WASHINGTON STATE DEPARTMENT OF HEALTH

# WA Trauma Services Assessment 2024

## An assessment of the trauma care and services in Washington State

Washington State Department of HEALTH

**DOH XXX-XXX September 2024**
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# Executive Summary

The Washington Trauma Services Assessment aims to investigate and summarize the demand for, accessibility, timeliness quality and cost of Trauma Services in Washington State. It is intended for use by multiple stakeholders and primarily as a tool for state and regional trauma system planning. This assessment is led by the Washington Department of Health (department) and will be revised and updated every two years beginning in 2024.

## Background

Washington's EMS and trauma care system aims to assure that the required resources are available, and the necessary infrastructure is in place to deliver the “right” patient to the “right” facility in the “right” amount of time. The system is built upon broad consensus and cooperation among diverse groups and around complex logistical, political, financial, legal, and medical issues.

The Washington Trauma System currently has 84 designated trauma centers across eight EMS and Trauma Regions. Each region convenes an EMS and Trauma Care Council, responsible for maintaining regional EMS and trauma care plans used to assess and analyze regional needs around care and resources. These plans are used by the department as a basis by which to establish the number and level of trauma centers to be designated in the region based on the availability of resources and distribution of trauma within the region. (RCW 70.168.100 and RCW 70.168.060)

Past efforts to assess the Washington Trauma System and identify methods for resource allocation include a 2019 full system assessment conducted by the American College of Surgeons (ACS), a 2020 department led workgroup of Trauma Medical Directors and a 2023 rulemaking process, which resulted in maintaining existing rules and the establishment of this assessment. This assessment will draw on these past efforts as well as continual stakeholder input to provide a continual understanding of resources and system needs throughout the state.

## Approach

The 2024 Washington Trauma Assessment is the first iteration of an assessment process led by the department biennially with input from key stakeholders including Trauma Medical Directors, the Washington EMS and Trauma Steering Committee and the EMS and Trauma Outcomes Technical Advisory Committee (TAC). The focus of the initial assessment is restricted to trauma services in Washington; however, future assessments may expand to include other aspects of Emergency Care included Emergency Medical Services (EMS), Cardiac and Stroke care, rehabilitation, pediatric trauma, injury prevention and emergency preparedness.

This assessment includes guidance to Regional EMS and Trauma Care Councils on use of this assessment and additional confidential data to inform their biennial regional plans. These plans include identifying the minimum and maximum number of trauma designated facilities at each designation level for inclusion in their recommendations to the EMS and Trauma Steering Committee and the department, who has final approval authority.

## Objectives:

Overall Aim: Assess the Washington Trauma System for gaps in services and provide data for informed decision-making at the state and regional levels.
Objective 1) Assess and describe the current state of demand and resources in the Washington Trauma System.
Objective 2) Provide a base for regions to understand the current state of trauma care and reflect on needed changes to their region.

## Key Findings

1) The population of Washington State is growing, representing a potential increase in trauma incidents and demand on trauma services statewide.
2) Trauma incidents are increasing more rapidly than the population, reinforcing the likely need for increased availability of services in future years.
3) Trauma services have not varied greatly over the past 10 years, despite a continually increasing patient volume.
4) Some level of trauma services (Level I thru V) is accessible to most Washingtonians within 60-minutes, though fewer have access to higher levels of care (Levels I and II) within 30 minutes, as is prescribed in the Washington State Trauma Triage Guidelines for severe trauma.
5) The average time to initial trauma care across the state is approximately 60-minutes, while definitive care is reached on average in 85 minutes. While these times are consistent with current benchmarks, there is variation across regions where geographic distances from higher levels of care pose a possible barrier to efficient care delivery.
6) In-hospital mortality has been slightly decreasing, with little variation between facilities across the state, demonstrating a consistency in quality of care throughout the trauma system.

## Limitations

The most recent trauma patient data available at the time of this assessment is from 2019. This represents a gap of 4-years of data. This data gap is the result of non-compliance of the current trauma registry vendor supported data system with Washington State Office of Chief Information Officer (OCIO) Technology Standard 183.20.10 for Identity Management User Authentication. Efforts have been underway since 2021 to resolve this issue and bring the data system back into compliance with state security standards. As of Spring 2024, The Department of Health (Department) is preparing to pursue legislative funding approval for a modernized trauma registry solution that would meet state security standards.

# Background

## Washington EMS & Trauma Care System History

In 1990, legislation was adopted which called for the development of a comprehensive statewide trauma care system. This legislation was the culmination of a series of initiatives which began in the late 1960s with the University of Washington pioneering the development of paramedic training programs; continued through the 1970s with the establishment of legislatively mandated minimum standards for prehospital providers and services, and certification for paramedics and other advance life support personnel; and concluded in the late 1980s with the completion of the "Washington State Trauma Patient Tracking Study," and the development of the 1990 Washington State Trauma Project: A Report to the State Legislature.

The key components of this 1990 legislation, the Trauma Care Systems Act, include:

- Clear lines of authority and responsibility;
- Designation of Trauma Care and Trauma Rehabilitation services;
- Trauma Care services;
- Verification of Prehospital Trauma services;
- Field triage criteria development;
- Regional planning and implementation;
- Cost containment considerations;
- Integration of trauma/injury prevention;
- Trauma registry development;
- Establishment of regional quality assurance/improvement programs;
- Integration of trauma rehabilitation services; and,
- Evaluation of system effectiveness.

Washington's EMS and trauma care system aims to assure that the required resources are available, and the necessary infrastructure is in place to deliver the “right” patient to the “right” facility in the “right” amount of time. The system is built upon broad consensus and cooperation among diverse groups and around complex logistical, political, financial, legal, and medical issues. It's a comprehensive system that includes a strong injury prevention component as well as the designation of rehabilitation services for post-acute care.

## Mission

The Washington Trauma System’s mission is to establish and promote a system of emergency medical and trauma care services. Such a system provides a timely and appropriate delivery of emergency medical treatment for people with acute illness and traumatic injury and recognizes the changing methods and environment for providing optimal emergency care throughout Washington State.

## Structure

The Washington EMS and Trauma Act of 1990 created three major groups of participants: the Department of Health's Office of Emergency Medical Services and Trauma System, the EMS and Trauma Care Steering Committee and the eight EMS and Trauma Care Regions.

State responsibilities include establishing standards and managing designation of trauma and rehabilitation services, coordination of injury prevention programs, regulation of EMS providers, standards for education of EMS personnel and training programs, management of a trauma registry and quality improvement programs, establishment of trauma triage criteria, patient care protocols, destination guidelines and administration of the Trauma Care Fund.

## Current State

The Washington Trauma System currently has 84 designated trauma centers across eight EMS and Trauma Regions. (Figures 1 and 2) Each region convenes an EMS and Trauma Care Council, responsible for maintaining regional EMS and trauma care plans, which among other purposes, are intended to assess and analyze regional needs around care and resource needs, and used by the department as a basis by which to establish the number and level of trauma centers to be designated in the region based on the availability of resources and distribution of trauma incidents within the region. (RCW 70.168.100 and RCW 70.168.060)

| *2024 Designated Trauma Centers* | *Acute Care* | *Pediatric* |
|---|---|---|
| *Level I* | 1 | 1 |
| *Level II* | 6 | 2 |
| *Level III* | 23 | 6 |
| *Level IV* | 36 | |
| *Level V* | 13 | |

*Figure 1 Number of Trauma Centers, Statewide, 2024*

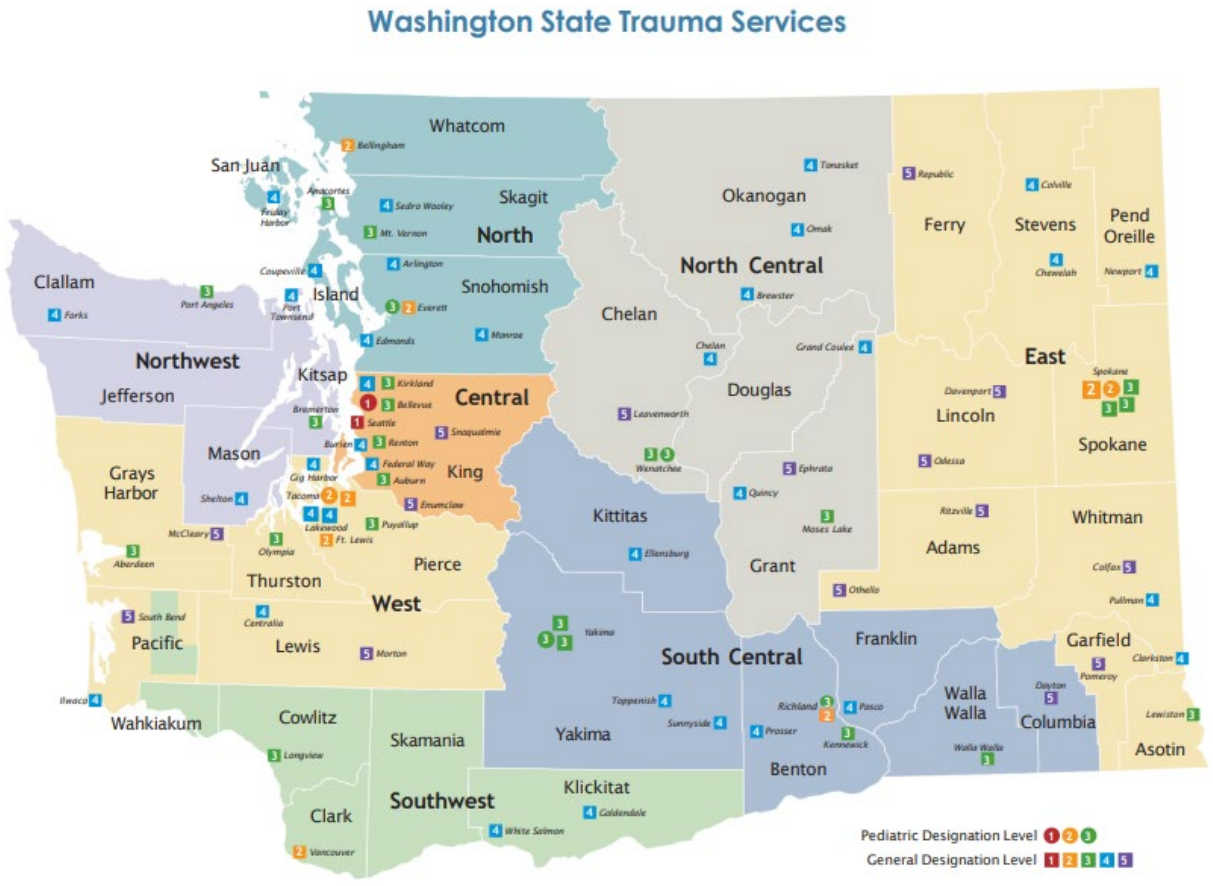



*Figure 2 Map of EMS and Trauma Regions and Trauma Centers in Washington State*

## Recent history of trauma system assessment

### 2019 ACS Assessment

In April of 2019, the American College of Surgeons assessed Washington's current system. As part of that assessment, the department then held five public forums across the state to engage stakeholders and gather community feedback on the assessment from EMS and Trauma care providers, community members, legislators, Tribes, and others. The assessment and forums yielded a list of recommendations for improving the Washington Trauma System. These recommendations include the need to

1) Perform a formal data-based gap analysis of the Washington State Trauma System and
2) Develop and disseminate a standard Trauma System Report for the lead agency and regional system stakeholders to drive Emergency Care System Strategic Plan advancement.
3) Establish an objective and standardized statewide process to revise the Minimum and Maximum criteria for all trauma designation levels.

This assessment is intended to address these three recommendations by developing a statewide assessment of the trauma system that may be used to, among other purposes, review and establish minimum and maximum criteria for trauma designation levels.

### 2020 Trauma Medical Directors Workgroup

To act on the ACS Trauma System Assessment and forum recommendations, the department created the Min/Max Workgroup. The workgroup met from February through May 2020 with a goal to develop an evidence-based methodology the department could use to determine the statewide minimum and maximum numbers of Level I and Level II trauma services the state needs to optimize patient outcomes. The department appointed trauma medical experts from across the state to participate on the Min/Max Workgroup and provide their expertise. The workgroup resulted in a recommendation However, the result of this work was inconclusive of a defined methodology, and it was determined that there was a need to establish rules to further this work.

### 2023 Trauma Designation Rules

The department conducted rulemaking in 2023 towards the same goal but were unable to identify a clear path forward on a defined methodology during rulemaking. The department rescinded its CR102 proposal (WSR23-11-166) for WAC 246-976-580 - Criteria for Trauma Designation on October 30, 2023.

## 2024 Trauma Services Assessment

Each of these past efforts included recommendations to assess the distribution of trauma services and gaps in care in Washington. To meet this need, the Department of Health initiated a statewide trauma services assessment to inform state and regional planning activities for recommending the need and distribution of trauma services around the state. The initial assessment began in January 2024 and concluded on September 30th, 2024. Updates to the assessment are expected to occur every two years to align with EMS and Trauma Care Council's regional planning cycles.

Department staff led efforts to facilitate the work, convene stakeholders and develop the assessment. Many representatives of the Emergency Care System provided valuable input and recommendations toward determining the trauma need in Washington through the ACS assessment, Min/Max Workgroup and Trauma Designation rulemaking process. This effort to develop a statewide Trauma Services Assessment built upon those past contributions and seeks to further support and inform decision making in the WA Trauma System moving forward.

Within this process, there are three distinct roles:

- Department of Health – Tasked with developing and conducting the assessment, approving Regional EMS & Trauma Care Plans and trauma designation for facilities in the state.
- Regional EMS and Trauma Councils – Leverage information from the assessment to inform regional planning activities and submit regional plans to the EMS and Trauma Steering Committee.
- EMS and Trauma Steering Committee – Review, provide input and make recommendations on Regional EMS and Trauma Care Plans to the department.

# Objectives

## Overall Aim: Assess the Washington Trauma System for gaps in services and provide data for informed decision-making at the state and regional levels.

### Objective 1) Assess and describe the current state of demand and resources in the Washington Trauma System.

This assessment assesses the current state of both the demand and availability of trauma services. It describes the current and projected population and injury patterns in Washington and assesses the availability, timeliness, and outcomes of trauma care. It also describes the impacts of changes to the trauma system on costs in the overall health care system.

### Objective 2) Provide a base for regions to understand the current state of trauma care and reflect on needed changes to their region.

The primary use of the assessment is for state and regional planning purposes. Each EMS and Trauma Care Council is responsible for maintaining regional EMS and trauma care plans, updated every two years. These plans, among other purposes, are intended to assess and analyze regional needs around care and resources, and to help establish the number and level of trauma centers to be designated in the region. The Trauma Services Assessment is intended as an aid to Regional Councils, in identifying and planning for these needs. The assessment provides both data and information to support decision-making.

# Limitations

## Data availability:

The most recent trauma patient data available at the time of this assessment is from 2019. This represents a gap of 4-years of data. This data limitation is due to a failure of the current trauma registry vendor supported data system to comply with Office of Chief Information Officer Technology Standard 183.20.10 for Identity Management User Authentication. Efforts have been underway since 2021 to resolve this issue and bring the data system back into compliance. As of Spring 2024, The Department of Health (Department) is preparing to pursue legislative funding approval for a modernized trauma registry solution that would meet state security standards.

While more recent data is preferred, the department will use the most recent available data to support understanding of the Trauma System. In the case of this assessment 2019 data is the most recent Trauma data available, while other sources used have more recently available information, which will be

used concurrently. While health data from multiple sources will be compared over the same time periods, information for planning information such as the number of designated trauma services at each level is assessed using current information. Therefore, in this assessment, maps and charts will display 2024 trauma designations along with 2019 trauma distribution.

The assessment will be updated as soon as more recent data is available. Timelines and updates regarding this data limitation will be communicated to stakeholders as they develop.

# Assessment

This assessment looks to answer five key questions related to the population, accessibility, timeliness, outcomes, and cost, each with findings summarized below. Beyond the five key questions it is recommended that EMS and Trauma Care Councils use an additional series of questions to guide their regional analysis for local planning. These questions require facility specific information that is not publishable in a public report but can be requested from the department and shown in confidential meetings and communications among the regional and trauma quality assurance (QA) programs. These programs provide guidance to their respective regional EMS and Trauma Care Councils.

Following this summary, each question is addressed in more detail.

## How is Washington's population changing and how do trauma volumes and injuries compare to that change?

Washington's population is on the rise and that is expected to continue with a 6.6% increase anticipated between 2020 and 2030. While the population is growing, the rate of trauma incidents is increasing even faster with a 50% trauma incident rate increase between 2010 and 2019. A growing aging population also has an impact on the demands for the trauma system, which has seen a marked increase in both fall injury rates and geriatric patients for some time.

## How accessible is trauma care in WA?

Much of the state's population (99%) is within an hour from some level of trauma care (Level I thru V). Though fewer (84%) have access within an hour from a level I or II facility. 35% of severe trauma incidents, which often require a higher level of care, occurred further than 30 minutes from a level I or II trauma facility. While most patients do not end up being transferred to a higher level of care, patient transfers out of the EMS and Trauma Region are most frequent among level V facilities while most patients transferred in for care from another region are going to the Level I trauma center.

## How long does it take to get appropriate trauma care?

How quickly a patient receives care after an injury is one of the most critical factors in trauma care. To assess this the time to care can be broken into segments:

*Time from EMS Notification to Scene Departure:* In 2019, the average time from EMS being notified by dispatch to EMS departing the scene of the injury with the patient was 29.2 minutes.

*Time from Scene Departure to arrival at initial facility:* In 2019, the average time from EMS departing the scene with the patient to arriving at the initial facility was 33 minutes.

Combined, the average time from EMS notification of an incident to the patient arriving at the initial facility was 60.2 minutes. I 2019, 64 percent of patients arrived at the initial facility within 60 minutes of injury.

*Time from EMS Notification to Definitive Care:* In 2019, the average time from injury to definitive care at the final facility was 85.6 minutes. This average includes those who were transferred to a higher-level facility and those who remained at their initial facility. Time to definitive care is substantially longer for patients who are transferred, than for patients who remain at their initial facility and longer still for those transferred outside of the EMS and Trauma region.

### Is the Washington state trauma system reducing mortality in injured patients?

Overall, after adjusting for age, in-hospital mortality rates among trauma patients have been in a slight decline between 2009 and 2019. Risk adjusted in-hospital mortality showed little to know differences between facilities and between facilities, though one higher level center was found to have lower than average mortality while one level III center was found to have higher than average.

### How does a changing trauma system affect costs in the overall healthcare system?

Overall health care costs in Washington and nationally continue to rise at rates higher than inflation, impacting the ability for individuals to pay for services and access the care they need. Understanding how any change to the health care system, including a change in trauma designation for a facility, impacts the cost of care across the system, including non-trauma services, is an important factor to review when assessing trauma designation levels. The final trauma assessment issued in September 2024 will include analysis of the impact on costs to the health care system due to changes in facility trauma designation.

## Population and Injury

Summary: Washington's population is on the rise and that is expected to continue with a 6.6% increase anticipated between 2020 and 2030. While the population is growing, the rate of trauma incidents is increasing even faster with a 50% trauma incident rate increase between 2010 and 2019. A growing aging population also has an impact on the demands for the trauma system, which has seen a marked increase in both fall injury rates and geriatric patients for some time.

