September 2014⁶									
Cause	Number of Cases				Mortality			Total	Fatality Rate
	Pediatric < 15 years	Adult 15–64 years	Geriatric > 64 years	Total	Pediatric < 15 years	Adult 15-64 years	Geriatric > 64 years		
Fall	1485	4123	7875	13484	1	41	347	389	3%
Vehicle-Related	747	4900	870	6517	7	85	44	136	2%
Other Accidents	549	1747	339	2635	3	14	6	23	<1%
Homicide & Injury Purposely Inflicted	95	1173	24	1292	6	24	1	31	2%
Suicide & Self-Inflicted Injuries	9	256	17	282	1	27	7	35	12%
Natural & Environmental Factors	82	144	32	258	1	1	1	3	1%
Fire & Flames	15	95	24	134	3	2	3	8	6%
Undetermined	12	80	15	107	1	4	3	8	7%
Submersion, Suffocation & Foreign Bodies	57	32	8	97	9	3	1	13	13%

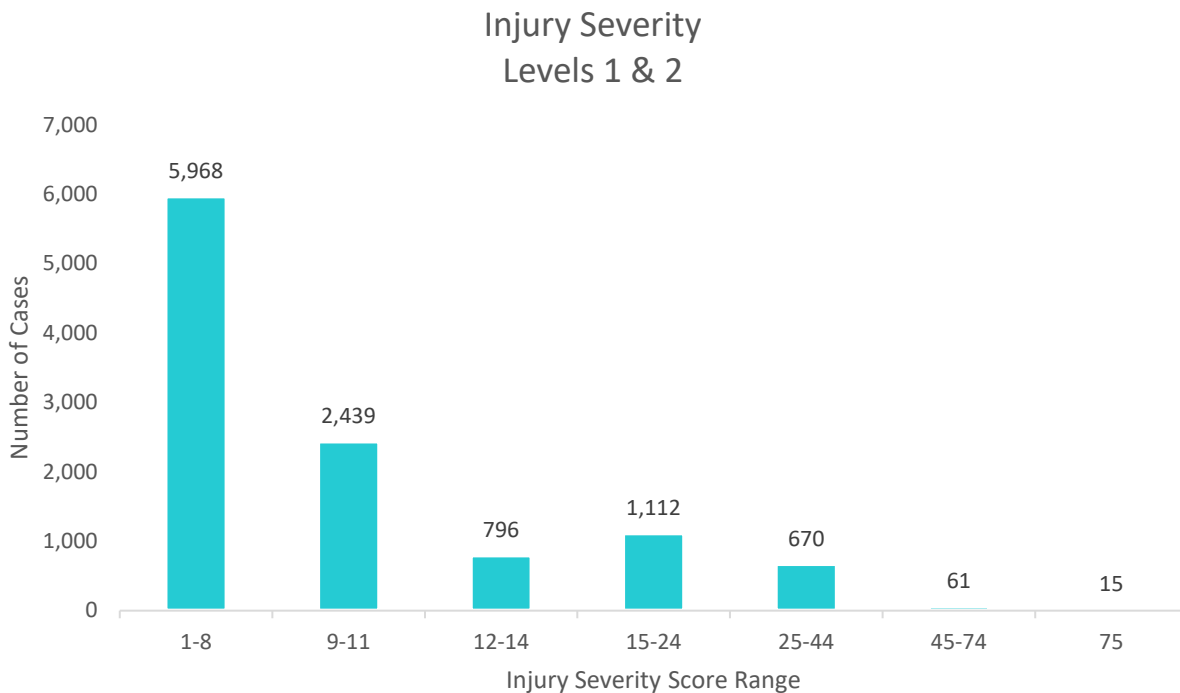
⁶ In October 2015 reporting of injury cause codes transitioned from the International Classification of Diseases, 9th revision (ICD-9) to the 10th revision (ICD-10). Since injury cause classifications between the two versions are disparate and could not be aggregated, only ICD-9 injury cause codes from before October 2015 were used in this analysis.

Trauma deaths are rare in the pediatric population compared to the other age groups, with thirty-two trauma deaths being reported in the first three quarters of 2015. The leading causes of pediatric death were submersion, suffocation & foreign bodies (28 percent), vehicle-related (22 percent) and homicide & injury purposely inflicted (19 percent). Trauma deaths in the middle adult age group occurred most commonly from vehicle-related causes (41 percent), falls (20 percent) and suicide and self-inflicted injuries (13 percent). Trauma deaths in elderly adults occur most frequently from falls (83 percent).

Overall mortality from the most common causes was 2.6%. A significantly increased mortality rate was seen in the submersion, suffocation & foreign bodies, and suicide & self-inflicted injuries categories.

Injury Severity Score

The Injury Severity Score (ISS) is a measure used to quantify the severity of traumatic injuries. Typically, an ISS score greater than 15 defines a case as major trauma. But the clinical significance of that definition is in question since many elderly patients with lower ISS scores experience a prolonged hospitalization and rehabilitation, or even die secondary to an injury from which a younger patient would quickly recover.



Generally, the higher the ISS score, the more serious the trauma case, though age and comorbid conditions can independently affect the seriousness of an injury. Since many confounding factors besides injury severity can affect outcomes, the statewide trauma system requires designated hospitals at all levels to critically review trauma cases and continuously challenge themselves to improve the care and care processes in their hospitals.

