Report to the Legislature

Emergency Cardiac and Stroke System Assessment

October 2023

Chapter 58, laws of 2022

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This report was made possible by the valuable contributions of the Emergency Cardiac and Stroke (ECS) Evaluation Workgroup and the many other EMS and hospital partners who provided data.

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The report presented here would not be possible without the time and wisdom of the Emergency Cardiac and Stroke (ECS) Evaluation Workgroup and the many other EMS and hospital stakeholders who provided data for this evaluation.

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The evaluation team would also like to acknowledge the following state leaders who contributed their expertise and insight: David Vrudny (Stroke/STEMI Section Chief for Arkansas Department of Health); Melissa Ball (Program Manager, Idaho Time Sensitive Emergencies System); Adam Harrel (Associate Director for Virginia Department of Health), Dolly Fernandes (Director, Emergency Care Systems Section, WA Department of Health); Jim Jansen (Health Systems Data and Research Manager, WA Department of Health); Catie Holstein (Director, EMS WA Department of Health); Matt Nelson (EMSC/ECS Program Manager, WA Department of Health).

Executive Summary

Ischemic heart disease and stroke account for 1 in 4 deaths in Washington state and an estimated 220,519 years of life lost due to premature death or disability.[1] These conditions are time-sensitive and benefit from strong regionalized systems of care, which have been shown to improve patient outcomes and lower health spending.[2–4]

Since the implementation of the emergency cardiac and stroke (ECS) system in Washington, more than 90% of hospitals have been certified as a cardiac center and/or stroke center and nearly all EMS agencies have adopted state prehospital patient care procedures. However, numerous challenges remain that limit the effectiveness of the system.

Chapter 58, Laws of 2022 directed the Washington State Department of Health (department) to contract with an independent party to evaluate the state's current system for cardiac and stroke emergencies and provide recommendations to the legislature for ways in which the current system might be improved.

Evaluation Methods

The department contracted with the University of Washington (UW) to complete the evaluation. The evaluation was a ten-month, mixed-method process consisting of three phases to assess the current systems of ECS care, which included convening a state ECS workgroup of different organizations required by SB 5821 to provide input. Evaluation methods included comprehensive document review, key informant interviews, EMS and hospital surveys, and outcomes and capacity evaluation, resulting in a gap analysis and recommendations for improving the system.

System Gaps

Current treatments for heart attack and stroke are some of the most effective in medicine when performed within a short period of time from symptoms onset. However, Washington falls behind many other states and the U.S. in timely access to these interventions.

The evaluation uncovered several fundamental gaps that are currently hindering system effectiveness: lack of an overarching strategy for data collection to support evaluation of ECS system performance, lack of system infrastructure and quality improvement standards, limited hospital capacity and access to specialists, and EMS capacity and staffing challenges. These findings suggest opportunities for Washington to substantially improve the health of its residents by investing in a robust and sustainable ECS system.

Summary of Recommendations

Gap/Challenge	Recommendations
I. Lack of Data Infrastructure	1. Establish and maintain a process for the statewide collection and dissemination of cardiac and stroke data. Define a standard set of measures and identify a sustainable and integrated clinical data repository to improve cardiovascular health and reduce disparities, quality improvement, and future policymaking. 2. Until an alternative exists, develop a statewide data strategy that maximizes the use and utility of currently available sources of ECS data for a routine program of system monitoring.
II. Lack of System Infrastructure and Quality Improvement Standards	1. Strengthen accountability in the process by which cardiac and stroke centers are certified. 2. Develop a statewide plan to better track and address ECS system capacity, including establishing metrics to identify when capacity is insufficient to meet demand. 3. Develop a roadmap towards a more robust infrastructure, including convening stakeholders, developing a strategic plan, and providing technical support to hospitals, EMS, and other providers. 4. Use monetary and non-monetary incentives to encourage hospitals to engage in quality improvement activities.
III. Limited Hospital Capacity and Access to Specialist	1. Expand early access to expert consultation for cardiac emergencies and stroke among rural and other referring hospitals. 2. Develop mechanisms to facilitate the sharing and adoption of best practices for stroke and cardiac emergencies across the system. 3. Engage stakeholders in solutions to emergency department (ED) overcrowding, ambulance diversion/offloading delays and discharge to rehabilitation.
IV. EMS Capacity and Staffing Challenges	1. Develop a plan to reduce delays in interfacility transport for patients with time-sensitive conditions. 2. Undertake a study to determine how best to address EMS workforce needs, especially in rural areas where the shortage is more acute.