### Key Question: How is Washington's population changing and how do trauma volumes and injuries compare to that change?

*Population, trauma volume and trauma hospitals*

In 2020, Washington State had nearly 8 million residents. That number is projected to increase by 6.6%, to nearly 8.5 million by 2030. All but two Washington counties are expected to grow in population between 2020 and 2030 with the highest percent growth expected for Clark and Franklin counties and a decline in population in Columbia and Garfield counties over that time. (Figure 3)

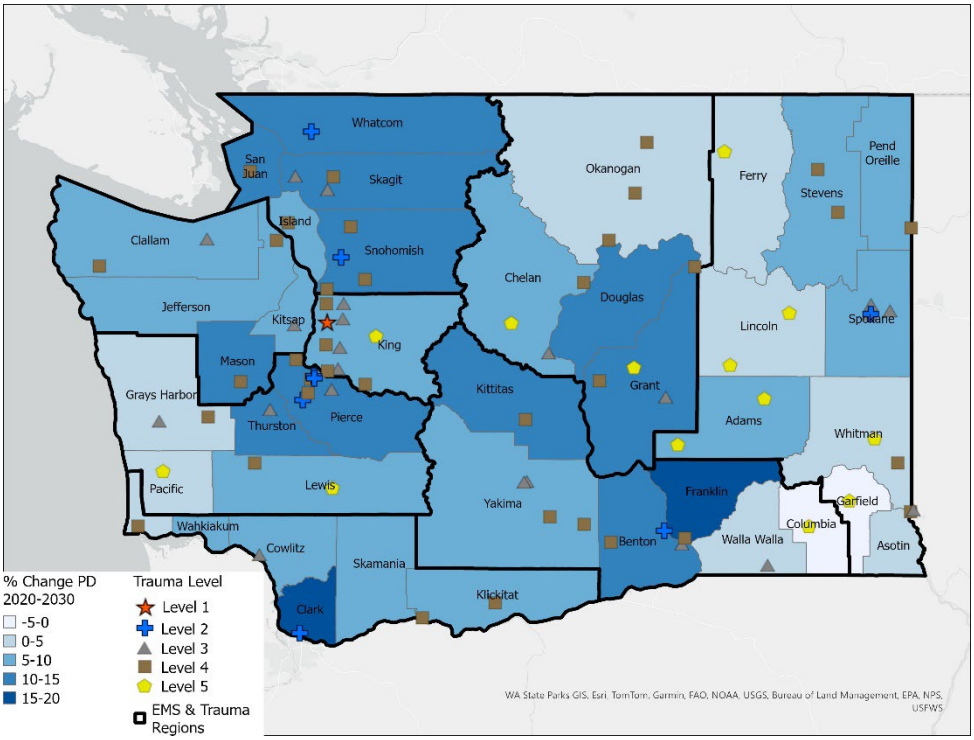
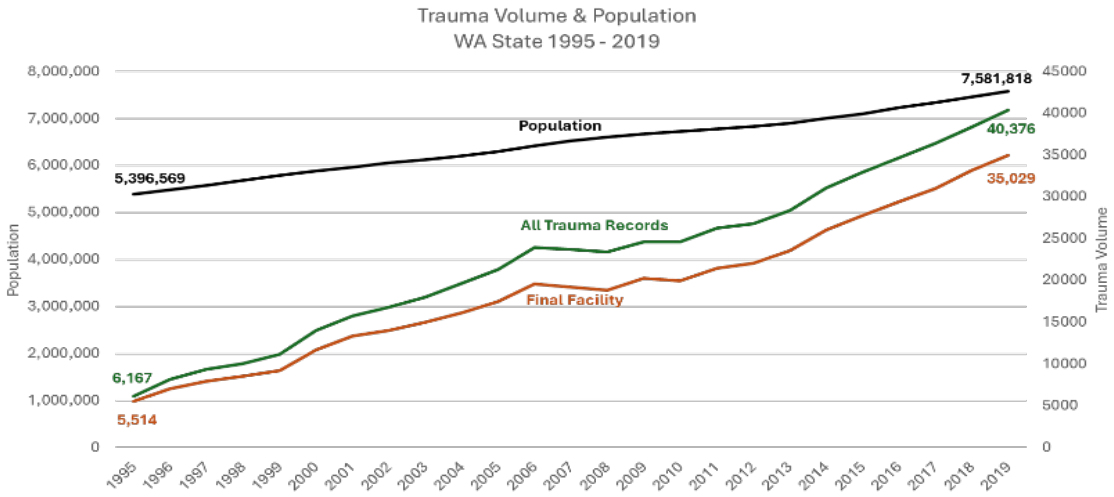



*Figure 3 WA Percent change in population by county and trauma center locations 2020-2030*[1,2]

While population has been rising in Washington, so have trauma incidents. In 2019 trauma incidents in Washington were six times higher than in 1995 when the trauma registry system began collecting information on trauma cases from designated trauma centers. (Figure 4) Figures 5 and 6 show the geographical distribution of trauma incidents in 2019 for all traumas and severe traumas relative to Washington trauma centers. From 1999 to 2020, WA has had a relatively consistent number of designated trauma centers at each level, with an increase in 5 level III centers and 3 level IV centers over two decades. Washington has had one level I facility since the inception of the trauma system in 1992. (Figure 7) Levels II, III and IV trauma centers have seen the greatest increase in patient volume in recent

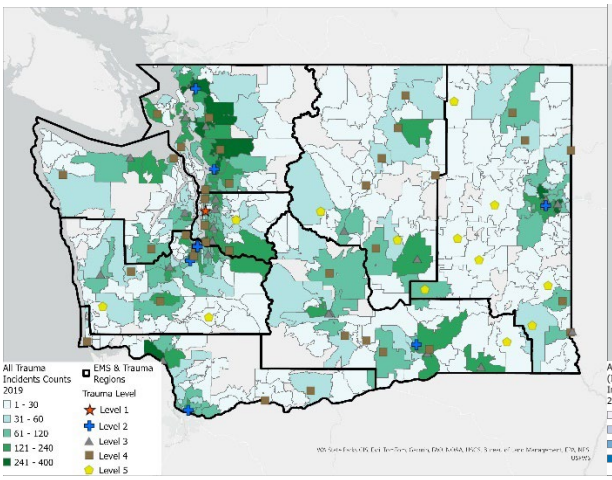
years, as both the initial and final facility where care was received. More patients receive their initial care at a level III trauma center than at any other level, and more patients receive their final care at level II and III centers than any other level. (Figure 8 and 9)




Trauma Incident Distribution by Zip Code, 2019

Severe Trauma (ISS≥16) Incident Distribution by Zip Code

*Figure 4 Trauma volume and population change 1995 – 2019[1,2]*



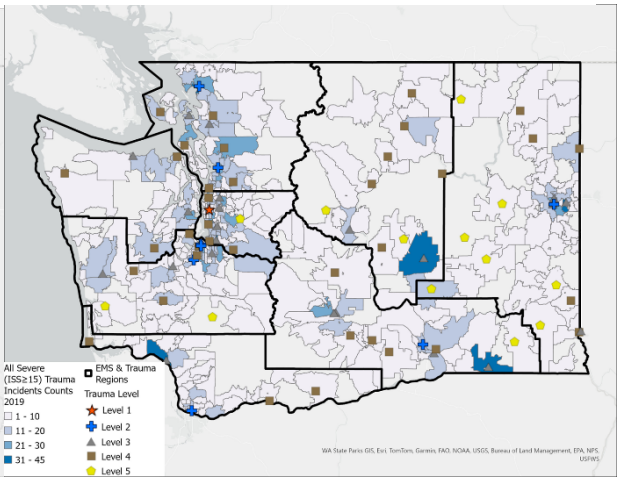




*Figure 5 Map of Trauma Distribution by Zip Code, 2019[2,3]* *Figure 6 Map of Severe Trauma Distribution by Zip Code, 2019[2,3]*

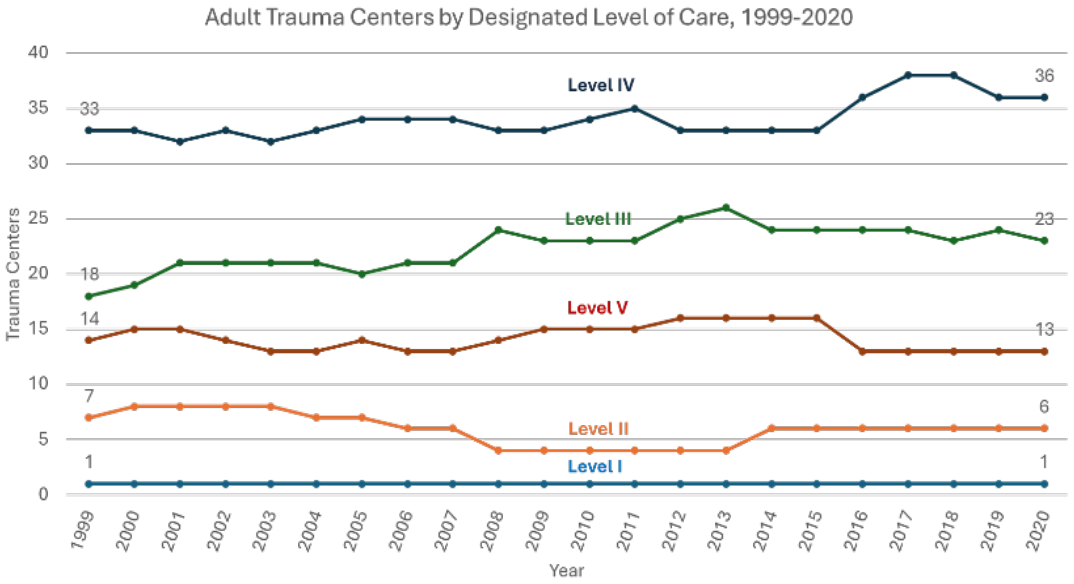



*Figure 7 Adult Trauma Center Designated Level of Care, 1999-2020*[2]

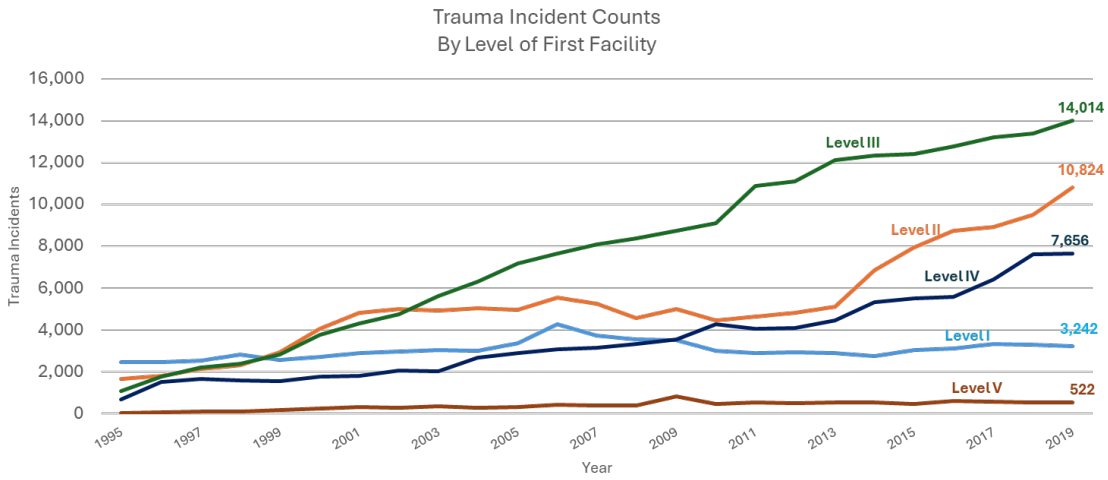



*Figure 8 Trauma Incident Counts by Level of First Facility, 1995-2019*[2]

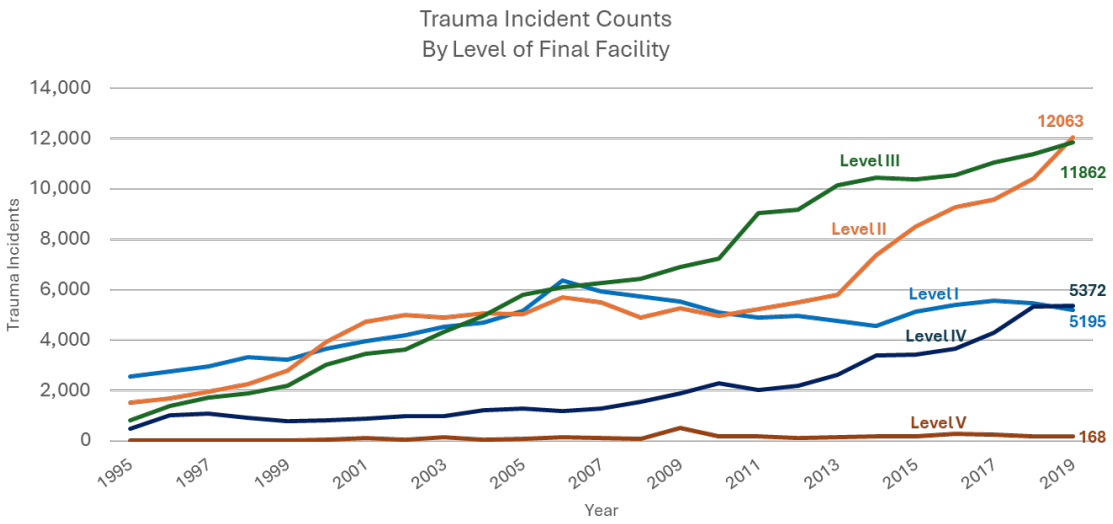



*Figure 9 Trauma Incident Counts by Level of Final Facility, 1995-2019*[2]

All EMS and Trauma regions in Washington have experienced population growth over the past 14 years and are projected to continue to see growth through 2030. (Figures 10 and 11). This period has also seen an increase in trauma volume in each of the regions, with the North, East, West and Central regions experiencing the most rapid growth in trauma volume. (Figure 12). In all but two regions, Southwest and North Central, the increase in trauma volume outpaces the population growth. In the North and East regions, this difference in growth is most pronounced. In the North region, the trauma incident rate increased by 132% between 2010 and 2019. During this same period the population in the North region increased by only 13%. (Figure 12)

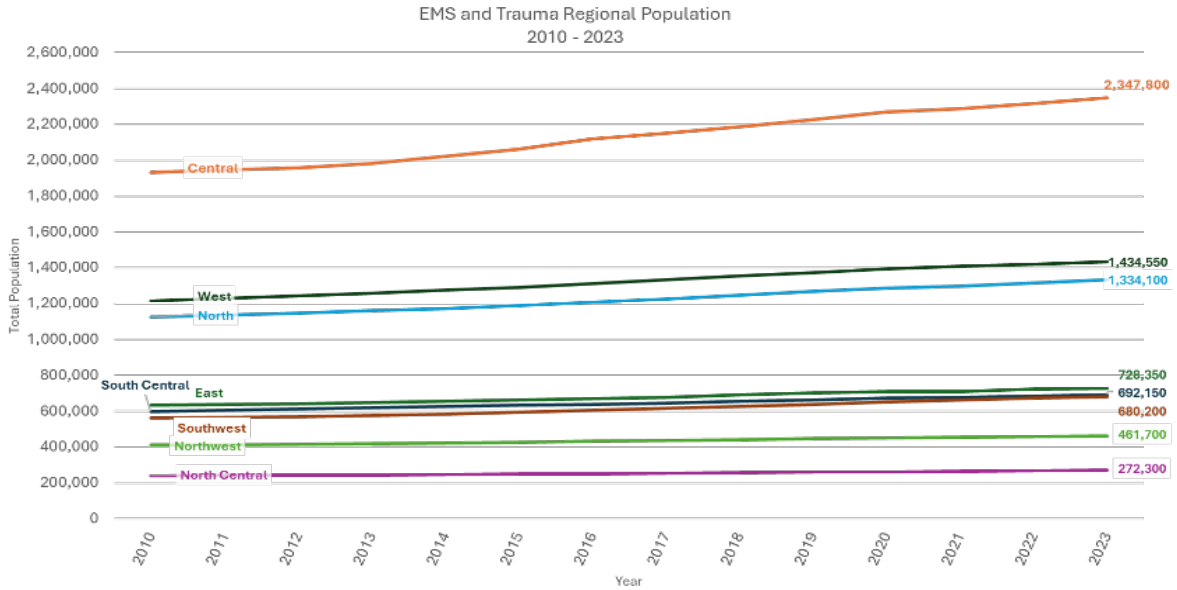



*Figure 10 Population of EMS and Trauma Regions*[1]

*Projected Percent Change in Population by EMS and Trauma Region*

| Region | Projected Change 2020-2030 |
|---|---|
| Central | +22% |
| East | +15% |
| North | +19% |
| North Central | +13% |
| Northwest | +12% |
| South Central | +15% |
| Southwest | +21% |
| West | +18% |

*Figure 11 Projected regional change in population[1]*

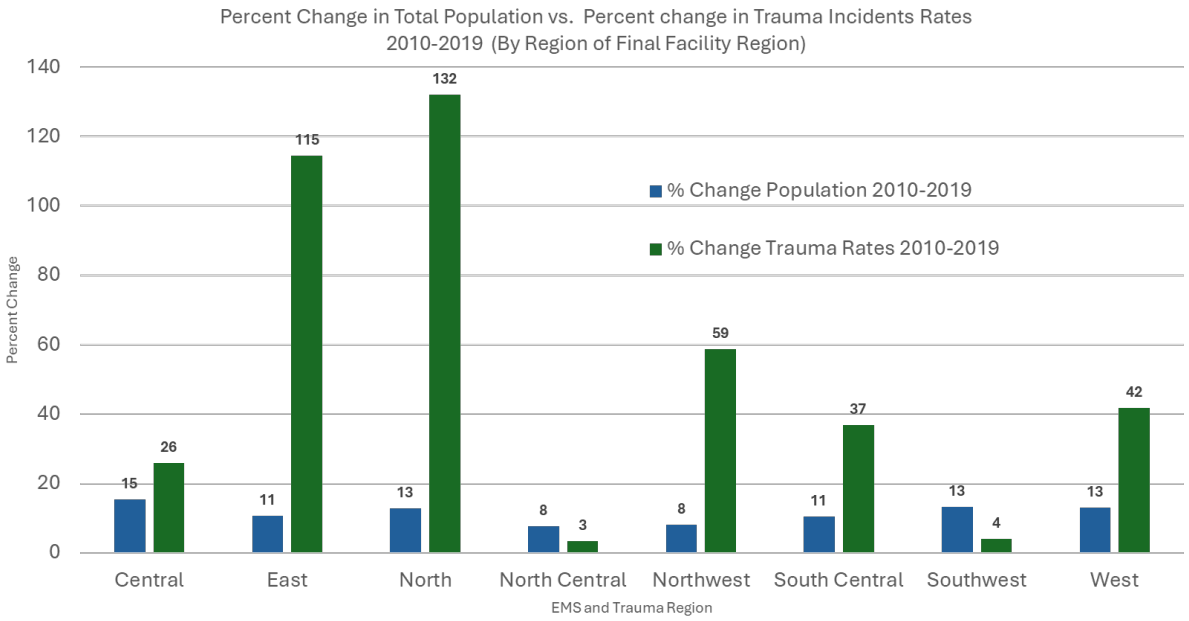



*Figure 12 Past regional change in population and trauma incidents[1,2]*

### *Rurality and Age*

The EMS and Trauma System faces unique challenges depending on where an incident occurs. In urban areas for instance, higher populations equate to higher total injuries requiring EMS response and potential trauma activation. In rural areas, longer distances to the scene and to the hospital may impact time to care. As these factors are considered, it is important to understand the rurality of an area in order to assess the particular trauma system resources that may be needed. Statwide, from 2010 to 2023, urban and suburban areas have had the fastest growing populations at 17% and 16% respectively, while small and large rural towns have also continued to grow at 12% and 9% respectively. (Figure 13)

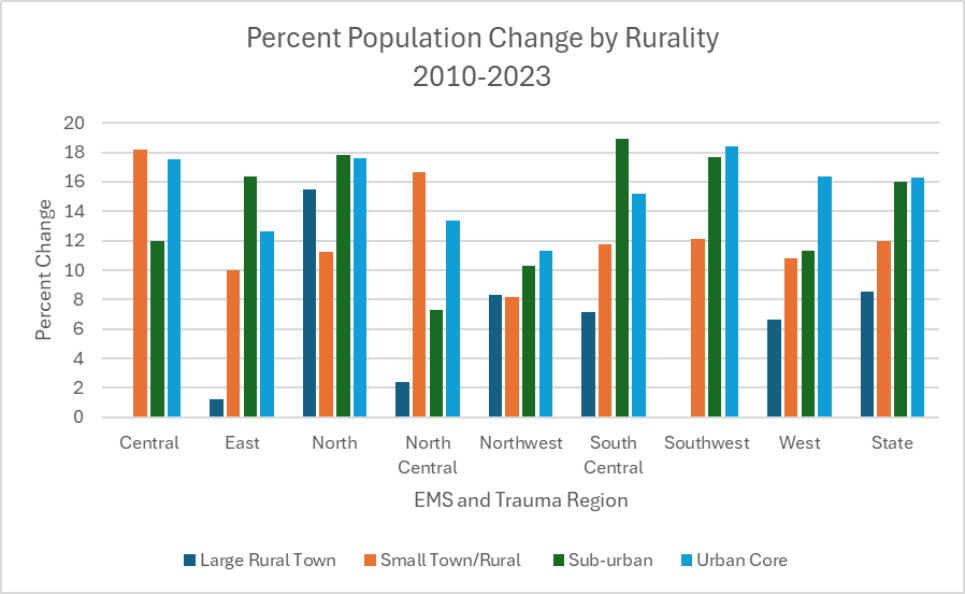



*Figure 13 Rurality Population Percent Change, State & Regions, 2010-2023[1]*

As populations continue to grow, it is projected that, although 15 to 64-year-olds account for most of the population statewide and in most regions, the population of 65 and older adults will grow most rapidly with a projected 30% increase statewide between 2020 and 2030. (Figures 14 & 15) This change may mean increases in geriatric trauma patients.