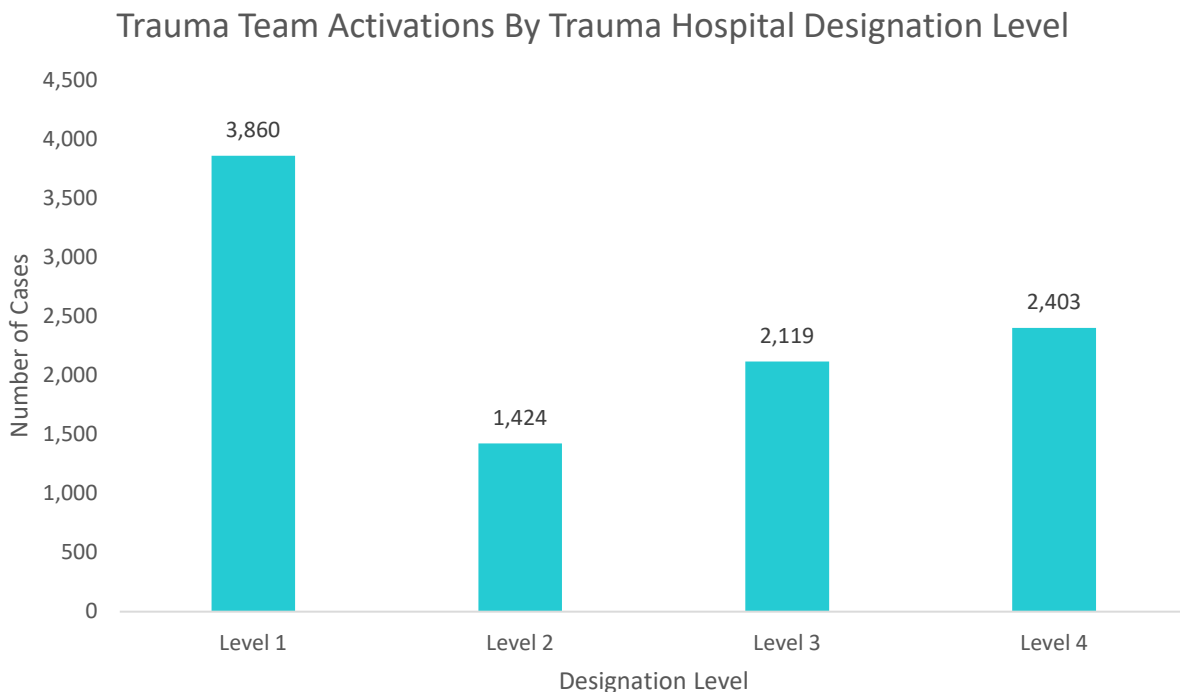
The majority of trauma cases treated at Level 1 and 2 trauma hospitals (54 percent) had an ISS less than nine. Seventeen percent of the cases had an ISS greater than 15. While cases with an ISS greater than 15 tend to require substantial clinical resources to achieve optimal outcomes, case involving elderly patients with lower ISS scores can also command intense clinical resources due to the complexity of their clinical condition.

Note: Since the ISS scores reported by Level 3 and 4 trauma hospitals have not yet been validated, only the ISS scores from Level 1 and 2 trauma hospitals were used in this analysis.

Trauma Team Activations

All trauma hospitals deploy a multidisciplinary team to promptly manage the care of a major trauma patient. This trauma team is activated when specific anatomic and physiological criteria are met. While there are minimum criteria for trauma team activation, each hospital largely establishes its own criteria. (See [Appendix E](#) for an example of trauma team activation criteria.)

There were 9,806 trauma team activations reported in 2015 representing 38 percent of the total number of trauma registry cases. Level 3 and 4 trauma hospitals were responsible for 46 percent of the trauma team activations.



Trauma teams represent a considerable expenditure of resources when activated. But trauma patients' injuries can be difficult to identify and time is of the essence. Serious, occult injuries are common and a multidisciplinary, hyper-vigilant team approach to the assessment and

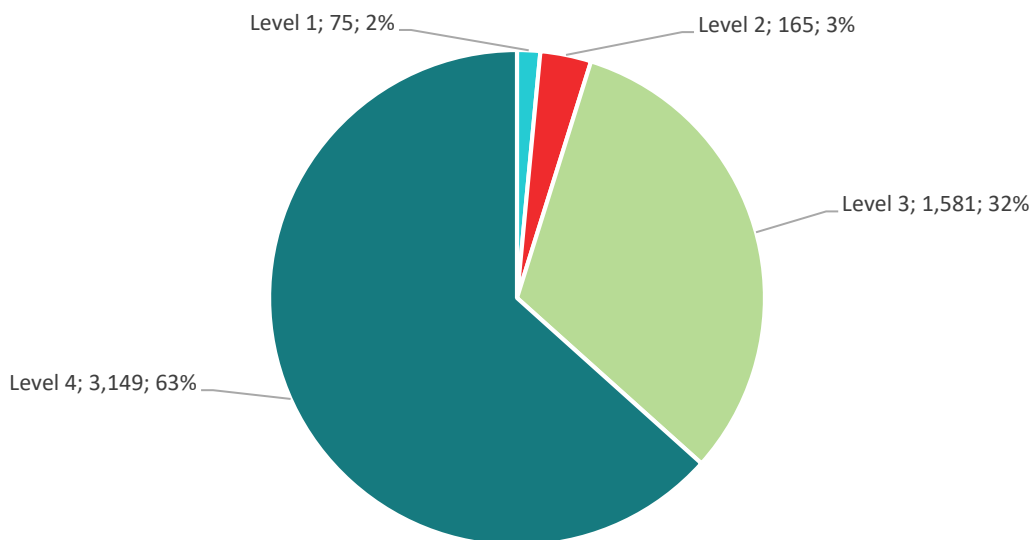
management of trauma patients maximizes the likelihood that serious injuries will be identified and treated promptly.

Inter-facility Transfers between Trauma Hospitals

Trauma patients requiring resources that are not available at the hospital that initially receives them must be transferred to a trauma hospital capable of caring for their injuries definitively. Sometimes patients are transferred to a regional hospital relatively close to their home. But most patients will require transfer to a one of the metropolitan areas within Minnesota or its neighboring states. While this is usually burdensome for both the patient and their family members, the practice optimizes outcomes.

Of the 4,970 trauma patients transferred, the majority were transferred from Level 4 trauma hospitals (63 percent). Only five percent were transferred from a Level 1 or 2 trauma hospital. Level 1 and 2 trauma hospitals typically provide definitive care for major trauma patients and rarely transfer them. Level 3 and 4 trauma hospitals frequently transfer major trauma patients to Level 1 and 2 trauma hospitals.