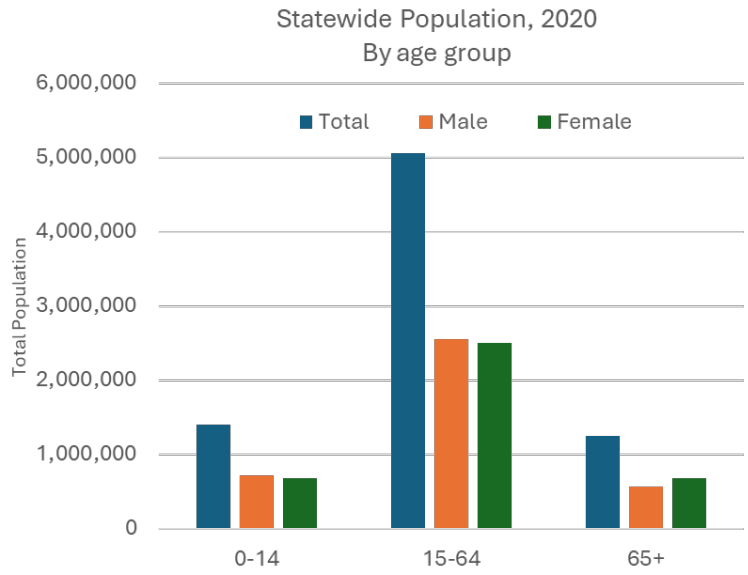



*Figure 14 State population by age group[1]*

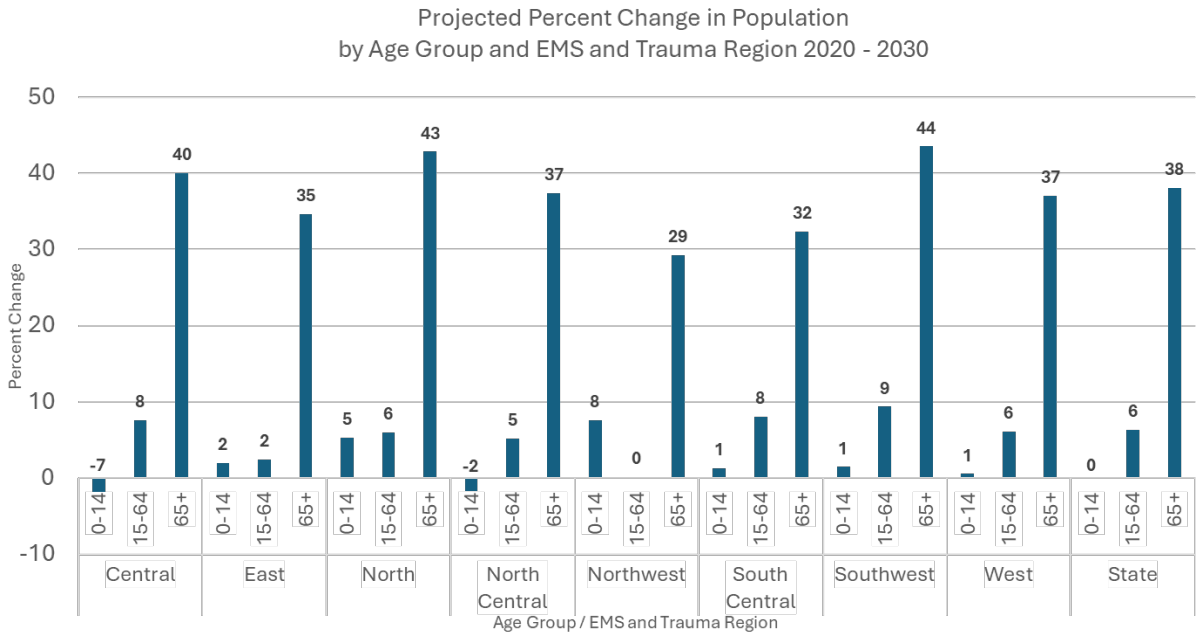



*Figure 15 State and regional projected population growth 2020-2030[1]*

### *Injury*

Washington has already begun to see an impact of its growing older adult population on the type of common injuries seen in the trauma system. Falls, common among older adults, have been the leading primary mechanism of injury among trauma patients since 1996, when it outpaced motor vehicle traffic. (Figure 16) It has continued to increase since that time. From 2015 to 2019 the geriatric population of Washington has increased 19% (figure 17) while the geriatric trauma patient volume has increased 49%. (figure 18) Over the same period the rate of falls in the trauma system has increased by 38% (figure 16)

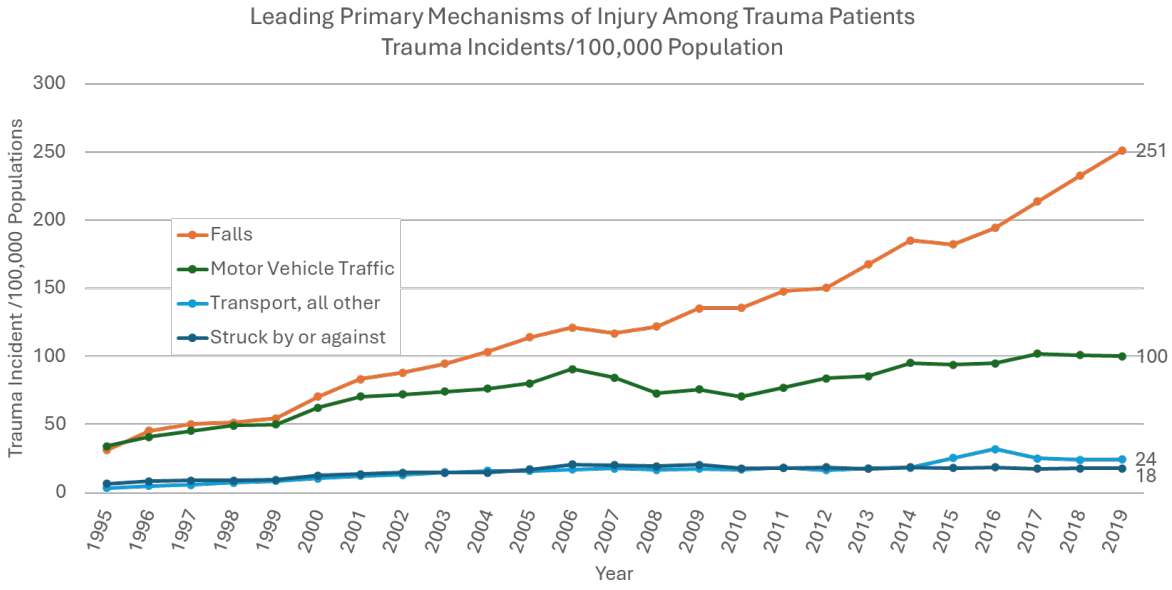



*Figure 16 Primary Mechanisms of Injury[2]*

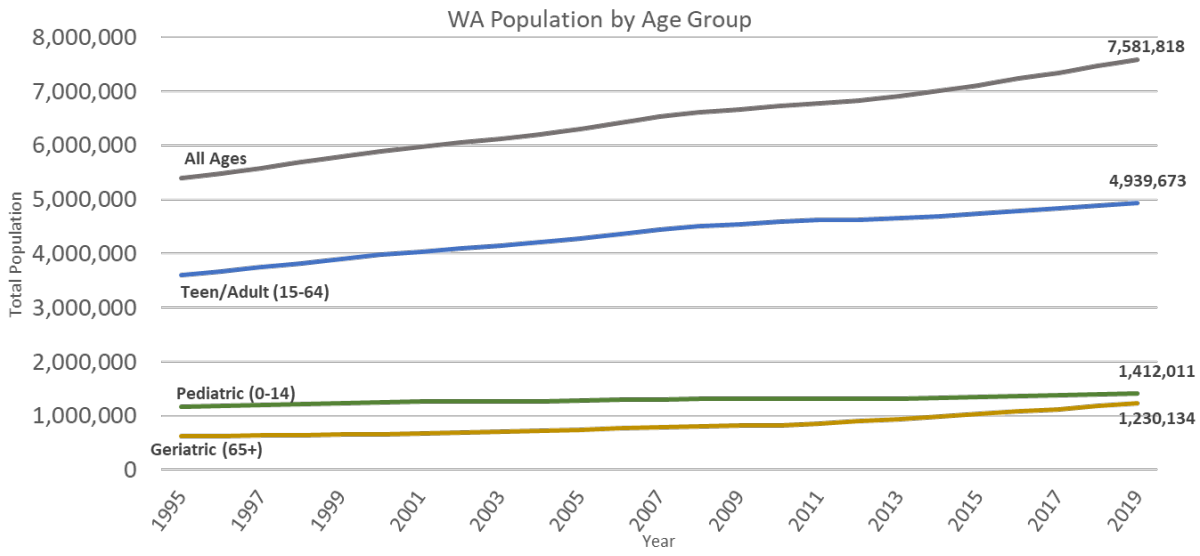



*Figure 17 WA Population by Age Group, 1995-2019*[1]

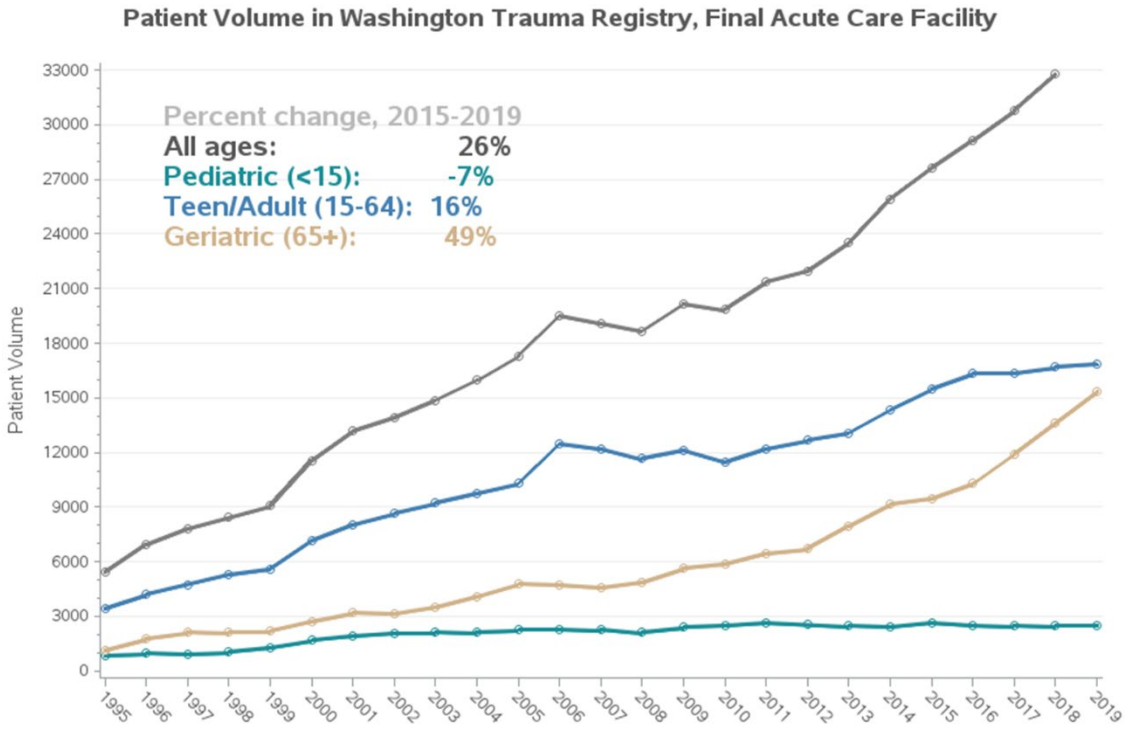



*Figure 18 Trauma volume by age group*[2]

## Access to Trauma Services

Summary: Much of the state's population (99%) is within an hour from some level of trauma care (Level I thru V). Though fewer (84%) have access within an hour from a level I or II facility.

35% of severe trauma incidents, which often require a higher level of care, occurred further than 30 minutes from a level I or II trauma facility.

While most patients do not end up being transferred to a higher level of care, patient transfers out of the EMS and Trauma Region are most frequent among level V facilities while most patients transferred in for care from another region are going to the Level I trauma center.

### Key Question: How accessible is trauma care in WA?

*Distance to care: How much of the state population is within an accessible distance from trauma services?*

In any needs assessment process, how accessible trauma care is to the affected population is critically important. Considering variation in accessibility based on different geographical locations within the state, geospatial analysis was used to determine the proportion of the state population and trauma incidents within a 60-, 45-, and 30-minute drive to trauma care. These times were selected to represent the potential to access care within the "Golden Hour", a measure of ideal time from injury to care at a trauma center. While a 60-minute drive time offers a baseline perspective of distance from care, the shorter time windows of 45- and 30-minutes help account for additional time that may be needed for EMS services to arrive at the scene following an injury. The 30-minute benchmark also serves as a useful measure of the potential to meet state trauma triage guidelines, which include transport of high risk patients to a level I or II trauma service within 30 minutes.

In 2019, most of the state population (99%) resided within an hour of some level of trauma care (Level I – V), while slightly lower proportions of the population (84%) were within an hour drive to higher levels of care (Levels I and II). These higher-level centers are important in providing care for higher severity injuries (Injury Severity Score ≥16). Among those severe injuries likely to result in the need for a level I or II trauma center, 85% occurred within an hour of such a facility, while only 65% occurred within 30 minutes from a Level I or II center. (figures 19-22)

***Drive Time to a Trauma Center, 2019***

| ***Level I or II Trauma Center*** | **< 60 Minutes** | **< 45 Minutes** | **< 30 Minutes** |
|---|---|---|---|
| *Population* | 84% | 78% | 66% |
| *All Trauma Incidents* | 88% | 82% | 71% |
| *Severe Trauma Incidents (≥16)* | 85% | 77% | 65% |
| ***Level I, II or III Trauma Center*** | | | |
| *Population* | 96% | 93% | 85% |
| *All Trauma Incidents* | 97% | 94% | 88% |
| *Severe Trauma Incidents (≥16)* | 96% | 93% | 85% |
| ***Any Trauma Center (Levels I thru V)*** | | | |
| *Population* | 99% | 97% | 93% |
| *All Trauma Incidents* | 99% | 98% | 94% |
| *Severe Trauma Incidents (≥16)* | 99% | 98% | 94% |

*Figure 19 30/45/60 min drive access to trauma centers[2,3]*

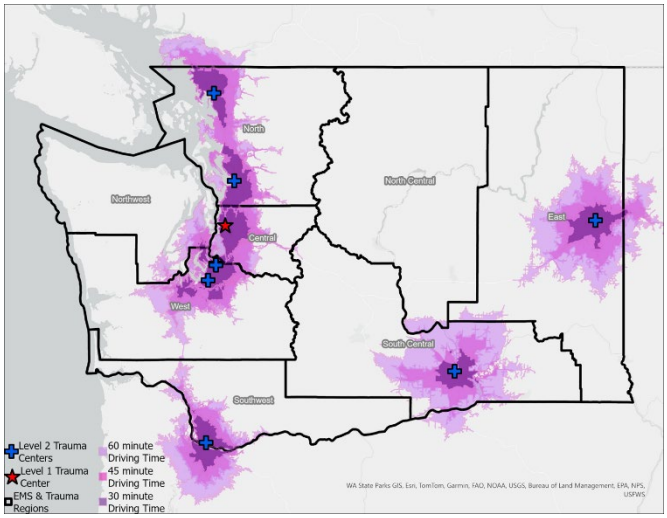



*Figure 21 30/45/60 min drive time to Level I or II Trauma Center[2,3]*

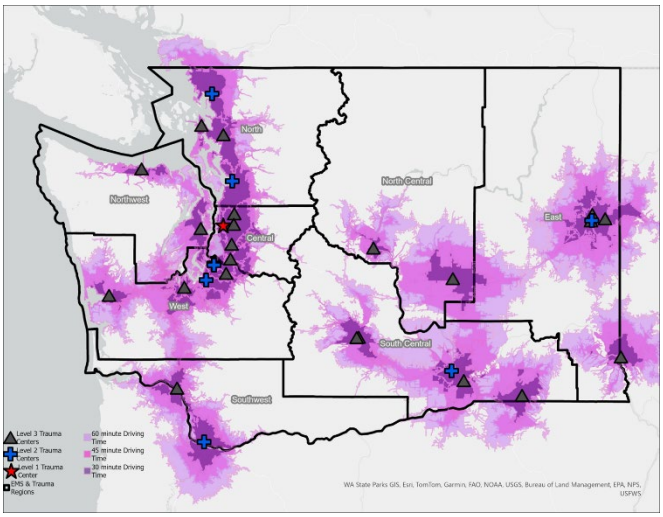



*Figure 20 30/45/60 min drive time to Level I-III Trauma Center[2,3]*

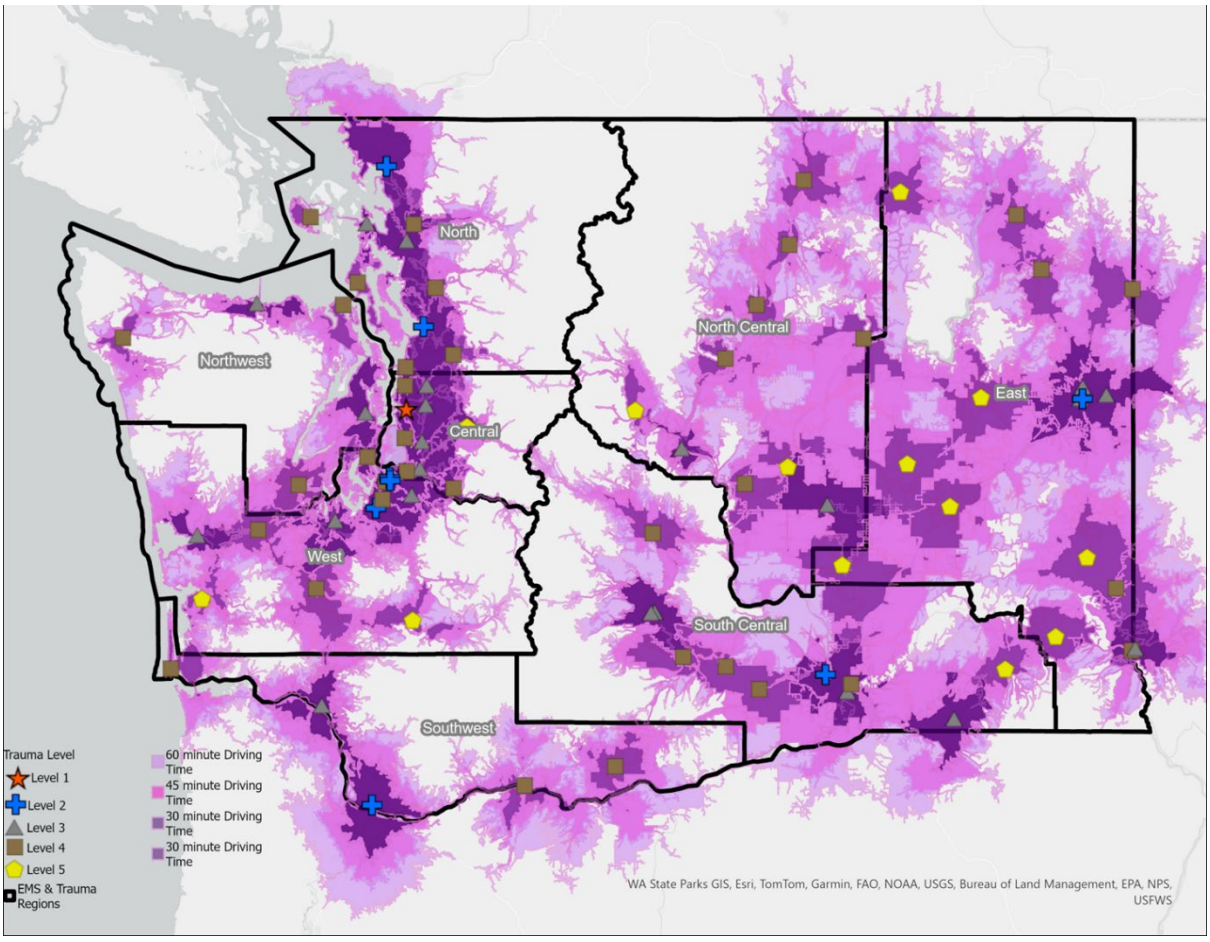



*Figure 22 30/45/60 min drive time to any trauma center[2,3]*

When looking at regional level, the access disparities become more apparent. Although population access to any trauma care center is similar across all regions, access to higher levels of care is much more restricted in regions like North Central and Northwest compared to other regions. (Figures 23) A similar pattern is seen when looking at trauma incident locations. (Figures 24 and 25)

Access disparities may be partially explained by the distribution of trauma centers with varying levels of care across the regions of the state. (Figure 26)

*Population within various driving distances to trauma centers*

| | Drive Time | Level I & II | Levels I, II, & III | Levels I - V |
|---|---|---|---|---|
| *Central* | ≤30 min% | 85% | 98% | 99% |
| | ≤45 min% | 99% | 99% | 99% |
| | ≤60 min% | 100% | 100% | 100% |
| *East* | ≤30 min% | 67% | 75% | 91% |
| | ≤45 min% | 74% | 85% | 97% |
| | ≤60 min% | 78% | 92% | 99% |
| *North* | ≤30 min% | 76% | 86% | 93% |
| | ≤45 min% | 88% | 94% | 97% |
| | ≤60 min% | 92% | 96% | 98% |
| *North Central* | ≤30 min% | 0% | 55% | 84% |
| | ≤45 min% | 0% | 68% | 92% |
| | ≤60 min% | 3% | 76% | 98% |
| *Northwest* | ≤30 min% | 4% | 60% | 76% |
| | ≤45 min% | 29% | 79% | 90% |
| | ≤60 min% | 59% | 90% | 97% |
| *South Central* | ≤30 min% | 38% | 78% | 96% |
| | ≤45 min% | 46% | 92% | 98% |
| | ≤60 min% | 53% | 98% | 99% |
| *Southwest* | ≤30 min% | 70% | 85% | 89% |
| | ≤45 min% | 81% | 91% | 97% |
| | ≤60 min% | 90% | 93% | 99% |
| *West* | ≤30 min% | 70% | 84% | 92% |
| | ≤45 min% | 86% | 95% | 98% |
| | ≤60 min% | 90% | 97% | 99% |

*Figure 23 Regional population within driving distances to trauma centers[2,3]*

*Percent of trauma Incidents within various driving distances to trauma centers*

| | Drive Time | Level I & II | Levels I, II, & III | Levels I - V |
|---|---|---|---|---|
| *Central* | ≤30 min% | 91% | 98% | 99% |
| | ≤45 min% | 98% | 99% | 100% |
| | ≤60 min% | 99% | 99% | 100% |
| *East* | ≤30 min% | 84% | 88% | 95% |
| | ≤45 min% | 89% | 94% | 99% |
| | ≤60 min% | 93% | 97% | 100% |
| *North* | ≤30 min% | 70% | 87% | 93% |
| | ≤45 min% | 86% | 93% | 97% |
| | ≤60 min% | 92% | 95% | 98% |
| *North Central* | ≤30 min% | 0% | 54% | 83% |
| | ≤45 min% | 1% | 70% | 91% |
| | ≤60 min% | 6% | 80% | 97% |
| *Northwest* | ≤30 min% | 7% | 75% | 84% |
| | ≤45 min% | 38% | 90% | 95% |
| | ≤60 min% | 61% | 95% | 99% |
| *South Central* | ≤30 min% | 33% | 84% | 95% |
| | ≤45 min% | 38% | 93% | 98% |
| | ≤60 min% | 42% | 98% | 99% |
| *Southwest* | ≤30 min% | 74% | 86% | 91% |
| | ≤45 min% | 85% | 92% | 98% |
| | ≤60 min% | 94% | 95% | 100% |
| *West* | ≤30 min% | 72% | 84% | 95% |
| | ≤45 min% | 85% | 96% | 99% |
| | ≤60 min% | 92% | 98% | 100% |

*Figure 24 Regional trauma incidents within driving distances to trauma centers[2,3]*

*Percent of Severe Trauma Incidents within various driving distances to trauma centers*

| | Drive Time | Level I & II | Levels I, II, & III | Levels I - V |
|---|---|---|---|---|
| *Central* | ≤30 min% | 90% | 98% | 99% |
| | ≤45 min% | 97% | 98% | 99% |
| | ≤60 min% | 99% | 99% | 100% |
| *East* | ≤30 min% | 77% | 81% | 94% |
| | ≤45 min% | 85% | 92% | 100% |
| | ≤60 min% | 89% | 96% | 100% |
| *North* | ≤30 min% | 68% | 85% | 95% |
| | ≤45 min% | 83% | 90% | 98% |
| | ≤60 min% | 90% | 95% | 99% |
| *North Central* | ≤30 min% | 0% | 67% | 87% |
| | ≤45 min% | 0% | 79% | 90% |
| | ≤60 min% | 3% | 87% | 100% |
| *Northwest* | ≤30 min% | 8% | 66% | 87% |
| | ≤45 min% | 38% | 80% | 91% |
| | ≤60 min% | 70% | 91% | 99% |
| *South Central* | ≤30 min% | 18% | 79% | 95% |
| | ≤45 min% | 22% | 94% | 99% |
| | ≤60 min% | 32% | 97% | 99% |
| *Southwest* | ≤30 min% | 67% | 82% | 88% |
| | ≤45 min% | 84% | 91% | 98% |
| | ≤60 min% | 93% | 94% | 100% |
| *West* | ≤30 min% | 61% | 78% | 93% |
| | ≤45 min% | 79% | 94% | 99% |
| | ≤60 min% | 89% | 99% | 100% |

*Figure 25 Regional severe trauma incidents within driving distances to trauma centers[2,3]*

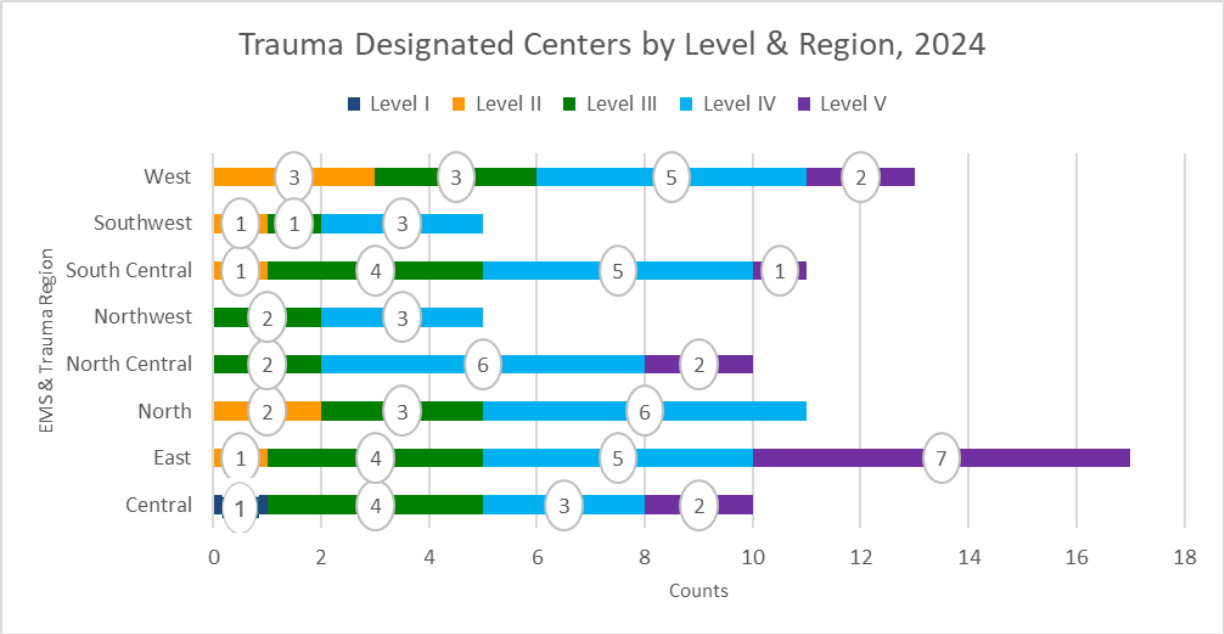



*Figure 26 Trauma Designated Centers by Level & Region, 2024*[2]

### *Where do patients go for trauma care?*

Figure 27 shows the proportion of trauma patients who were transferred to a higher level of care at some point during their care journey. Most patients in the trauma system remain at their initial facility, however, the number of patients transferred out of that initial facility is higher for lower-level facilities (Levels III -V). While these statewide transfer patterns for 2019 are consistent with what is to be expected, with patients increasingly transferred to higher levels of care when they first arrive at lower levels, this measure represents an important tool for monitoring the volume of patients needing higher levels of care and requiring transfer. For the purposes of identifying additional resources needs in a region, for instance, a high percentage of patients being transferred to a higher level of care could indicate a need for resources or redesignation in an area. One potential benefit of redesignation of a facility with a high number of transfers is shorter times to definitive care for higher severity patients.

Figure 28 shows the proportion of trauma patients based on their transfer status between different levels of care. We can see that for levels II through IV most patients were admitted with no transfers. Most patients transferred out were those admitted to a level V, while the Level I facility mostly received patients transferred in from other levels of care. Level V facilities also showed the largest proportion of patients transferred out of region compared to other levels of care. Transfers out of the region are a helpful indicator of possible gaps in resources. Though often necessary to ensure patients receive the appropriate care for their injury, transfers out of region may result in patient and family burden due to increased travel costs for visitation. Out of region transfers may also burden EMS capacity as EMS units may be required to transport the patient long distances, preventing them from responding to other calls during that time. Interfacility transport methods and family considerations vary across the state.

***Trauma Patients Initial and Highest Designated Level of Care (%), State, 2019***

| | | Highest Level of Care | | | | |
|---|---|---|---|---|---|---|
| | | **Level I** | **Level II** | **Level III** | **Level IV** | **Level V** |
| **Initial Level of Care** | **Level I** | 100% | - | - | - | - |
| | **Level II** | 3% | 98% | - | - | - |
| | **Level III** | 6% | 5% | 89% | - | - |
| | **Level IV** | 6% | 10% | 1% | 83% | - |
| | **Level V** | 9% | 21% | 7% | - | 63% |

*Figure 27 Trauma Patients Initial & Highest Designated Level of Care (%), State, 2019[2]*

**Patient Flow in Trauma Registry by Trauma Level of Care,State 2019**

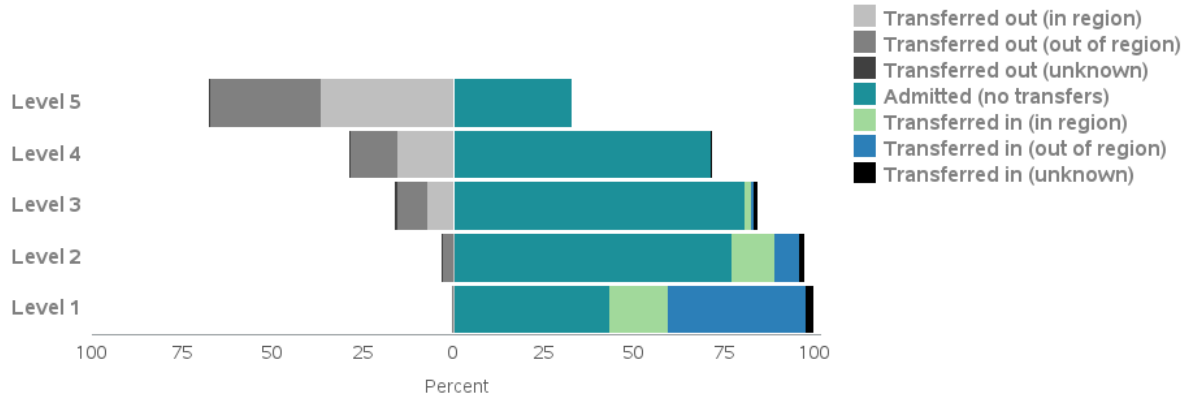
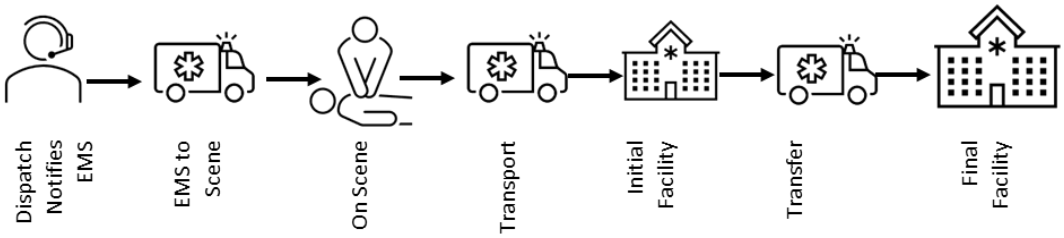



*Figure 28 Patient Flow in Trauma Registry by Trauma Level of Care, State 2019[2]*

## Time to Care

Summary: To assess the timeliness of appropriate trauma care, time to care can be broken into segments:



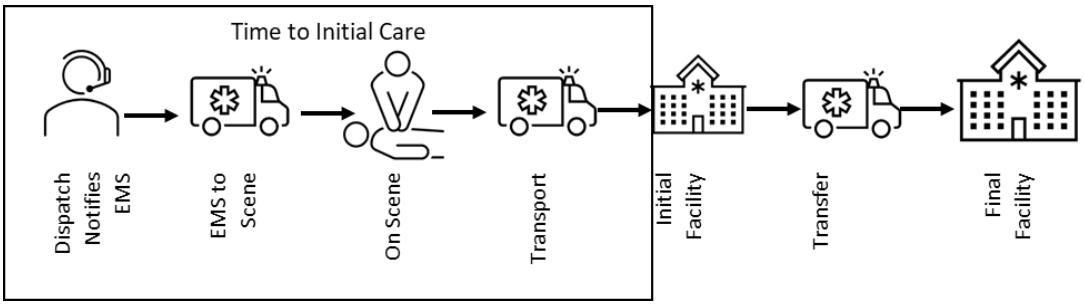

*Time from EMS Notification to Scene Departure:* In 2019, the average time from EMS being notified by dispatch to EMS departing the scene of the injury with the patient was 29.2 minutes.

*Time from Scene Departure to arrival at initial facility:* In 2019, the average time from EMS departing the scene with the patient to arriving at the initial facility was 33 minutes.

Combined, the average time from EMS notification of an incident to the patient arriving at the initial facility was 60.2 minutes. I 2019, 64 percent of patients arrived at the initial facility within 60 minutes of injury.

*Time from EMS Notification to Definitive Care:* In 2019, the average time from injury to definitive care at the final facility was 85.6 minutes. This average includes those who were transferred to a higher-level facility and those who remained at their initial facility. Time to definitive care is substantially longer for patients who are transferred, than for patients who remain at their initial facility and longer still for those transferred outside of the EMS and Trauma region.

## Key Question: How long does it take to get appropriate trauma care?




The golden hour is a helpful benchmark to assess whether timely care is being achieved in a particular area. The “golden hour” is the first 60 minutes following severe injury which is considered a crucial period for determining the patient's outcome. During this period it is critical that severely injured patients reach care where emergency and resuscitative surgical teams are available. One way to assess whether this 60-minute window is likely to be achieved is to combine

the drive time or transport time to a facility with the time it takes EMS to respond to and depart from the scene of the injury.

For instance, if the average time for EMS to respond to and depart a scene is 30 minutes, the golden hour is likely to be achieved in a geographic area where a trauma facility is located within a 30-minute drive time. If the average time for EMS to respond to and depart a scene is 15 minutes, the golden hour is likely to be achieved in a geographic area where a trauma facility is located within a 45-minute drive-time. For this reason, this section first considers these two stages of the EMS response to trauma incidents: Time from EMS notification to scene departure and time from scene departure to arrival at the initial facility. From there the time at the initial facility and the transfer time between facilities are assessed to look more closely at the total time from injury to definitive care at the final trauma facility.