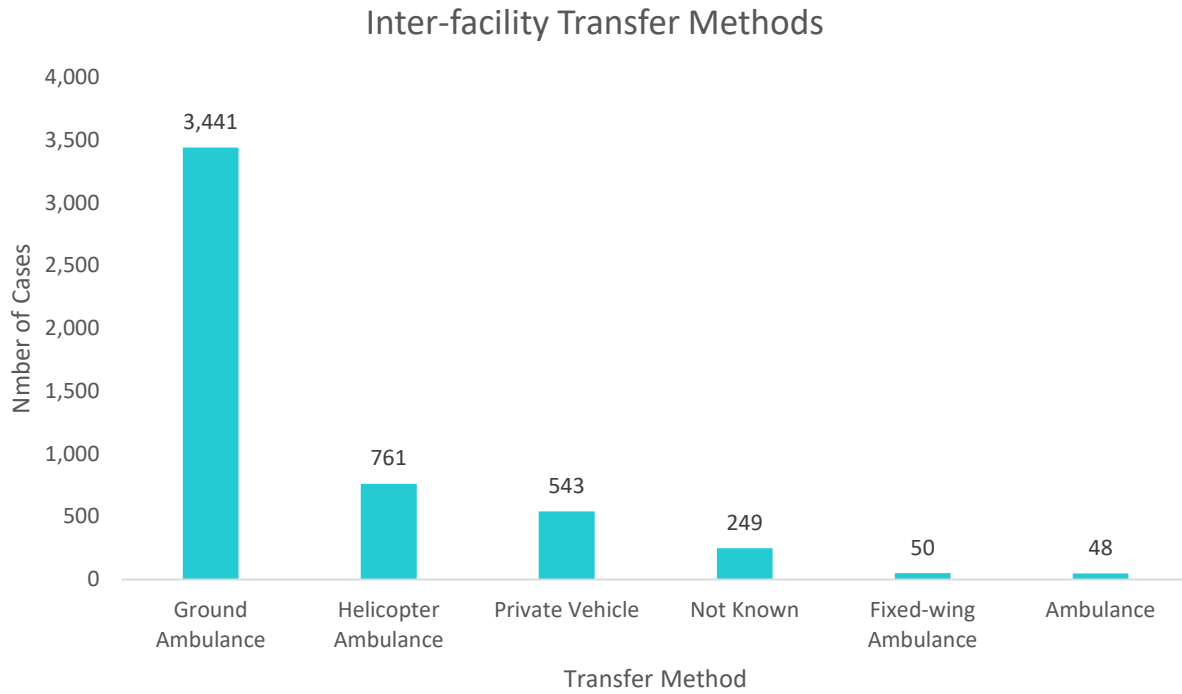
Inter-facility Transfers Between Trauma Hospitals By Trauma Hospital Designation Level

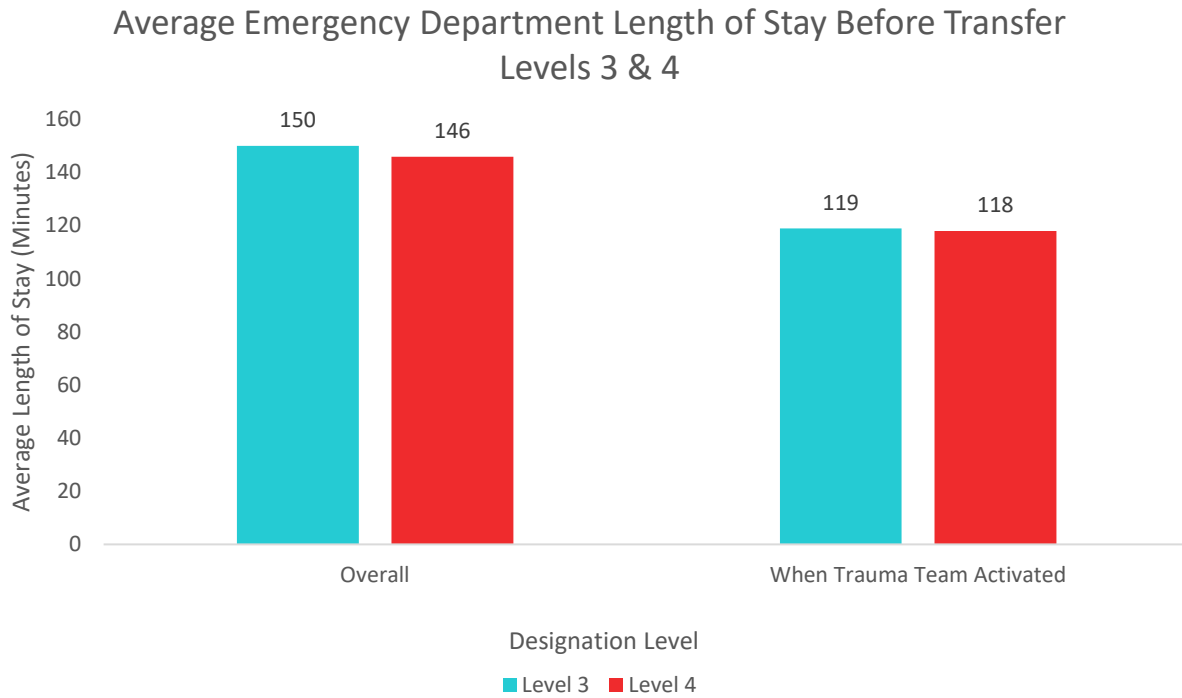


Nineteen percent of all reported registry cases indicated that the patient was transferred. But this is deceptively low, since many of these patients were transferred to another Minnesota hospital, which results in a second trauma registry record. In such cases, the patient is counted twice.

Most major trauma patients requiring transfer are transported to the destination hospital by ground ambulance (68 percent of the cases in which the mode is known). Only 15 percent were transferred via helicopter.

Trauma care clinicians are challenged to balance the patient’s medical needs with the cost of the transportation resource. This is particularly difficult in the setting of major trauma because patients’ injuries tend to reveal themselves over the course of time. But time is precious and the decision to transfer must be made quickly.