*Stage 1: Dispatch to scene departure – How quickly can EMS provide care and leave the scene after being notified by dispatch?*

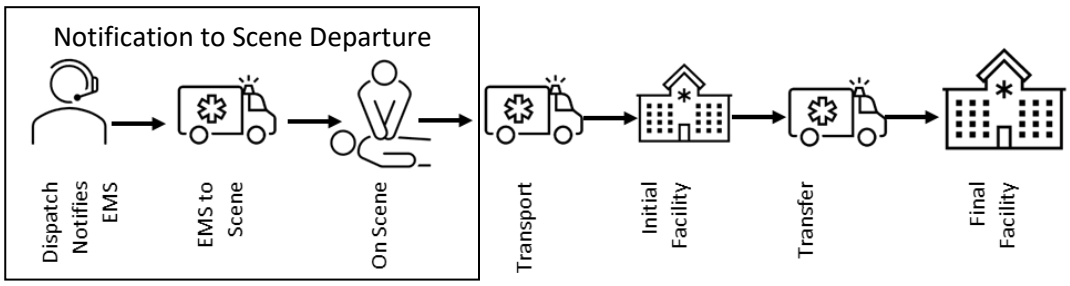



Figure 29 shows the average time from when the first EMS unit was notified by dispatch to when the unit left the scene of the incident, which includes the response and scene time portions of the initial EMS response. The data used here include linked trauma and EMS data, which may involve multiple EMS units responding to the same patient. The average time from the first unit notified to departure of ambulance was 29.2 minutes. With the average time as an example, the patient would need to be transported to a trauma facility within 30.8 minutes to receive care within 1-hour. However, this goal may be less feasible in certain counties, such as the six counties where the average unit notified to departure time exceeds 45 minutes. The average unit notified to departure time in these counties would leave less than 15 minutes for EMS to transport the patient to a trauma facility within a 60-minute time window. Across the state, about 35 percent of trauma incidents have a notification to scene departure time greater than 30 minutes, meaning they have less than 30 minutes to reach initial care within an hour of injury. (Figure 30)

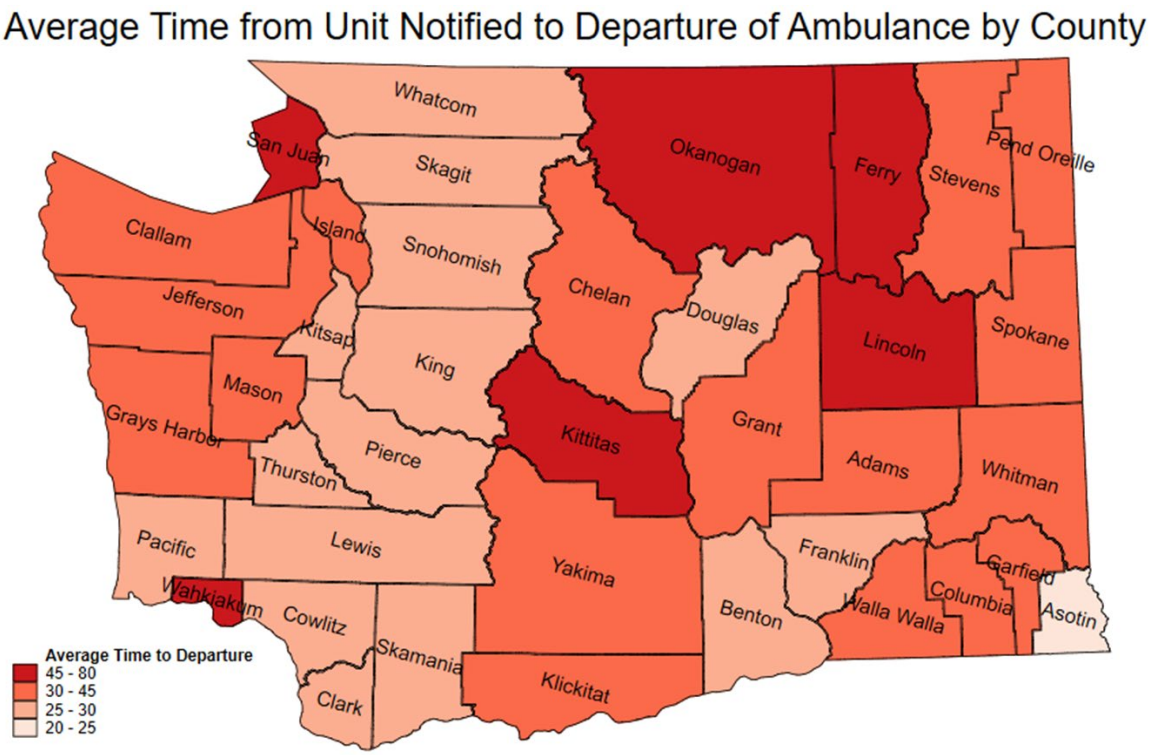



*Figure 29 Average Time from EMS Unit Notification to Ambulance Scene Departure by County[2,3]*

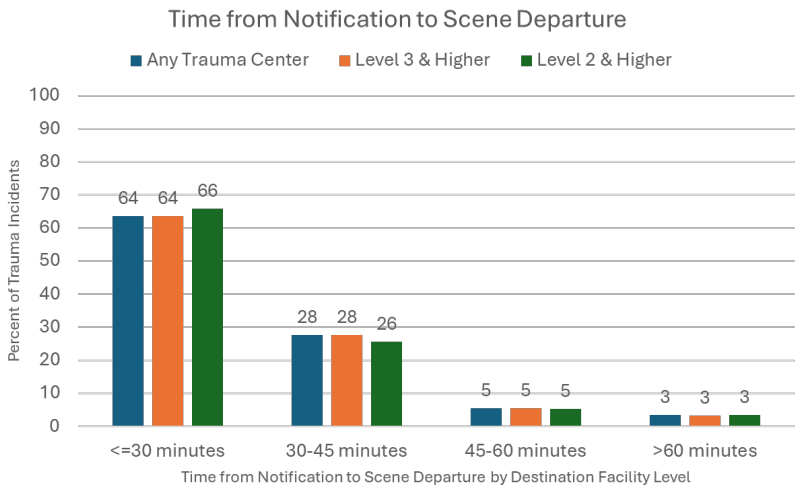
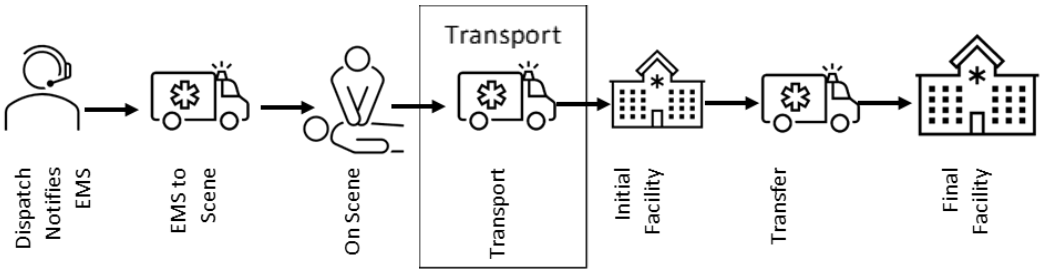



*Figure 30 Time from EMS Unit Notification to Ambulance Scene Departure by Destination Facility Level[2,3]*

*Stage 2: Transport time – How quickly can the ambulance transport the patient from the scene to the hospital?*




Next, we consider the transport portion of the EMS response. Figure 31 shows the average transport time to the first trauma facility by the county of the initial EMS response. The transport times here include potential transfers to air medical units if they occurred prior to the initial facility. Statewide, the average transport time to initial trauma facilities in 2019 was 33 minutes. Across the state, about 35% of trauma incidents had a transport time to the initial facility greater than 30 minutes. (Figure 32)

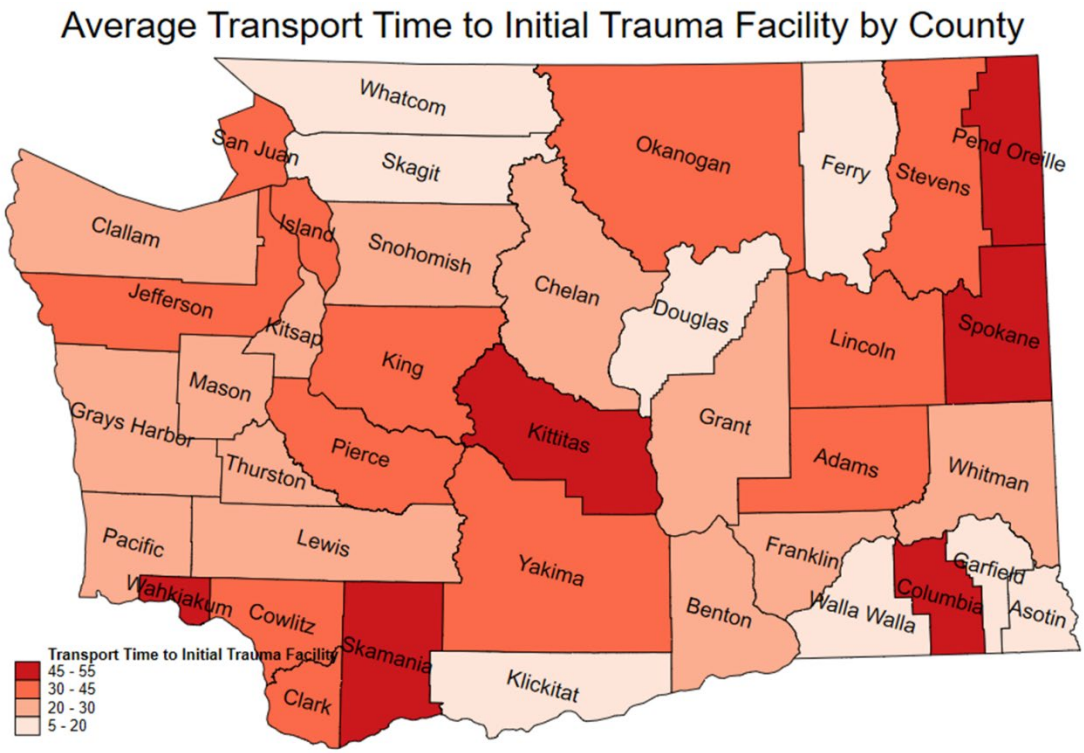



*Figure 31 Average Transport Time to Initial Trauma Facility by County*[2,3]

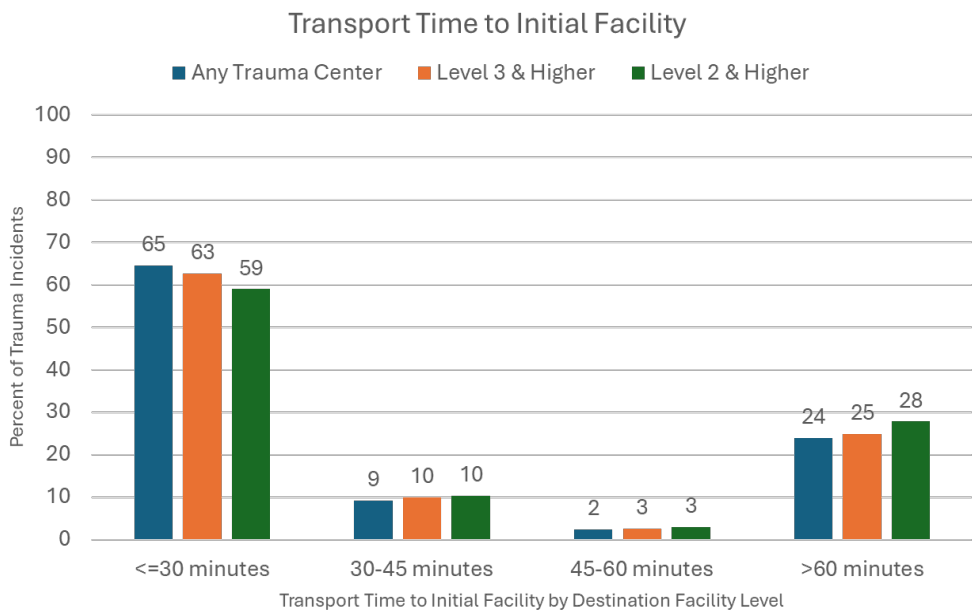
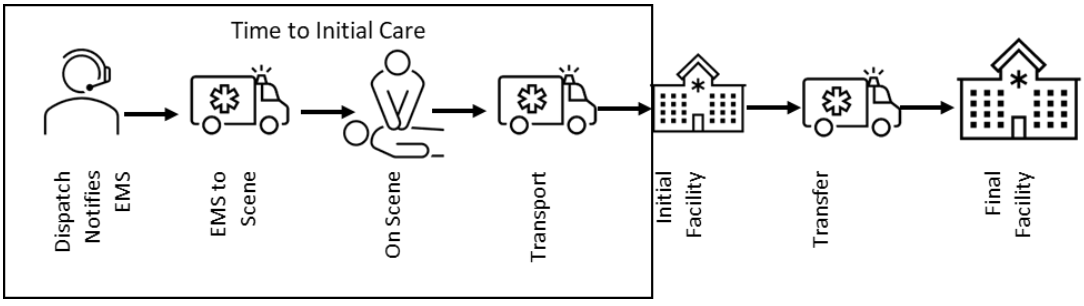



*Figure 32 Transport Time to Initial Facility by Destination Facility Level*[2,3]

### *EMS Facility Wait Times (aka "Wall Time")*

In addition to response, scene, and transport times, the time needed to transfer care from EMS to the emergency department after arriving at the hospital, known as wall time, would help inform potential gaps in hospital capacity that may impact care times. While this information can be reported in EMS patient care records, the frequency of wall-time documentation varies greatly across EMS services. In 2024, only 10 counties reported EMS wall time data in more than 50 percent of EMS records. This completion rate was determined to be too low to report reliably. Inclusion of this indicator will be reconsidered in future updates to this assessment.

### *Putting it together: How quickly do patients arrive at their initial facility after injury?*




Now that we have assessed both the time from dispatch to scene departure and the time from scene departure to hospital arrival, it is time to look at the whole picture: time from EMS notification to arrival at the first facility. This span of time is crucial to effective patient care.

Figure 33 shows the average time from when the first responding EMS unit was notified by dispatch until the patient arrived at the first trauma facility. The averages are mapped by the county of the initial EMS response.

In 2019, time to first trauma facility varied greatly by county. The average time to first trauma facility was 60.2 minutes. County averages vary from less than 45 minutes for selected counties and greater than 90 minutes for others. Notably, the counties where average time to first facility was greater than 90 minutes are in more rural areas and have either a level 4 trauma center or no trauma center at all. Still, rurality is not the only factor in time to first facility, as all five counties with an average time to first trauma facility of less than 45 minutes are counties that are designated as rural by the WA State Office of Financial Management.

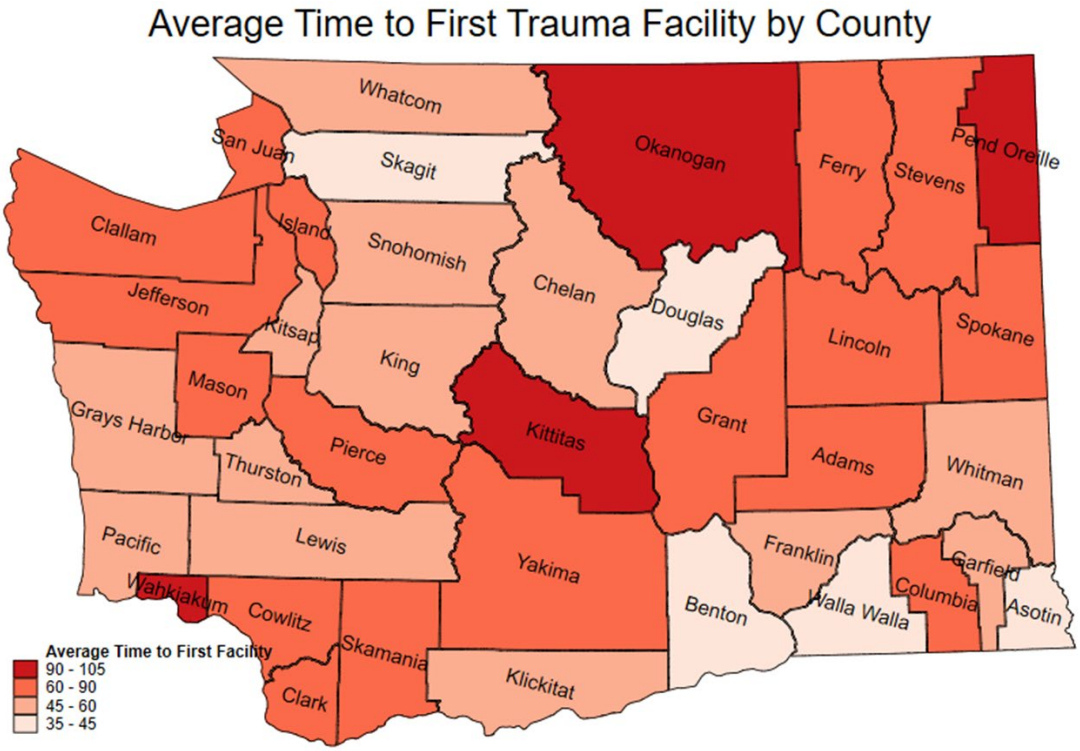



*Figure 33 Average Time to First Trauma Facility by County*[2,3]

Figure 34 shows the percentage of trauma incidents where the time to first facility was within each time grouping by the trauma center level to which the patient was first taken. In 2019, patients arrived at the first trauma center within 60 minutes from when dispatch notified the EMS unit in 64 percent of trauma incidents. This shows that 64 percent of trauma patients are making it to a trauma facility within 60-minutes. It took longer than 90 minutes for the patient to arrive at the first trauma center in 20 percent of incidents. When considering incidents where patients were initially transported to a level 2 trauma center or higher, 55 percent of patients made it to the trauma center within 60 minutes and 27 percent took longer than 90 minutes. The difference in time to first facility for all trauma levels versus level II centers and higher is likely related to greater availability of the level III centers and lower, as well as triage protocols that prioritize transports to lower trauma

levels if available. However, there was little difference in the time to first facility when comparing ISS of 15 or lower to ISS of 16 or higher.

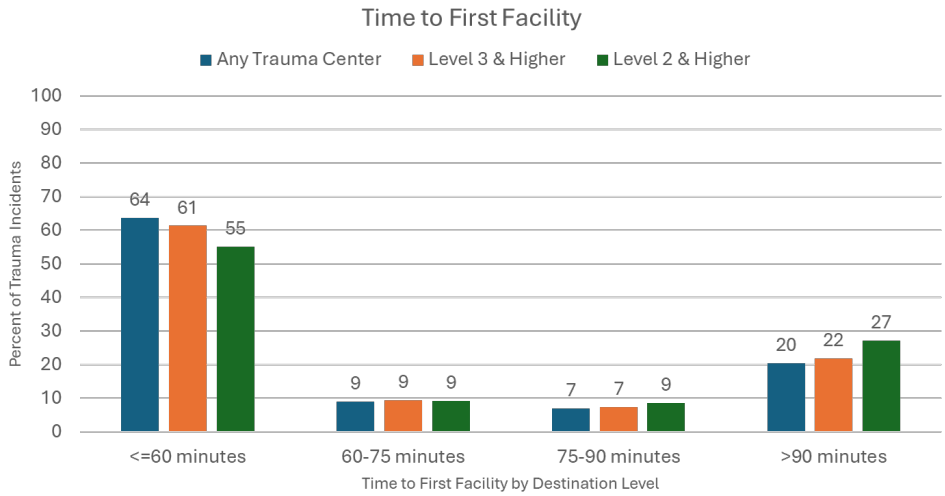
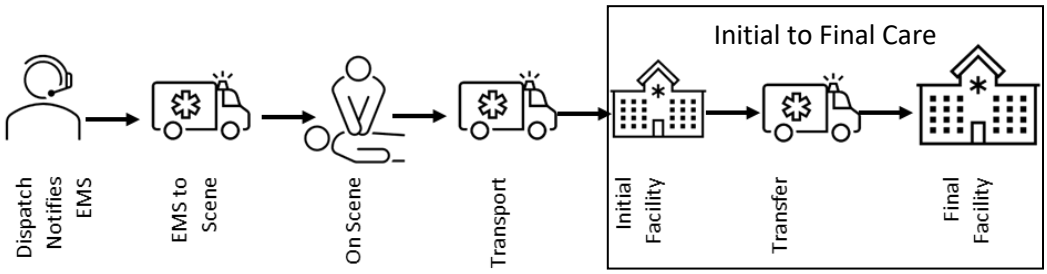



*Figure 34 Time to First Facility by Destination Facility Level*[2,3]

### *After Initial Care – What happens to patients after they arrive at the initial facility?*




To ensure seriously injured patients are rapidly triaged, assessed, and transferred to higher levels of care, a consensus was developed between the EMS and Trauma Hospital Technical Advisory Committee (TAC), Outcomes TAC, and the Department to measure the emergency department (ED) length of stay and set a benchmark of three hours. This benchmark was also included in the 2019 version of the trauma service standards requiring facilities to measure ED length of stay (LOS) and set a three-hour benchmark for their individual facility.