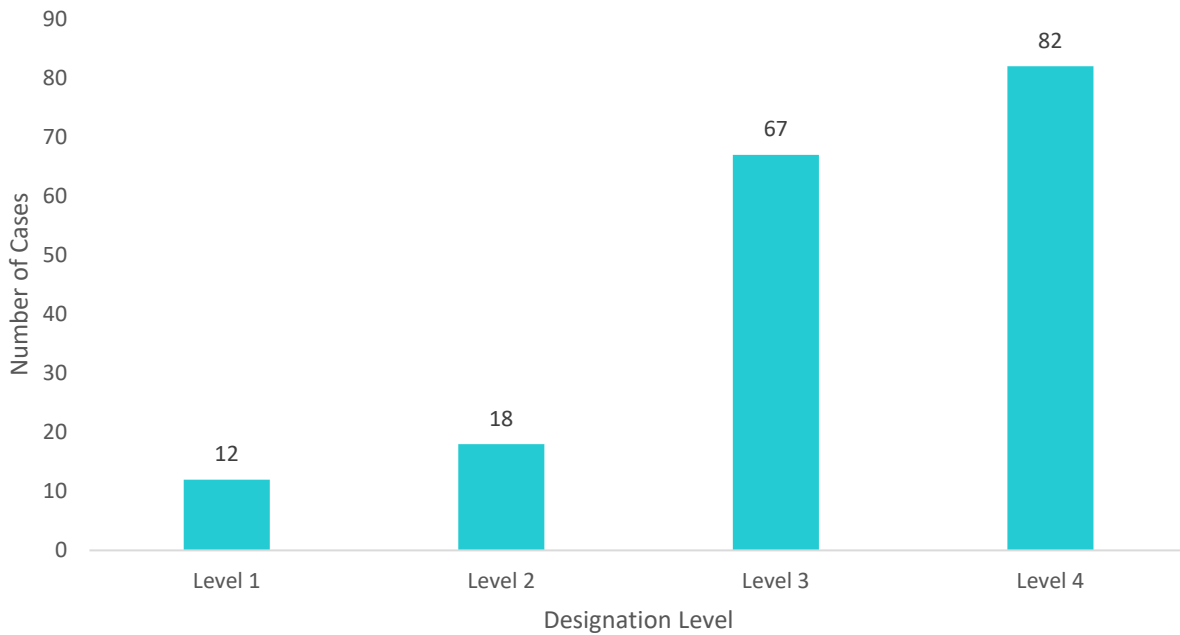




For those cases in which the trauma team was activated and the patient was transferred to another hospital, the average length of stay in the emergency department was shorter when the trauma team was activated. This indicates that major trauma patients' care tends to be expedited when a hospital deploys its trauma team, and it illustrates the value of the trauma team in expediting transfer. But even when the team is activated, transfers do not commonly occur within 60 minutes, a goal of the trauma system.

Note: Length of stays greater than 360 minutes were excluded from this analysis.

Admitted Then Transferred by Designation Level

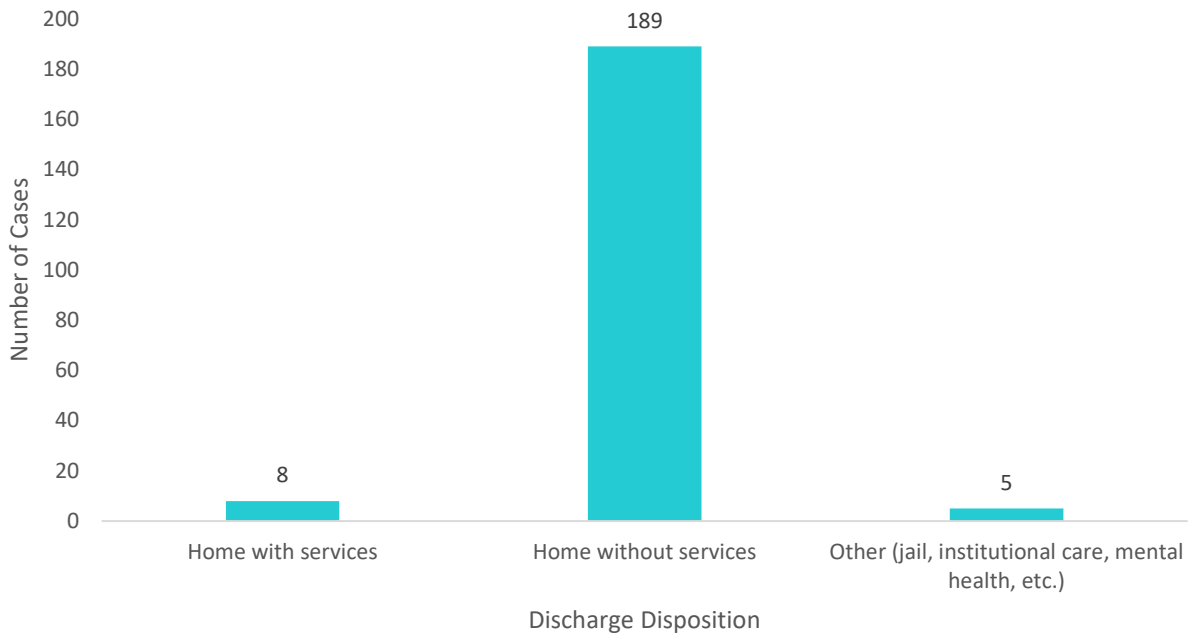


The trauma system and individual trauma hospitals monitor both the care provided to trauma patients and the process used to provide that care. One measure of trauma care performance is the number of patients who were admitted to the initial hospital, but then were transferred to another hospital later. This suggests that the patient's needs could not be met by the resources at the initial hospital and, therefore, the patient should not have been admitted to that hospital in the first place.

Of the 4,970 transfers, 179 (four percent) were first admitted to the initial hospital before being transferred to another hospital. Forty-eight percent of these cases were transferred from a Level 4 trauma hospital. While this is a very low number, improvements may still be possible.

Another measure of trauma care performance is the number of patients who are transferred to another hospital, but then discharged from the emergency department of the receiving hospital. It suggests that the patients' acuity may not have indicated a need for transfer. Still, the decision to transfer must be made quickly, often without having a complete knowledge of a patient's injuries. And it is better to transfer promptly based on a provider's suspicion that a high acuity injury is present, rather than delaying the transfer decision until those suspicions are confirmed.

Transferred Then Discharged From the Emergency Department

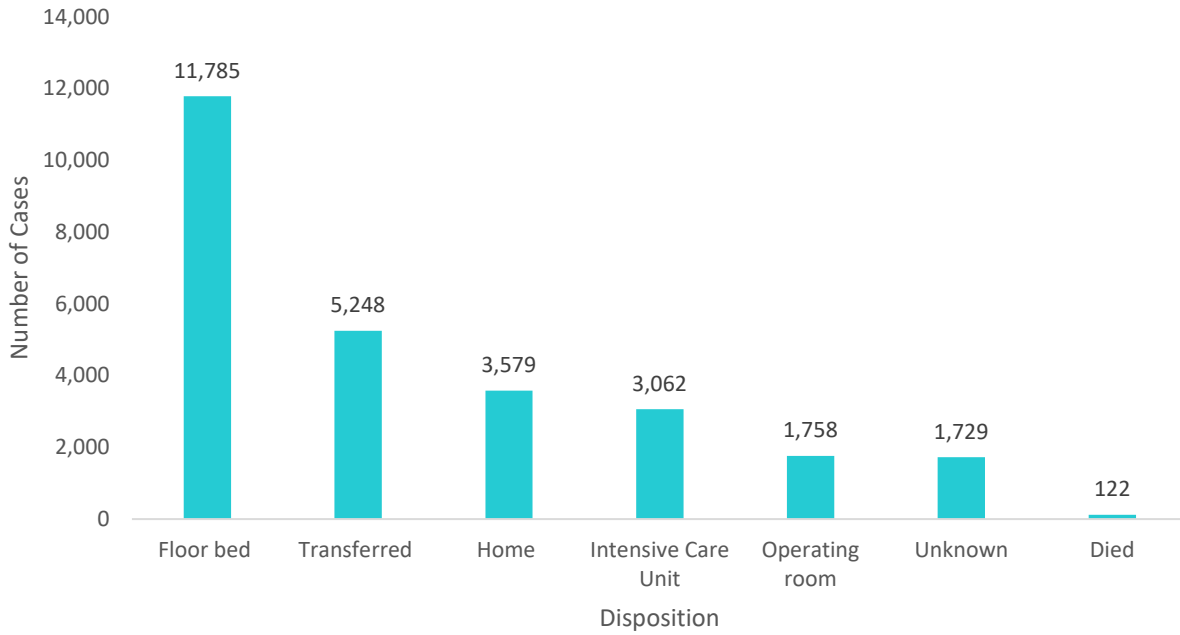


Of the 2,936 major trauma cases reported by Level 1 and 2 trauma hospitals in which the ED discharge disposition is known and that arrived from a referring hospital, seven percent were discharged from the emergency departments of those hospitals. This suggests that, while the trauma system is operating efficiently with respect to this measure, there may be opportunity for improvement.