Figure 35 shows the distribution of lengths of stay at a trauma facility from which the patient is transferred by ISS level. Patients with an ISS of 15 or lower had an average length of stay before transfer of 3.8 hours, while patients with an ISS of 16 or higher had an average length of stay of 4.1 hours. However, there was no statistically significant difference between the two groupings.

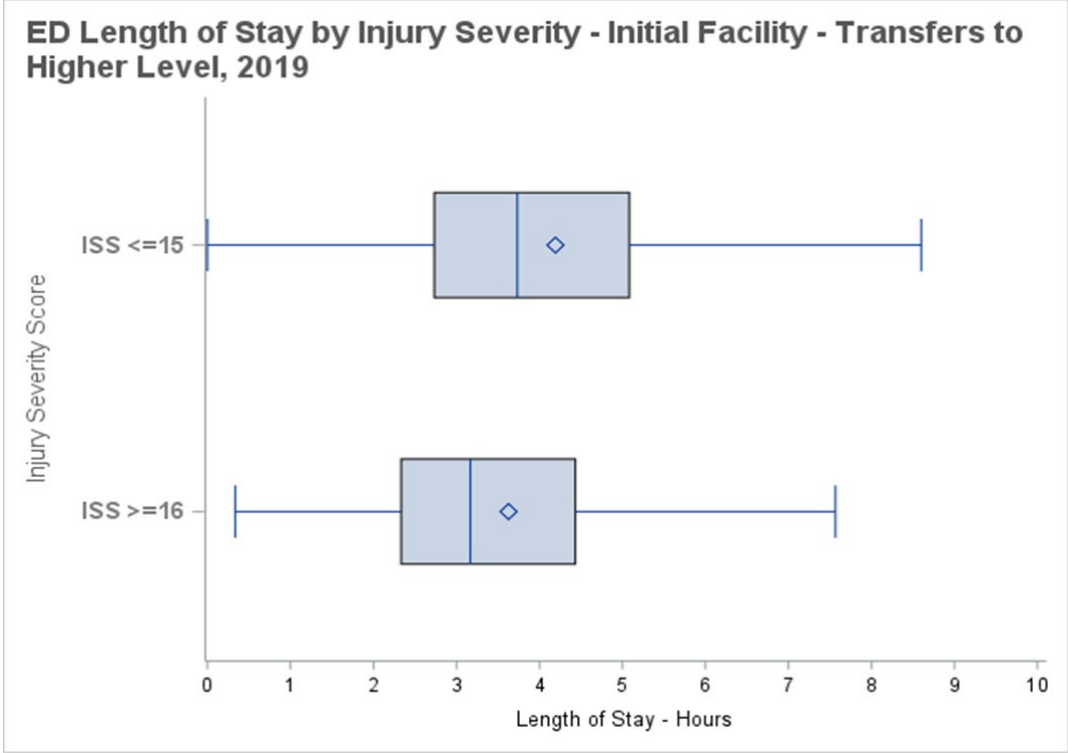



*Figure 35 Emergency Department Length of Stay at Initial Facility, Patients Transferred to Higher Level of Care, by ISS*[2]

Figure 36 shows the average length of stay at the initial facility compared across ISS level and the region of the initial trauma facility. Despite variation in the distributions of lengths of stay across counties, there was also no statistically significant difference between the ISS and region groupings.

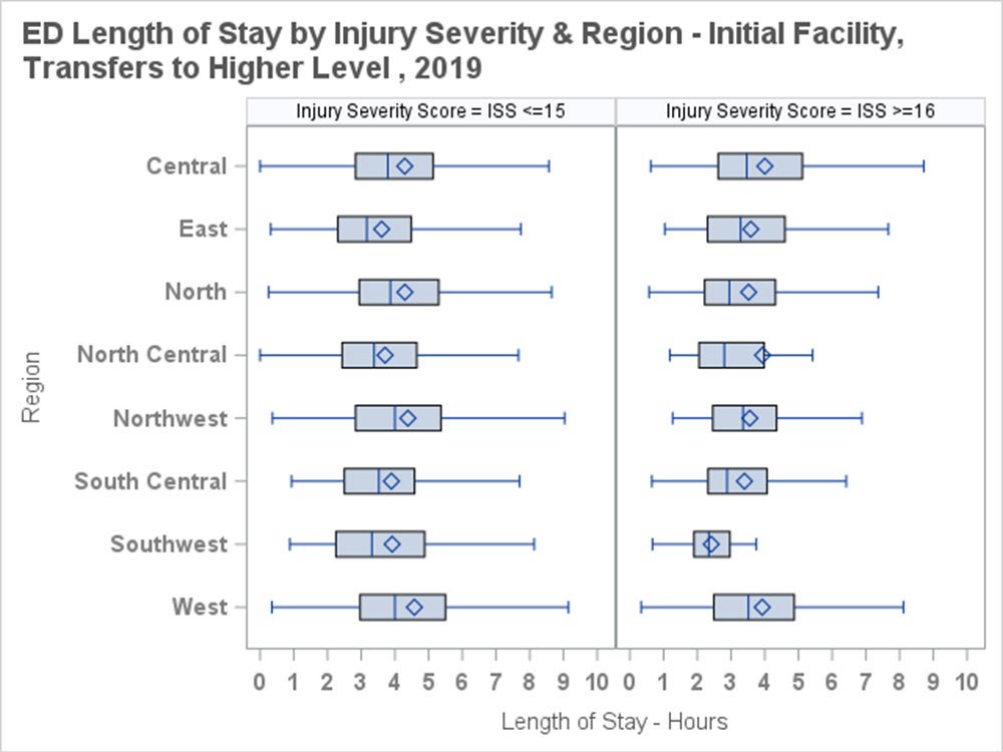



*Figure 36 Regional Emergency Department Length of Stay at Initial Facility, Patients Transferred to Higher Level of Care, by ISS[2]*

Figure 37 shows the time from the first EMS unit notified by dispatch until the time of arrival at the definitive trauma facility, or the highest level of care to which they are transferred. These times combine time to first trauma facility, the length of stay at the initial facility or facilities, and the EMS transports to their definitive trauma facility. In 2019, the statewide average time to definitive facility was 85.6 minutes. The counties with a time to definitive trauma facility of greater than 120 minutes were the largely those with only level 4 or 5 trauma centers or were geographically isolated from the nearest level 2. These averages include both patients who were transferred to a higher level of care and those who remained at their initial facility. Time to definitive care increases substantially when patients are transferred. (Figure 40)

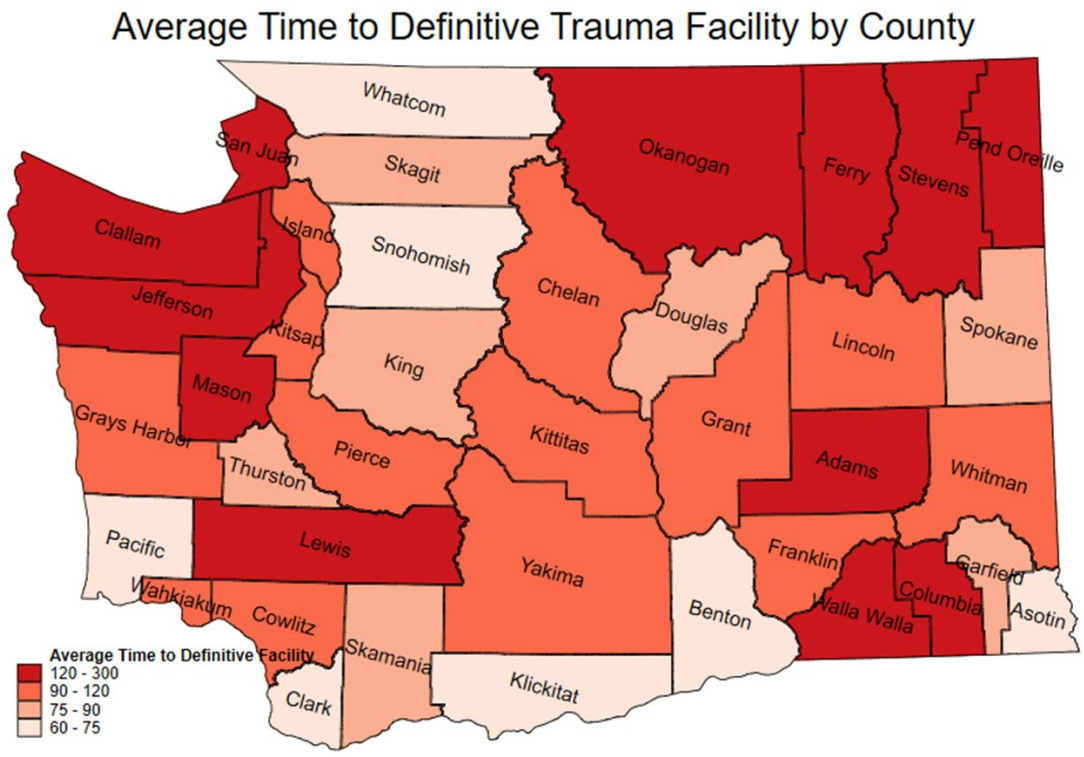



*Figure 37 Average Time to Definitive Trauma Facility by County*[2,3]

Figure 38 shows the average time to definitive trauma facility by ISS. While patients with an ISS of 15 or lower reach their definitive care facility on average in 80 minutes, patients with an ISS of 16 or higher reach their definitive trauma facility in 124 minutes. This is likely due to higher severity trauma patients being more likely to require transfer to a higher level of care.

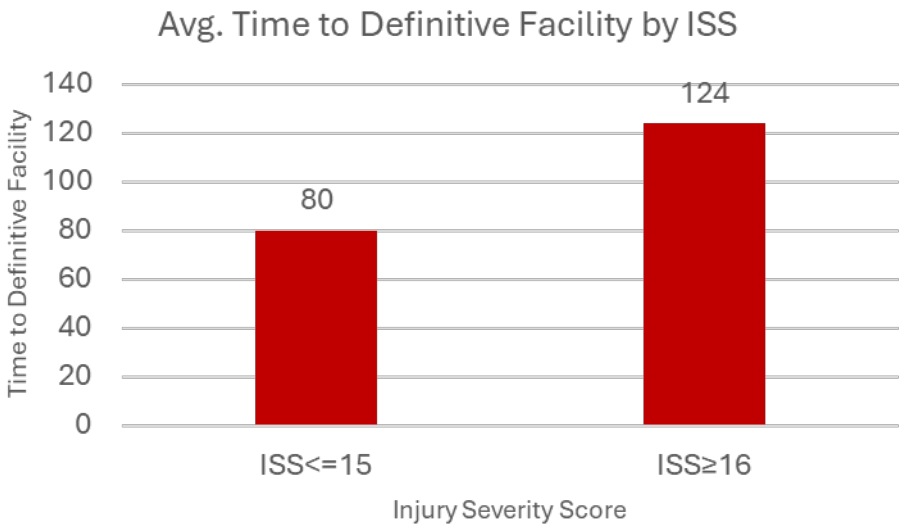



*Figure 38 Average Time to Definitive Trauma Facility by Injury Severity Score*[2,3]

The increased time required to transfer to higher levels of care is highlighted in figure 39, which shows the average time to definitive care by the level of the definitive trauma facility. While patients whose definitive trauma facility is a level 5 reach that facility in 47 minutes on average, patients whose definitive trauma facility is level 1 reach that facility in 163 minutes on average. Longer times to definitive care at higher level facilities (levels I and II) can in part be explained by the higher volume of patients transferred to these facilities to receive a higher level of care and the more dispersed locations of these facilities across the state. Another contributing factor to time to definitive care is the need to transfer a patient out of the region of injury. Patients transferred out of region have a longer average time to definitive care compared to those transferred within their region. Patients transferred in from another facility have a longer average time to definitive care due to the inclusion of patients being transferred from non-designated facilities. Average transfer times for facilities transferring a patient out are restricted to transfers between designated trauma facilities. (Figure 40)

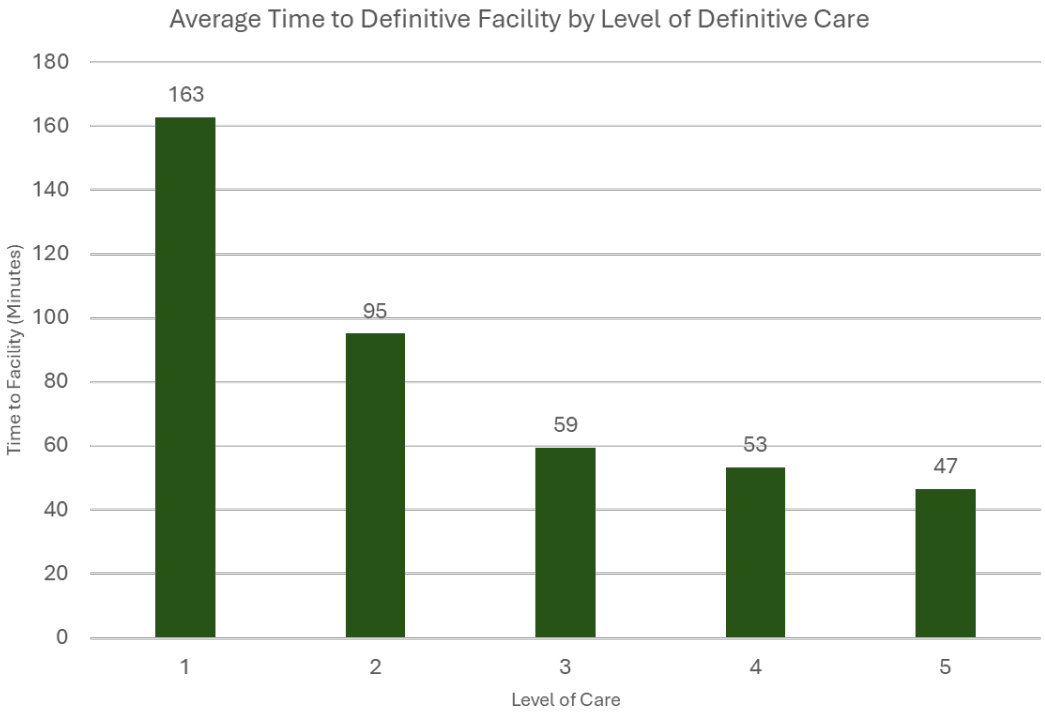



*Figure 39 Average Time to Definitive Facility by Facility Level of Care[2,3]*

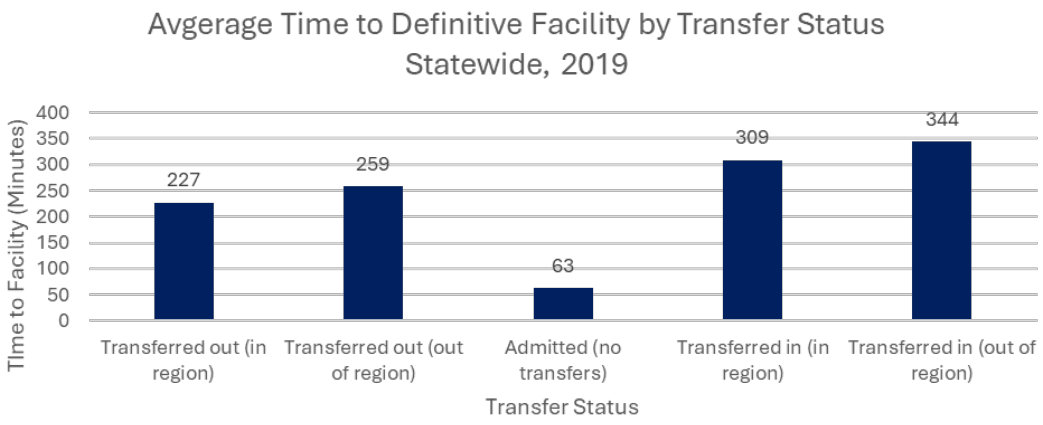



*Figure 40 Average Time to Definitive Facility by Transfer Status*[2,3]

## Outcomes:

Overall, after adjusting for age, in-hospital mortality rates among trauma patients have been in a slight decline between 2009 and 2019.

Risk adjusted in-hospital mortality showed little to know differences between facilities and between facilities, though one higher level center was found to have lower than average mortality while one level III center was found to have higher than average.