After being cared for in the emergency department, trauma patients will either be discharged, admitted to the initial hospital or transferred to another hospital.

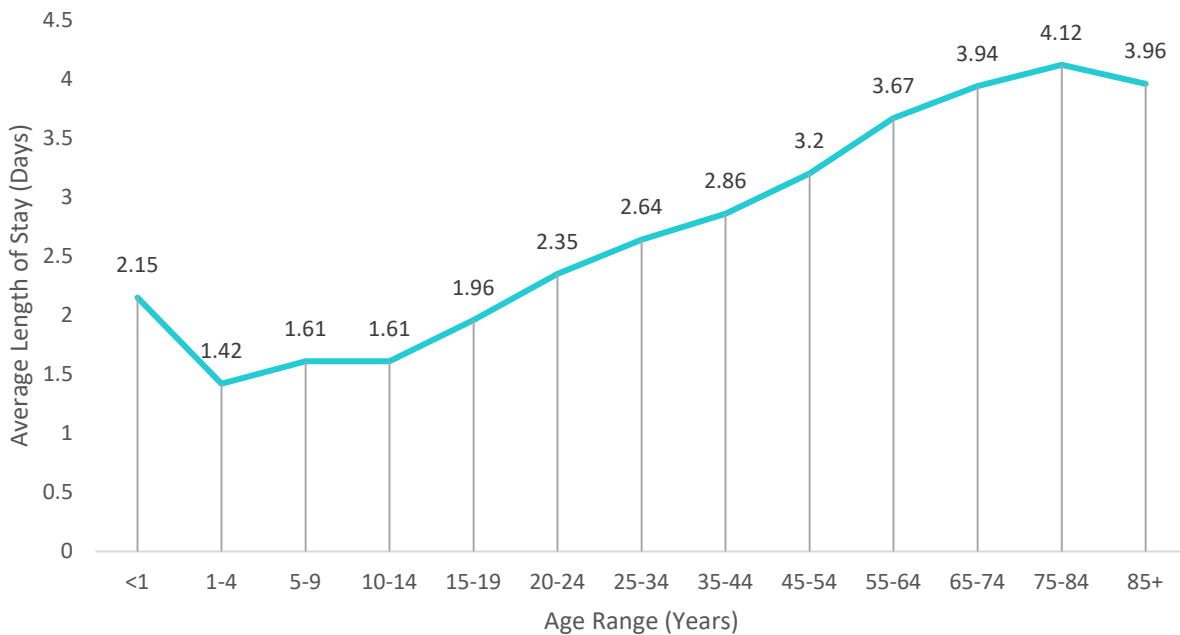
Sixty-one percent of the major trauma cases presenting to the emergency room resulted in an admission to the hospital and nineteen percent were transferred to another hospital for definitive care. Only thirteen percent were discharged from the emergency department. This is much lower than the general emergency department patient population, which illustrates that the major trauma population tends to require more healthcare resources than the general emergency department patient population.

Emergency Department Discharge Disposition



The duration of a trauma patient’s admission is related to the cost of care. Generally, as age increases, so does the length of a patient’s hospitalization. Falls become more and more common as patients age; and the elderly are more likely to require admission after their fall because of complications from their co-morbid conditions.

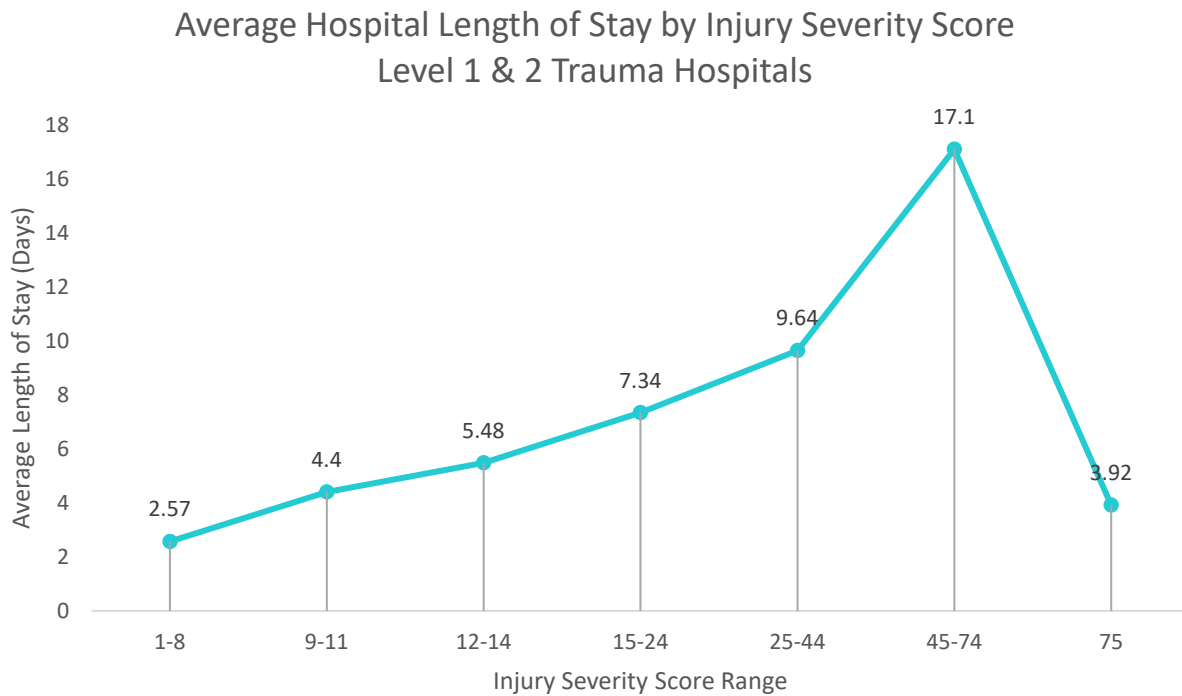
Average Hospital Length of Stay by Age



Patients that were not admitted to the intensive care unit and discharged within 48 hours are not included in this analysis. (See [Appendix D](#): Trauma Registry Inclusion Criteria.)

As would be expected, as injury severity increased, so did patients' length of stay in Level 1 and 2 trauma hospitals. This suggests that higher injury severity is positively correlated with the cost of care.

The length of stay decreased with an ISS of 75. At such a high ISS level, most patients are not expected to survive their injury. The decrease in length of stay likely reflects patients who died early in their hospitalization.



Looking Ahead

State trauma system staff, stakeholders, partners, and vendors must work together to mitigate the data limitations described above. The trauma system stakeholders at all levels rely on data to drive the performance improvement and injury prevention initiative in their communities. Specifically:

- The State Trauma Advisory Council relies on data to assess the performance of the trauma system and its governing laws and criteria.
- Regional advisory committees rely on data to determine the need for regional modifications to the statewide trauma system criteria and identify regional injury prevention opportunities.
- Individual trauma hospitals rely on data to drive their clinical performance improvement processes and local injury prevention initiatives

Ultimately, a robust trauma database is a tool that stakeholders at all levels can use to assess performance and identify opportunities to reduce variations in the care and care processes used to manage trauma patients across Minnesota.

As the trauma system data continues to mature, the ability to use it to measure progress will likewise improve, driving the trauma system and its stakeholders to improve trauma care and meet the ultimate goals of reducing costs in both dollars and life lost.

To achieve these outcomes, the trauma system continues to focus on three important development goals:

- Develop methodologies to:
 - account for and eliminate double-counting of trauma cases
 - ensure all required cases are reported
 - measure compliance with EMS transport requirements
 - validate the accuracy of the data
- Ensure disparate registry vendors accurately map and submit required data elements
- Collect data from Level 2 trauma hospitals in North Dakota, South Dakota and Wisconsin that treat major trauma patients injured in Minnesota.

These improvements will ensure a robust dataset from which clinical and system quality improvement, injury prevention, treatment and rehabilitation programs can be assessed, analyzed and reported. The State Trauma Advisory Council and other regional and local industry leaders can use this data to drive their state, regional and local performance improvement and injury prevention initiatives. Ultimately, data-driven best practices will lead to uniform trauma management practices across the system.

Appendix A: State Trauma Advisory Council Members

Ron Furnival, M.D., Chair

Pediatrician

University of Minnesota Medical Center-
Fairview, Minneapolis

Sharon Moran, M.D.

Level 1 or 2 Trauma Surgeon

Essentia Health St. Mary's Medical Center,
Duluth

Aaron Burnett, M.D.

State EMS Medical Director

EMS Regulatory Board

Colonel Matt Langer

Commissioner of Public Safety Designee

Minnesota State Patrol

John Fossum

Rural Hospital Administrator

Ely-Bloomenson Community Hospital

Gayle Williams, R.N.

Level 3 or 4 Trauma Program Manager

Ridgeview Hospital, Waconia

Daniel DeSmet, EMT-P

Rural EMS Attendant or Ambulance Director

North Memorial Medical Transportation,
Marshall Area

John Hick, M.D.

Emergency Medicine Physician

Hennepin County Medical Center,
Minneapolis

Carol Immermann, R.N., Vice Chair

Level 1 or 2 Trauma Program Manager

Saint Mary's Hospital—Mayo Clinic,
Rochester

Steven Lockman, M.D.

Rehabilitation Specialist

Hennepin County Medical Center,
Minneapolis

Alan Johnson, PA-C

Rural Physician Assistant or Nurse

Practitioner

RC Hospital, Olivia

Peter Cole, M.D.

Orthopedic Surgeon

Regions Hospital, St. Paul

Robert Roach, M.D.

Level 1 or 2 Neurosurgeon

North Memorial Medical Center,
Robbinsdale

Craig Henson, M.D.

Rural General Surgeon

Lakewood Health System, Staples

Mark Paulson, M.D.

*Level 3 or 4 Family Medicine Emergency
Physician*

Perham Memorial Hospital

Appendix B: Regional Trauma Advisory Committees

The **Western Minnesota Regional Trauma Advisory Committee (WESTAC)** includes Becker, Beltrami, Clay, Clearwater, Douglas, Grant, Hubbard, Kittson, Lake of the Woods, Mahnomen, Marshall, Norman, Otter Tail, Pennington, Polk, Pope, Red Lake, Roseau, Stevens, Traverse and Wilkin counties.

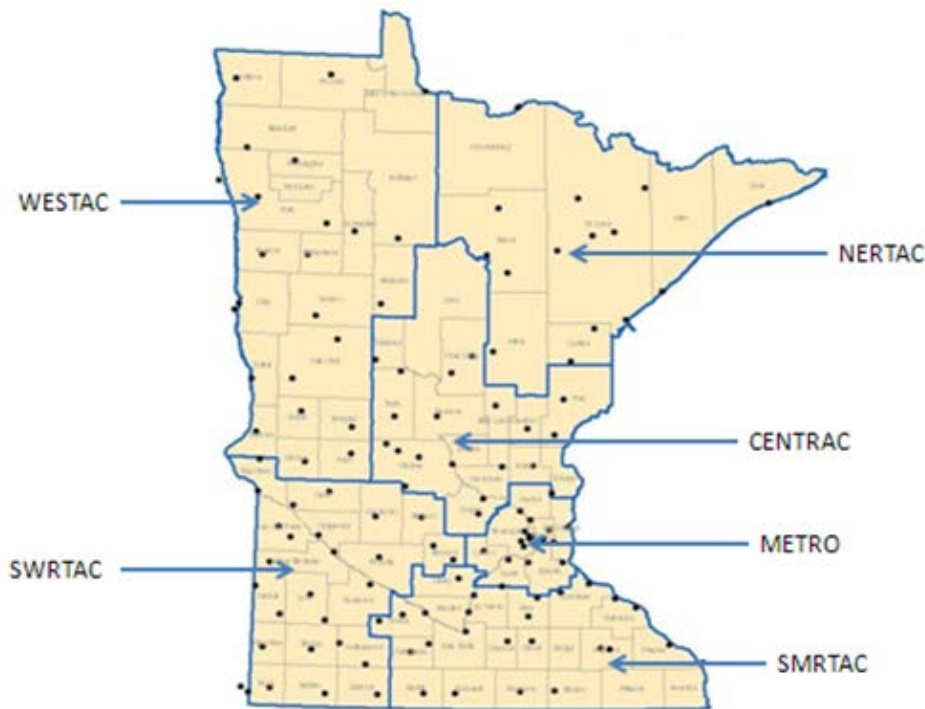
The **Minnesota Metropolitan Regional Trauma Advisory Committee** includes Anoka, Washington, Ramsey, Hennepin, Carver, Scott, and Dakota counties. It is not yet officially established.