### Key Question: Is the Washington state trauma system reducing mortality in injured patients?

#### *Mortality Patterns*

In 2019, in-hospital mortality among Washington trauma patients was overall more common in males than females across all age groups except for the 85+ years where the distribution was equal in both sexes. (Figure 41)

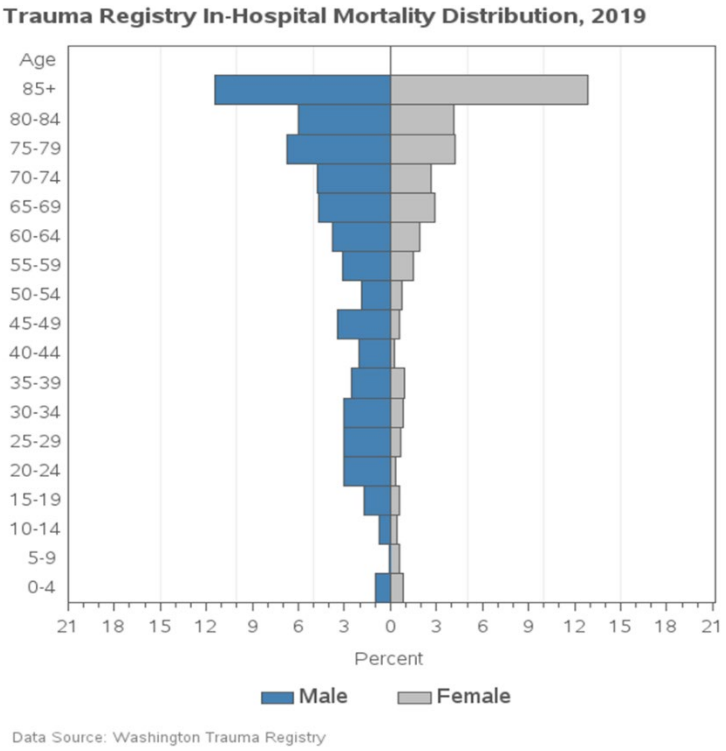



*Figure 41 Trauma Registry In-hospital Mortality Distribution, 2019*[2]

Over a 10-year period from 2009 to 2019, age-adjusted trauma mortality rates have been relatively constant ranging between 2 and 3 per 100 patients with a slight decline over time in Washington. (Figure 42)

Age-adjusted mortality rates have been higher for males compared to females over the same period, 2009 to 2019. (Figure 43)

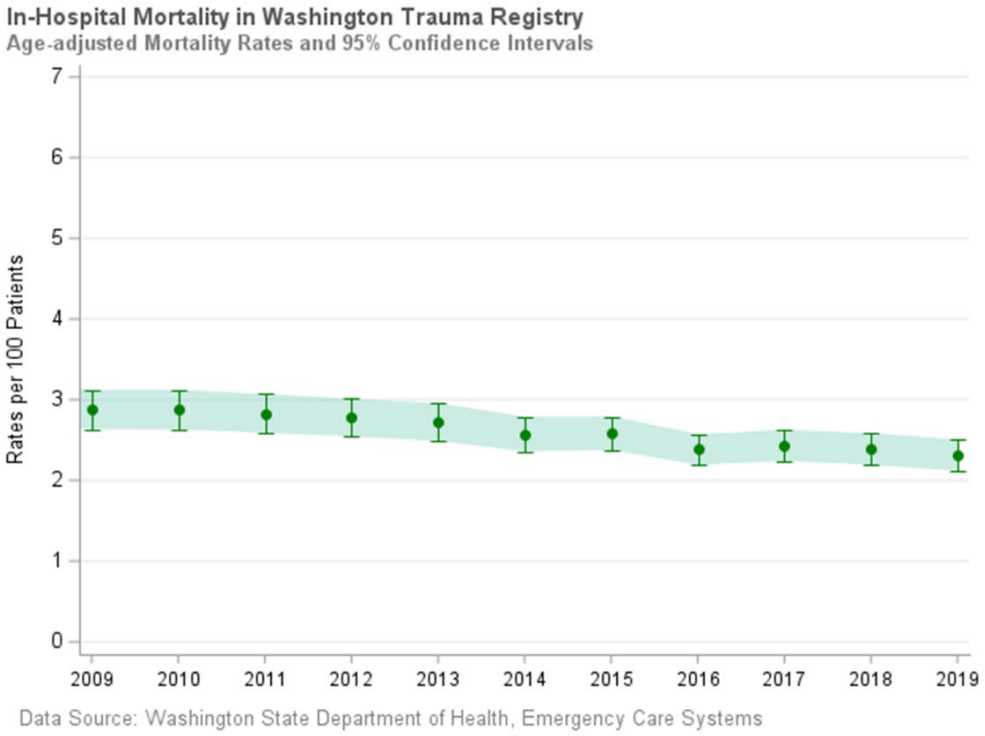



*Figure 42 In-hospital Mortality in Washington Trauma Registry (Age-adjusted Rates), 2019[2]*

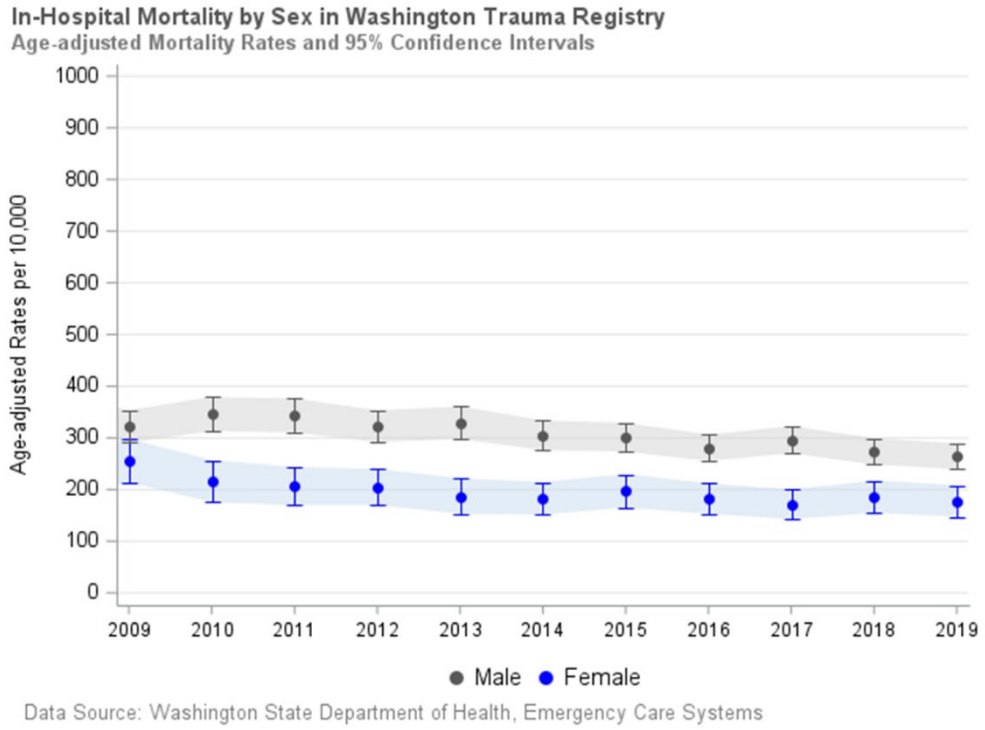



*Figure 43 In-hospital Mortality in Washington Trauma Registry (Age-adjusted Rates by Sex), 2019[2]*

*Risk Adjusted Mortality*

Figure 44-46 show the risk-adjusted mortality odds ratios (OR) for each facility at level I & II, level III, and level IV & V adult trauma centers relative to all the facilities combined at the same level. The method used to adjust for risk is based on that used by the American College of Surgeons (ACS) Trauma Quality Improvement Program (TQIP). Adjusting for risk is important in comparing mortality between facilities who may see varying levels of severity among their patient populations. By adjusting for risk, the mortality odds ratios become a better measure of the quality of care. Across regions and facilities, the results indicate a consistent quality of care, though one facility shows lower odds of in-hospital mortality and one shows higher odds compared to the average of similar level trauma centers.

The OR for each facility indicates the odds of in-hospital mortality in the facility compared to all the facilities combined at the same level. An OR above 1 indicates that the odds of in-hospital mortality in the facility is higher than average and an OR below 1 indicates that the odds of in-hospital mortality in the facility is lower than average in the same level. If the confidence interval for the estimate OR is completely above/below the reference line (OR=1), it indicates the odds of in-hospital mortality in the facility is significantly higher/lower than the average (alpha=0.05). The variables considered for risk-adjusted mortality modeling include age, sex, race, ISS, body region, pre-existing conditions, transfer status (admitted or transferred in), initial GCS motor, initial pulse, initial SBP, and mechanism of injury.

Among Levels I & II facilities, one facility showed a statistically significantly lower odds of in-hospital mortality compared to all the facilities combined. (Figure 44)

Among level III facilities, one facility showed a statistically significantly higher odds of in-hospital mortality compared to all the facilities combined. (Figure 45)

Among levels IV&V facilities, no statistically significant difference in odds of in-hospital mortality in each facility compared to all the facilities combined. (Figure 46)

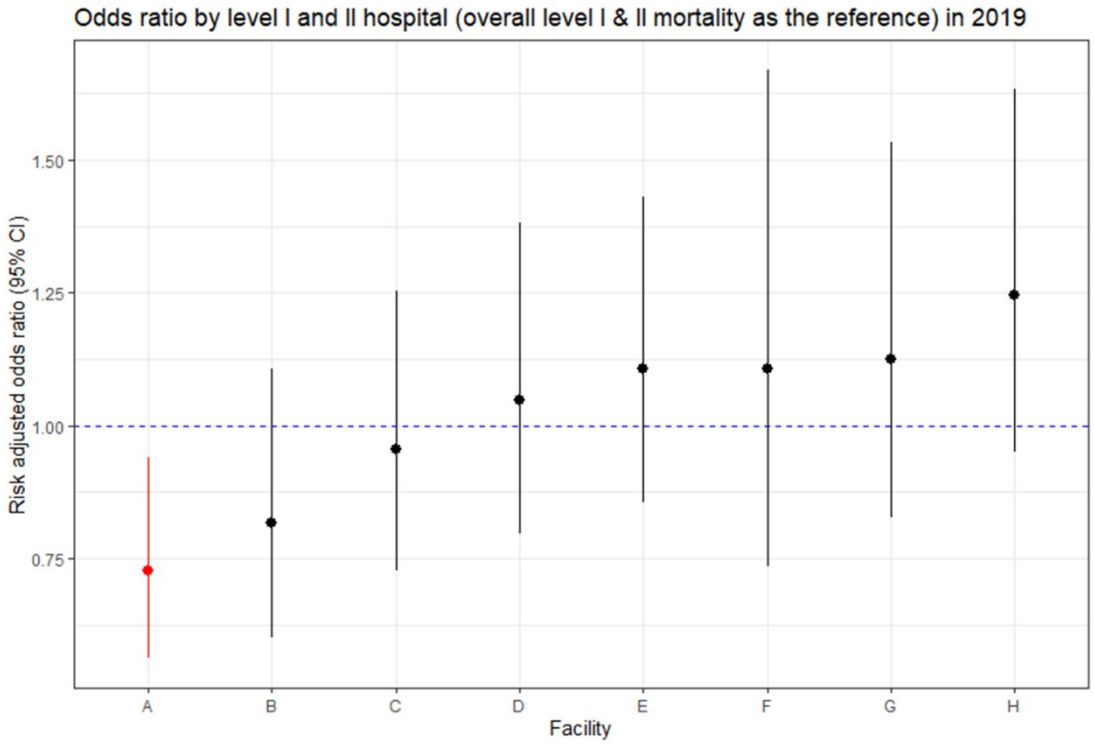



*Figure 44 Risk-adjusted Mortality in Washington Trauma Registry, Levels I &II Trauma Centers, 2019[2]*

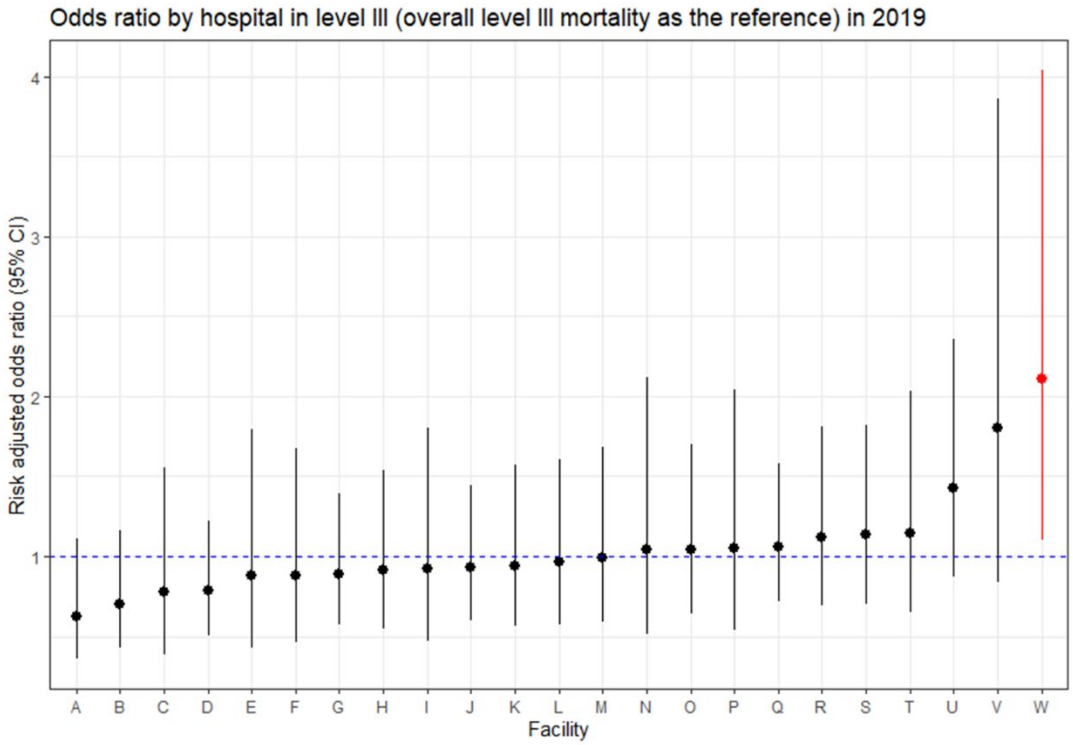



*Figure 45 Risk-adjusted Mortality in Washington Trauma Registry, Level III Trauma Centers, 2019[2]*

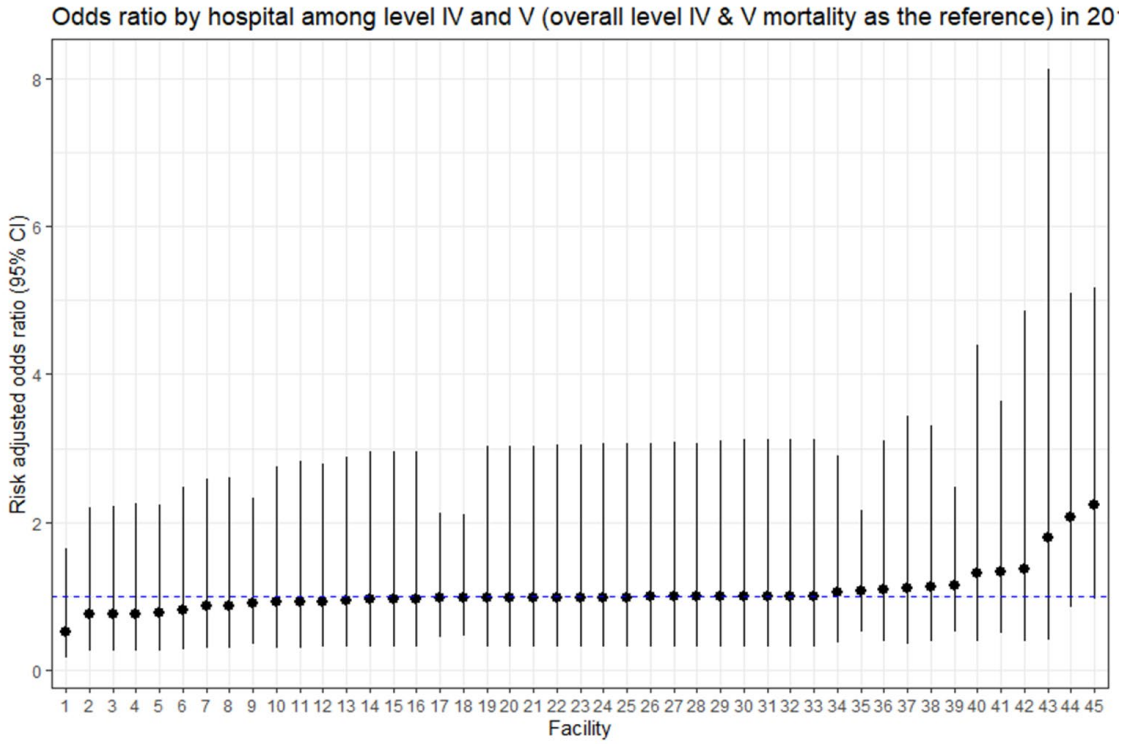



*Figure 46 Risk-adjusted Mortality in Washington Trauma Registry, Levels IV & V Trauma Centers, 2019*[2]

# Cost of Care

## Summary

Overall health care costs in Washington and nationally continue to rise at rates higher than inflation, impacting the ability for individuals to pay for services and access the care they need. Understanding how any change to the health care system, including a change in trauma designation for a facility, impacts the cost of care across the system, including non-trauma services, is an important factor to review when assessing trauma designation levels.

## Key Question: How does a changing trauma system affect costs in the overall healthcare system?

**DRAFT NOTE: The final trauma assessment issued in September 2024 will include analysis of the impact on costs to the health care system due to changes in facility trauma designation.**

# Regional Planning Guidance

The Washington Trauma System currently has 84 designated trauma centers across eight EMS and Trauma Regions. (Figures 1 and 2) Each region convenes an EMS and Trauma Care Council, responsible for maintaining regional EMS and trauma care plans, which among other purposes, are intended to assess and analyze regional needs around care and resources, and to establish the number and level of trauma centers to be designated in the region based on the availability of resources and distribution of trauma within the region. The Trauma Services Assessment is intended as an aid to regional councils, in identifying and planning for these needs. Regional councils are advised to use this report to support data-driven decisions and planning around regional care and resource needs, including those described in their biennial regional EMS and trauma care plans.

The data contained in this assessment is publicly available and does not contain any information considered confidential under RCW 70.168.090. For this reason, the information provided in this assessment may not be as detailed as is needed to adequately assess the need for changes to the minimum and maximum number of trauma centers needed in a region. To address this, each region may request additional data and information from the Department regarding confidential statistics for their region. Confidential data may only be provided to regional EMS and trauma quality assurance (QA) programs, which are confidential settings protected by statue (RCW 70.168.090). EMS and Trama Care Councils are advised to request this review of confidential data by their QA programs and receive advisement on trauma service needs in their regions based on this.

## Assessing the need for minimum/maximum number of trauma centers

It is recommended that each Regional Council and QA program use this report as well as the suggested questions listed below to guide them in determining the minimum and maximum number of trauma services needed in their region. Department staff in the EMS and Trauma Program are available to provide additional ongoing data and analytic support, including examining and sharing confidential data and information about care in a region with regional QA program.

### If a trauma center were added or had a change in designation:

*What is the potential impact on trauma volume to neighboring trauma centers?*

How many patients are transferred from the existing center to neighboring centers?
How many patients are transferred out of the region?
How many patients are transferred to a level I? Level II? Level III?

*What is the potential impact on timely care delivery for patients?*

Will patients likely arrive at their initial care facility in a shorter or longer time?
How many patients are currently transferred from the facility to the level of care being proposed as a designation change?

*What is the potential impact to patients and family burden?*

How many out of region transfers are transferred more than 60/80/100 miles from the initial care facility?
What is the average length of stay for patients transferred more than 60/80/100 miles from the initial care facility?

*What is the impact on trauma patients going to non-designated facilities?*

How many trauma patients are transferred within the region from a non-designated facility to a designated facility?

How many of these patients go to which level of centers?

*What is the impact on diversion?*

How might the number of times current centers go on divert change?

# Considerations for future assessment topics

Additional topics have been identified as important for consideration in this assessment but have not been included in this version to-date due time or data limitations. Those areas of focus are expected to be included later. Each of these areas are described below.

## Equity:

### Key Question: Are trauma services accessible equitably across the state and within regions?

At the time of release of the draft WA Trauma Services Assessment, analysis of data to explore impacts to equity had not yet been conducted. This area is planned for the final version of the report and will consider the following questions:

A) Does access to trauma services differ by race/ethnicity, rurality, or socioeconomic status?
B) Does the under-triage rate differ by race or other sociodemographic groups?
C) Do those in occupations with higher risk of injury have equitable access to timely trauma care?
D) What are the health disparities in Washington that may be influencing timely access to care following injury?
E) What are the impacts of transfer distance on health equity?
    a. How does length of stay exacerbate these impacts?

## Bed/Staff Capacity:

### Key Question: Do trauma centers have the resources to adequately meet the demand for care?

Though data limitations prevent inclusion of this topic in the 2024 iteration of the WA Trauma Services Assessment, both the bed and staff availability to support trauma care in WA designated trauma centers is an area of analysis that may be explored in future iterations, pending data availability.