The **Northeastern Minnesota Regional Trauma Advisory Committee (NERTAC)** includes Koochiching, Itasca, Aitkin, Carlton, St. Louis, Lake and Cook counties.

The **Central Minnesota Regional Trauma Advisory Committee (CENTRAC)** includes Benton, Cass, Chisago, Crow Wing, Isanti, Kanabec, Mille Lacs, Morrison, Pine, Sherburne, Stearns, Todd, Wadena, and Wright counties.

The **Southwestern Minnesota Regional Trauma Advisory Committee (SWRTAC)** includes Big Stone, Brown, Chippewa, Cottonwood, Jackson, Lac Qui Parle, Kandiyohi, Lincoln, Lyon, Meeker, Murray, Nobles, Pipestone, Redwood, Renville, Rock, Swift, Waseca and Yellow Medicine counties.

The **Southern Minnesota Regional Trauma Advisory Committee (SMRTAC)** includes Blue Earth, Brown, Dodge, Faribault, Fillmore, Freeborn, Goodhue, Houston, Le Seuer, Martin, Mower, Nicollet, Olmsted, Rice, Sibley, Steele, Wabasha, Waseca, Watonwan and Winona counties.



Appendix C: Hospitals Designated During Calendar Year 2015

Level 1 Trauma Hospitals

Hennepin County Medical Center, Minneapolis
Mayo Clinic Rochester Hospital, Saint Marys Campus
North Memorial Medical Center, Robbinsdale
Regions Hospital, St. Paul

Level 1 Pediatric Trauma Hospitals

Children's Hospitals and Clinics, Minneapolis
Regions Hospital/Gillette Children's Specialty Healthcare, St. Paul
Hennepin County Medical Center, Minneapolis
Mayo Clinic Rochester Hospital, Saint Marys Campus

Level 2 Trauma Hospitals

Essentia Health – St. Mary's Medical Center, Duluth
Mercy Hospital, Coon Rapids
St. Cloud Hospital
St. Luke's Hospital, Duluth
University of Minnesota Medical Center, Fairview, Minneapolis

Level 2 Pediatric Trauma Hospitals

Essentia Health – St. Mary's Medical Center, Duluth
North Memorial Medical Center, Robbinsdale

Level 3 Trauma Hospitals

Abbott-Northwestern Hospital, Minneapolis
Avera Marshall Regional Medical Center
Children's Hospitals and Clinics, Saint Paul
Cuyuna Regional Medical Center, Crosby
Douglas County Hospital, Alexandria

Essentia Health – St. Joseph's Medical Center, Brainerd
Essentia Health St. Mary's Hospital – Detroit Lakes
Fairview Lakes Medical Center, Wyoming
Fairview Range Medical Center, Hibbing
Fairview Ridges Hospital, Burnsville
Fairview Southdale Hospital, Edina
Glencoe Regional Health Services
Grand Itasca Clinic and Hospital, Grand Rapids
Hutchinson Health
Lake Region Healthcare, Fergus Falls
Lakeview Hospital, Stillwater
Lakewood Health System, Staples
Mayo Clinic Health System in Red Wing
Mayo Clinic Health System in Mankato
Park Nicollet Methodist Hospital, St. Louis Park
Rice Memorial Hospital, Willmar
Ridgeview Medical Center, Waconia
Riverwood Healthcare Center, Aitkin
Sanford Worthington Medical Center
St. Francis Regional Medical Center, Shakopee
St. John's Hospital, Maplewood
St. Joseph's Hospital, St. Paul
United Hospital, St. Paul
Unity Hospital, Fridley
University of Minnesota Masonic Children's Hospital, Minneapolis
Woodwinds Health Campus, Woodbury

Level 4 Trauma Hospitals

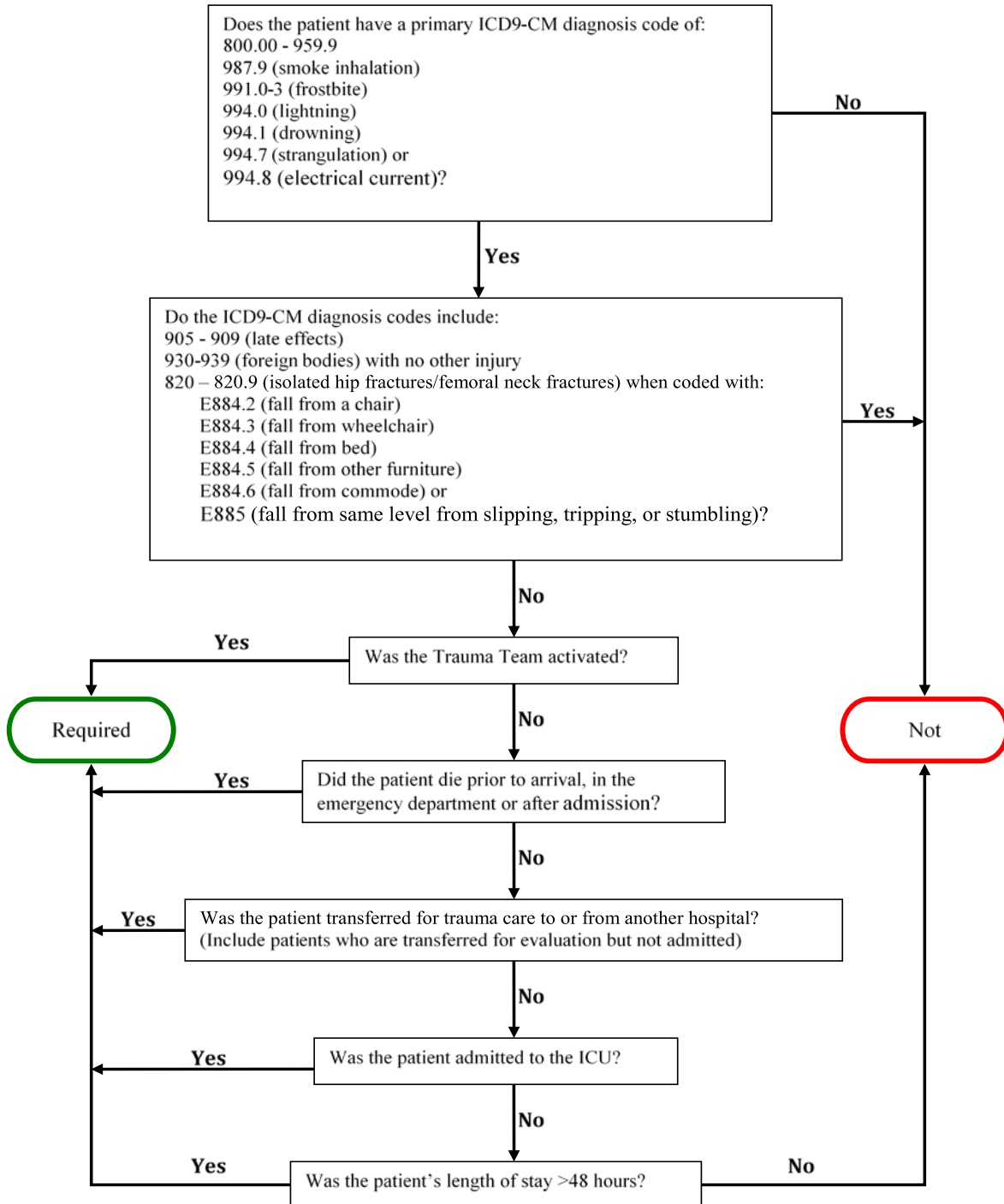
Albany Area Hospital
Appleton Area Health Services
Bigfork Valley Hospital

Buffalo Hospital
Cambridge Medical Center
CentraCare Health – Long Prairie
CentraCare Health – Melrose
CentraCare Health – Monticello
CentraCare Health – Paynesville
CentraCare Health – Sauk Centre
Chippewa County-Montevideo Hospital
Community Memorial Hospital, Cloquet
Cook Hospital
District One Hospital, Faribault
Ely-Bloomenson Community Hospital
Essentia Health – Ada
Essentia Health – Deer River
Essentia Health – Fosston
Essentia Health – Graceville
Essentia Health – Sandstone
Essentia Health – Virginia
Essentia Health Northern Pines
Fairview Northland Medical Center, Princeton
FirstLight Health System, Mora
Glacial Ridge Health System, Glenwood
Granite Falls Municipal Hospital
Hendricks Community Hospital Association
Johnson Memorial Health Services, Dawson
Lake View Memorial Hospital, Two Harbors
LifeCare Medical Center, Roseau
Madelia Community Hospital
Madison Hospital
Mahnomen Health Center
Mayo Clinic Health System - Albert Lea & Austin, Albert Lea

Mayo Clinic Health System - Albert Lea & Austin, Austin
Mayo Clinic Health System in Cannon Falls
Mayo Clinic Health System in Fairmont
Mayo Clinic Health System in Lake City
Mayo Clinic Health System in New Prague
Mayo Clinic Health System in Springfield
Mayo Clinic Health System in St. James
Mayo Clinic Health System in Waseca
Meeker Memorial Hospital, Litchfield
Mercy Hospital, Moose Lake
Mille Lacs Health System, Onamia
Minnesota Valley Health Center, LeSueur
Murray County Medical Center, Slayton
New Ulm Medical Center
Northfield Hospital
Olmsted Medical Center, Rochester
Ortonville Area Health Services
Owatonna Hospital
Perham Health
Pipestone County Medical Center, Pipestone
Prairie Ridge Hospital and Health Services, Elbow Lake
Rainy Lake Medical Center, International Falls
RC Hospital & Clinics, Olivia
Redwood Area Hospital, Redwood Falls
Regina Medical Center, Hastings
Ridgeview Emergency Department at Two Twelve Medical Center, Chaska
Ridgeview Sibley Medical Center, Arlington
River's Edge Hospital, St. Peter
RiverView Health, Crookston
Saint Elizabeth's Medical Center, Wabasha
Sanford Bagley Medical Center

Sanford Bemidji Medical Center
Sanford Canby Medical Center
Sanford Jackson Medical Center
Sanford Luverne Medical Center
Sanford Thief River Falls Medical Center
Sanford Tracy Medical Center
Sanford Westbrook Medical Center
Sanford Wheaton Medical Center
Sleepy Eye Medical Center
St. Francis Healthcare Campus, Breckenridge
St. Gabriel's Hospital, Little Falls
St. Joseph's Area Health Services, Park Rapids
Tri-County Hospital, Wadena
Tyler Healthcare Center
United Hospital District, Blue Earth
Windom Area Hospital
Winona Health Services

Appendix D: Trauma Registry Inclusion Criteria



Appendix E: Sample Trauma Team Activation Criteria

Activate the trauma team upon realization that any of the following patient conditions exists, either upon arrival of the patient or notification by EMS.

Adult or pediatric trauma patient and presenting with:

- Altered level of consciousness secondary to trauma: Glasgow Coma Scale score ≤ 13 or less than “Verbal” on Alert-Verbal-Pain-Unresponsive scale
- Respiratory distress, airway compromise, intubation or respiratory rate outside of acceptable range:
 - Adult respiratory rate <10 or >30
 - Child respiratory rate

Age	RR
≥ 6	<10 or >30
2-5	<10 or >40
12-24 months	<10 or >50
0-12 months	<20 or >60

- Shock, evidence of diminished perfusion, transient hypotensive episode or vital signs outside of acceptable range:
 - Adult blood pressure <90 or heart rate >120
 - Child capillary refill >2 seconds or

Age	BP	HR
≥ 6	<90	<60 or >140
2-5	<80	<60 or >160
12-24 months	<75	<70 or >180
0-12 months	<70	<80 or >180

- Suspected cardiac or major vessel injury
- Penetrating wound to the head, neck, chest or abdomen
- Suspected severe orthopedic injuries:
 - Pelvic fracture
 - Femur fracture

- Unstable facial fracture
- Open long bone fracture
- Knee dislocation
- More than one proximal long bone fracture
- Burns:
 - With concomitant trauma
 - >20% total body surface area
 - Facial burns
 - Suspected inhalation burn
- Pregnancy >20 weeks with vaginal bleeding or contractions
- Aeromedical launched by EMS
- Traumatic paralysis or focal neurological signs/symptoms (i.e., numbness, tingling)
- Provider discretion; consider for:
 - Multiple injuries (two or more systems) or severe single system injury
 - Co-morbid factors:
 - Anti-coagulant therapy
 - Age <5 or >55 years old
 - Multiple co-morbidities
- Ejection from auto
- Pedestrian struck and thrown by auto
- Death in same passenger compartment
- Extrication time >20 minutes (i.e., time spent accomplishing the extrication)
- Motorcycle, snowmobile or ATV crash with separation of rider
- Bicyclist struck by auto with separation of rider
- Fall:
 - >15 feet
 - > 65 years old and fall from elevation or down stairs
 - Pediatric <10 years old: >2x patient's height