## Emergency Preparedness:

### Key Question: How does the WA Trauma System contribute to emergency preparedness and what is the current capacity of Trauma Services to fulfill this need in the state?

Emergency Preparedness was not included in the scope of this project and will be considered in future iterations of this assessment. Department EMS and Trauma program staff will collaborate with Department Emergency Preparedness staff as well as stakeholders to guide development of this area.

## Cost of Care:

### Key Question: How does the accessibility of trauma services impact the cost of care to the patient?

This assessment has addressed the impact of the makeup of the trauma system on cost of care to the patient through review of the existing literature. In future iterations of the assessment, it is intended to look further at costs and factors specific to Washington State through secondary data sources.

## Conclusions

The Washington Trauma Services Assessment investigates the demand, accessibility, timeliness, quality, and cost of Trauma Services in Washington State. Key findings from the assessment are summarized here:

1) The population of Washington State is growing, representing a potential increase in trauma incidents and demand on trauma services statewide.
2) Trauma incidents are increasing more rapidly than the population, reinforcing the likely need for increased availability of services in future years.
3) Trauma services have not varied greatly over the past 10 years, despite a continually increasing patient volume.
4) Some level of trauma services (Level I thru V) is accessible to most Washingtonians within 60-minutes, though fewer have access to higher levels of care (Levels I and II) within 30 minutes, as is prescribed in the Washington State Trauma Triage Guidelines for severe trauma.
5) The average time to initial trauma care across the state is approximately 60-minutes, while definitive care is reached on average in 85 minutes. While these times are consistent with current benchmarks, there is variation across regions where geographic distances from higher levels of care pose a possible barrier to efficient care delivery.
6) In-hospital mortality has been slightly decreasing, with little variation between facilities across the state, demonstrating a consistency in quality of care throughout the trauma system.

**DRAFT NOTE: Conclusions provided in this section are intentionally high-level. The final trauma assessment issued in September 2024 will include a complete conclusions section.**

# Appendix

## A. Glossary of terms

- *Trauma incident:* Trauma incidents is an important measure to understand the precise injury count the trauma system must address. To avoid overestimating the injuries in the state, trauma incidents represent a count of the total individual patient incidents in the trauma registry. Therefore, when measuring incidents, a trauma case is counted only once, regardless of the number of times the patient was transferred to other trauma centers.

- *Trauma volume:* Trauma volume is an important measure to understand the demand on each designated trauma center. To avoid underestimating the injuries burden and hospital demand in the state trauma system, Trauma volume represents a count of each patient/hospital interaction. Therefore, when measuring volume, a trauma case is counted twice if the case has been transferred to a second facility or three times if the case has been transferred to a third facility, and so on. This is opposed to the measure of trauma incidents, which would count the transferred patient only once.

- *Trauma incident rate:* Trauma incidents per 100,000 population.

- *Injury Severity Score (ISS):* A scoring system for assessing multiple injuries on a scale from 0 (least severe) to 75 (Most Severe, not survivable). A core of 16 or higher is considered a major or severe injury.

## B. Data Sources

1.) Washington State Office of Financial Management, Population Data, 2024
2.) Washington State Department of Health, Washington Trauma Registry, 2019
3.) Washington State Department of Health, Washington Emergency Medical Services Information System (WEMSIS), 2024

## C. Literature Summary

### Review of Literature related to Trauma System Assessment

The Washington State Trauma System was established to ensure timely and appropriate delivery of emergency medical treatment for people with traumatic injury. Designated trauma centers (trauma services) provide emergency lifesaving trauma care throughout the state. The Trauma System, access, outcomes, and resources must be evaluated to ensure community needs are met.

This literature review aims to summarize current research and highlight methodologies to inform the Trauma System Needs Assessment. It is divided into common themes found in literature.

The methods of assessing trauma systems range from simplistic, resource-based approaches to more complex iterative spatial optimization. Comprehensive resource or regional based models, such as that presented by Nathens et al., analyzed trauma system access across 18 states (including Washington) by comparing statistics across qualitative boundaries. This method is useful for identifying disparities in discharge rates, bed-use, or trauma centers per capita. It also considered treatment in non-designated

trauma centers of which Washington has several in urban areas. This study, although aging, should be considered as a reference that could add value to the WA needs assessment.

## Needs-Based Assessment of Trauma Systems (NBATS)

The American College of Surgeons (ACS), Needs-Based Assessment of Trauma Systems (NBATS) model, involves attributing points based on Trauma Service Area (TSA) characteristics that identify need. These characteristics include TSA population, median transport times, organization support, volumes of severely injured (ISS>15), patients at non-designated trauma centers, current presence of level I trauma centers, and volumes of severely injured patients at level I and II trauma centers. The assigned points are then translated into recommendations for between one and four trauma centers within the TSA.

In a 2017 study, Uribe-Leitz et al. compared the results of the NBATS model from three California trauma data sources – trauma registry, EMS data, and a survey of local EMS agencies. The model recommendations varied widely from the allocation of trauma centers at the time. In 70% of urban TSAs, the NBATS recommendations were lower than the current number of trauma centers. Meanwhile, the model suggested increasing trauma centers in 88% of rural TSAs. There would probably be similar results in Washington given the number of rural areas in the state.

Focusing instead on injured populations, Dooley et al. used an altered version of NBATS, called NBATS-2, to assess potential coverage increases around Memphis, TN, utilizing GIS software. The authors selected trauma center candidate hospitals near an existing level I trauma center. Designating an additional level I center nearby the existing center increased coverage within 45 minutes of both injured and total populations by only 1%, while decreasing volume at the existing center by 40%. On the other hand, designating two additional level I trauma centers in rural areas outside of the range of the existing center increased coverage within 45 minutes by at least 13%. While the NBATS-2 method can estimate the impacts to access and existing centers' volume when establishing a new trauma center, the selection of the new trauma center was done subjectively. Further work could repeat this process to select the location that maximizes access. This study and methods should be considered to gauge the impact in Washington and help with decision-making if a facility requests a higher designation near another facility of the same level.

More recently, Dalton et al., used the NBATS tool to evaluate the existing trauma infrastructure across the nation to identify geographical regions in need of additional trauma centers. This study did not fully implement all the components of the NBATS assessment and were unable to obtain "stakeholder support" from all areas across the nation. As a result, they automatically gave each trauma service area full stakeholder support and awarded the full (5) points for that category. There may be a similar issue in identifying stakeholder support here in WA. For that reason, this study and its methodology may be helpful in implementing NBATS into the WA needs assessment.

## Access / Geospatial Analysis

Current research on trauma hospital access and trauma center locations is heavily focused on using geospatial analysis and calculating time from injury to arrival at a trauma center.

Branas developed the Trauma Resource Allocation Model for Ambulances and Hospitals (TRAMAH) which was an early attempt to incorporate geographic location of injuries into the assessment of trauma

system access. TRAMAH was used to maximize access to trauma centers of Maryland trauma cases, derived from hospital discharge data. The model allowed assessment of either an area without trauma centers or an existing trauma system. At the time, Maryland had 9 existing trauma centers, covering 70% of observed severe injuries within 15 minutes. Optimally replacing 2 of these trauma centers increased coverage by nearly 7%. Though TRAMAH represented a more objective method of selecting trauma center locations, the computational requirements make replication difficult.

TRAMAH was later adapted by Branas to analyze the overall trauma access in 18 states. As of 2005, "an estimated 69% and 84% of all US residents had access to a level I or II trauma center within 45 and 60 minutes, respectively." However, nearly 47 million Americans, mostly in rural areas, had no access within 60 minutes. Similarly, Winchell et al. analyzed access to trauma centers by the overall population but include the addition of trauma hospitals to a hypothetical situation where no trauma centers exist. Once an optimally placed trauma center exists, adding another optimally placed center increased access by 14%, with a 14% decrease in trauma volume at the existing center. Adding a third center increased access by another 4% while further decreasing volumes at the initial center.

A 2014 Pennsylvania (PA) report on trauma needs noted five criteria (access, volume and outcome, population, and injury distributions, staffing availability, and healthcare finances) which spurred research on optimal trauma center placement methods in PA. Horst et al. analyzed all possible configurations of the trauma system from a set of candidate trauma centers and provides a number of options that maximize coverage within a set travel time. The approach estimates the maximum attainable level of trauma center access, as well as optimal reconfiguring of current trauma resources. For example, the Horst model determined that PA could achieve the same level of access of the 27 existing trauma centers in 2015 by optimally placing only 22 centers. Conversely, adding between one and six trauma centers would increase coverage of trauma incidents within one hour from 91% to 96%, though higher additions would significantly reduce average trauma center volume.

Regional trauma system design aims to identify the most severely injured patients and directs them to the highest levels of care. As such, most studies focus on access to level I and II trauma hospitals for patients with injury severity scores (ISS) greater than 15. While this approach presents an aggregate analysis of severe trauma cases, it does not allow for separate recommendations for level I and II hospitals. The Geospatial Evaluation of Systems of Trauma Care (GEOS) model by Jansen represents a step toward providing objective recommendations for multiple levels of care. Like the Horst model, GEOS analyzes all possible configurations of the trauma system, given a set of candidate trauma centers. However, GEOS assumes a triage approach to separate the most serious trauma patients using recommendations from the 2012 National Expert Panel on Field Triage recommendations by Sasser et al. GEOS then prioritizes coverage of the most severe trauma patients by level I or "major trauma center" access, followed by coverage of other severe trauma cases at level II and III trauma centers. Furthermore, GEOS ignores possibilities where level I centers do not achieve a minimum threshold of severe trauma patients. Jansen's research in 2014, 2015, and 2018 proved the results of the GEOS can be applied to reconfigure existing trauma systems or establish a new trauma system. However, the GEOS model is limited due to being computationally cumbersome and requiring a standard triage method.

Two model inputs commonly vary within models to allow for sensitivity analysis – travel time from the injury location to the trauma center and a minimum volume threshold. Branas's TRAMAH model used considerably shorter travel times of 15 and 30 minutes, while Horst et al. considered access from 45 to 120 minutes. Medrano et al. in the MIMIC study adapted a four-component definition for total prehospital time, which includes activation, response, on-scene, and transport intervals. They defined timely access to care as the ability to reach a trauma center within 60 minutes via ground MES or helicopter EMS locations. A recent geospatial study from Patal et al., developed an association between access to trauma centers (level I-III) and traffic fatalities which demonstrated a positive relationship between delayed access and higher mortality rates following motor vehicle crashes. Predicted access times were operationalized into categories by 15-minute increments (<15, 15-30, 30-45, 45-60, or ≥60). The most commonly compared travel times in all the studies were from 45 to 60 minutes.

A recent study by Medrano et al. and the MIMIC study group was conducted in five states, including Washington, and used GIS and a system-based model that incorporates the entire trauma response to more accurately estimate present and future needs using prehospital time intervals. The author's aim was that the study be used as a blueprint for creating an assessment to better determine geographical gaps and seek to identify optimal location for additional level I and II trauma centers. In 2020, the same MIMIC study group also completed a GIS Mapping Model of Washington State "Washington State Access to Care" using the same methodology as described above. Both of these studies and there methodologies may be helpful to the WA needs assessment.

Another example of Washington State GIS mapping to assess access to trauma centers can be found in the 2019 ACS Washington State Trauma System Consultation Report, starting on page 60. The report uses 60-minute ground transport time and differentiates between all levels. It highlights limited access to level I and II trauma centers, especially in the central and far western parts of the state. The specific methodology details are not included.

The determination of injury location is also a model specification worth considering. With the optimal data, the precise geolocation of incident sites would be used in determining access. However, this approach is not feasible with information available in most trauma-related datasets. As a result, most models use the zip code area centroid of the patient's address as a proxy for incident location. [4, 7, 9, 10] Though occasionally limited by missing location information, only the GEOS model involved analysis by exact incident location. Also, none of the papers considered here incorporate changes in population over time, changes in population density, or volume limits of existing trauma centers.

## Trauma Volume

The impacts on patient volumes of established trauma centers are a common concern expressed in the trauma designation literature. Studies from Tempas and Ciesla concluded that establishing a new trauma center may reduce the volumes of nearby trauma centers, especially if trauma cases are trending downward, and may increase trauma staffing costs. In a second study, Tempas concluded that new trauma designations may also impact triage performance and redistribute trauma volume. Beyond the potential impacts to the financial feasibility of the trauma system, Ogola, Haider, and Shafi discovered that decreases in trauma patient volume are generally considered to worsen mortality rates, however, the design of the research may affect the conclusions of these studies.

As a result of volume concerns, advanced trauma system assessment models include restrictions to ensure level I centers treat a minimum number of severely injured trauma patients each year. These

thresholds range in Jansen's studies from 240 to 650 severely injured admissions. The ACS Committee on Trauma recommends that level I trauma centers admit a minimum of 1200 trauma patients annually or a minimum of 240 admissions of severely injured (ISS>15) patients. Similarly, Ogola et al. suggest the mortality rate in hospitals treating less than 688 emergency general surgery (EGS) patients was 5%, while the rate at hospitals treating more than 688 EGS patients was 2%. Though results such as this may be influenced by study design, it is important that researchers consider the implications of volume in designing trauma system assessment models.

A systematic review conducted by Sewalt et. al, aimed to evaluate the relationship between hospital and surgeon volume and health outcomes in severely injured patients. They identified eighteen cohort studies conducted from 1980 to 2018. The majority (13) of the studies concluded a positive relationship between higher hospital or surgeon volume and lower mortality rates. Their work confirmed that the ACS requirement for level I facilities to admit at least 240 severely injured patients (ISS > 15) was in fact associated with lower mortality rates.

There was no research discovered which demonstrated whether there was a relationship between high volume centers who are over capacity and increased mortality rates.

## Mortality

Risk adjusted mortality models are widely used to assess individual trauma center performance. This is often reported in the American College of Surgeons Trauma Quality Improvement Program (TQIP) risk adjusted benchmarking reports. A retrospective cohort study by Wiebe was conducted in Pennsylvania using the TQIP methodology to perform a statewide morality assessment. The results concluded it is feasible to apply the methodology to statewide assessment efforts and can be used to explore characteristics of trauma centers, patients, and other factors including geography that may influence trauma center performance.

## Summary

A report from the Pennsylvania Trauma System Foundation concluded that trauma system design should consider five areas – access, volume and outcome, population, and injury distributions, staffing availability, and healthcare finances. Similarly, the ACS-COT included in their Revised Statement on Trauma Center Designation, that trauma system needs should be assessed using measures of access, quality, population mortality rates, and trauma system efficiency. These recommendations should be used as the foundation for the WA needs assessment. The criteria of staffing, financing, and community support may initially be outside the scope of assessment until a means to collect this data is available.

Most current literature related to trauma system designation and access is based on geospatial analysis. The WA needs assessment should certainly include GIS mapping to highlight timely access to higher levels of care following injury. The time scales most frequently used from the time of injury to arrival at the trauma center are 45 and 60 minutes. Consideration should be given to using 15-minute increments from <15 minutes to > 60 minutes to demonstrate a more complete picture.

The WA needs assessment should also consider the admission volume of severely injured patients at each facility and be aware of the potential consequences if facility volumes are too low or drop below

the ACS-COT recommendation of 240 annually severe trauma admissions. In addition, there should be consideration given in the assessment to population and trauma centers per capita. There may also be a need to measure the number of trauma patients treated at non-designated trauma centers.

Lastly, the goal of any trauma system is to prevent mortality and limit disability following injury. Understanding the state and regional mortality rates would add value to the WA needs assessment. Risk adjusted mortality reports are used in the ACS-COT Trauma Outcomes Quality Improvement Program which is considered a world leader in trauma assessment.

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## D. Data Tables

### Tables of data contained in figures from report.

1) Population by state, region, and county
2) Trauma volume by state, region, and county
3) Injury by state, region, and county
4) Drive time to a trauma center by state and region
5) Patients transfers
6) Time to care by state, region, and county
7) Emergency Department length of stay by state, region, and county
8) In-hospital Mortality distribution by sex, state, and region

9) Age-adjusted mortality by year, sex, state, and region
10) Risk adjusted mortality odds ratios

## E. Central Region data figures and tables

1) Population by state, region, and county
2) Trauma volume by state, region, and county
3) Injury by state, region, and county
4) Drive time to a trauma center by state and region
5) Patients transfers
6) Time to care by state, region, and county
7) Emergency Department length of stay by state, region, and county
8) In-hospital Mortality distribution by sex, state, and region
9) Age-adjusted mortality by year, sex, state, and region
10) Risk adjusted mortality odds ratios

## F. East Region data figures and tables

1) Population by state, region, and county
2) Trauma volume by state, region, and county
3) Injury by state, region, and county
4) Drive time to a trauma center by state and region
5) Patients transfers
6) Time to care by state, region, and county
7) Emergency Department length of stay by state, region, and county
8) In-hospital Mortality distribution by sex, state, and region
9) Age-adjusted mortality by year, sex, state, and region
10) Risk adjusted mortality odds ratios

## G. North Region data figures and tables

1) Population by state, region, and county
2) Trauma volume by state, region, and county
3) Injury by state, region, and county
4) Drive time to a trauma center by state and region
5) Patients transfers
6) Time to care by state, region, and county
7) Emergency Department length of stay by state, region, and county
8) In-hospital Mortality distribution by sex, state, and region
9) Age-adjusted mortality by year, sex, state, and region
10) Risk adjusted mortality odds ratios

## H. Northwest Region data figures and tables

1) Population by state, region, and county
2) Trauma volume by state, region, and county

3) Injury by state, region, and county
4) Drive time to a trauma center by state and region
5) Patients transfers
6) Time to care by state, region, and county
7) Emergency Department length of stay by state, region, and county
8) In-hospital Mortality distribution by sex, state, and region
9) Age-adjusted mortality by year, sex, state, and region
10) Risk adjusted mortality odds ratios

## I. North Central Region data figures and tables

1) Population by state, region, and county
2) Trauma volume by state, region, and county
3) Injury by state, region, and county
4) Drive time to a trauma center by state and region
5) Patients transfers
6) Time to care by state, region, and county
7) Emergency Department length of stay by state, region, and county
8) In-hospital Mortality distribution by sex, state, and region
9) Age-adjusted mortality by year, sex, state, and region
10) Risk adjusted mortality odds ratios

## J. Southwest Region data figures and tables

1) Population by state, region, and county
2) Trauma volume by state, region, and county
3) Injury by state, region, and county
4) Drive time to a trauma center by state and region
5) Patients transfers
6) Time to care by state, region, and county
7) Emergency Department length of stay by state, region, and county
8) In-hospital Mortality distribution by sex, state, and region
9) Age-adjusted mortality by year, sex, state, and region
10) Risk adjusted mortality odds ratios

## K. South Central Region data figures and tables

1) Population by state, region, and county
2) Trauma volume by state, region, and county
3) Injury by state, region, and county
4) Drive time to a trauma center by state and region
5) Patients transfers
6) Time to care by state, region, and county
7) Emergency Department length of stay by state, region, and county
8) In-hospital Mortality distribution by sex, state, and region
9) Age-adjusted mortality by year, sex, state, and region
10) Risk adjusted mortality odds ratios

## L. West Region data figures and tables

1) Population by state, region, and county
2) Trauma volume by state, region, and county
3) Injury by state, region, and county
4) Drive time to a trauma center by state and region
5) Patients transfers
6) Time to care by state, region, and county
7) Emergency Department length of stay by state, region, and county
8) In-hospital Mortality distribution by sex, state, and region
9) Age-adjusted mortality by year, sex, state, and region
10) Risk adjusted mortality odds ratios