Background

Purpose of this Report

Chapter 58, Laws of 2022 (SSB 5821) directed the Department of Health (department) to evaluate the state's current system response for cardiac and stroke emergencies (ECS system) and provide recommendations to the legislature regarding potential improvements. The department in turn contracted with a University of Washington based team to:

- Assess the existing ECS system, including a review of the current gaps of the emergency medical system.
- Analyze the current state of quality data collection and the feasibility and associated costs to improve data collection, submission, and analysis, including the value and costs of registries to improve cardiac and stroke care.
- Analyze the potential benefits of establishing a statewide cardiac and stroke steering committee to monitor the provision of cardiac and stroke care and prioritize an improvement initiative.
- Provide recommendations to support a cardiac and stroke care system for Washington.

Cardiovascular Disease Is a Significant Public Health Problem in Washington State

Although mortality rates have improved in recent years, ischemic heart disease (IHD) and stroke remain the 2nd and 6th leading causes of death in Washington, respectively.[1] In 2019, these two conditions accounted for 13,126 deaths, or 1 in 4 (22.7%) of all deaths in the state, and an estimated 220,519 years of life lost due to premature death or disability (Figure 1). To place this into context, injuries, a subset of which are traumatic injuries supported by a robust trauma system, accounted for 3,675 deaths and 202,023 and years of life lost due to premature death and disability. Similarly, substance use disorders (including drug overdoses), which have been recently prioritized by the state, accounted for 1,682 deaths and 161,923 years of life lost due to premature death and disability (Figure 1).

Beyond their substantial toll on health, the economic impact of cardiovascular disease is significant. Data from the Disease Expenditure Study, which provides some of the most robust and contemporary data on health spending by condition, shows that direct health spending for IHD and stroke totaled $131 billion in the United States in 2016 (Table 1).[5] Given the number of heart attacks and strokes in 2016, the cost per incident case is roughly $117,286 for heart attack and $119,394 for stroke when adjusted to 2023 $USD. Public payers, including Medicare and Medicaid, pay for 54% and 57% of the costs related to these conditions, respectively. Stroke is associated with high rates of disability requiring long-term care and other home and community-based services, which are frequently funded by state governments through

Medicaid. Stroke accounts for a much larger share of nursing home spending nationally (7.31%) than it does for total costs.

Figure 1: Comparison of Disability Adjusted Life Years and Deaths by Cause in Washington State, 2019

Institute for Health Metrics and Evaluation. Global Burden of Disease Study, 2019.

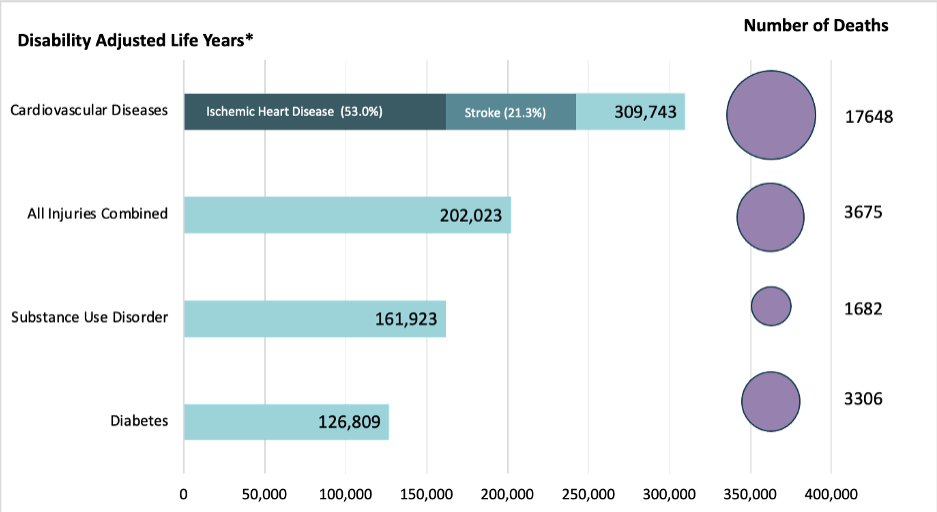


Table 1: U.S. Spending on IHD and Stroke in 2016 in Billions of US$

Institute for Health Metrics and Evaluation. Disease Expenditure Study, 2016.

	All Payers				Public Payers			
	IHD		Stroke		IHD		Stroke	
	$USD	%	$USD	%	$USD	%	$USD	%
Total	89	3.3	42	1.55	48	4.19	24	2.05
Inpatient	44	5.79	20	2.65	21	5.9	12	3.34
Emergency	4.6	3.36	1.7	1.26	2.2	3.45	1.2	1.86
Ambulatory	21	2.38	1.9	0.22	14	4.02	1.2	0.34
Pharmaceutical	6.7	1.99	0.4	0.12	3.4	2.49	0.2	0.17
Nursing care	3.4	1.79	14	7.31	2.3	2.12	6.6	6.13
Administration	9.2	3.46	3.9	1.49	4.7	4.19	2.3	2.05

Using Washington's most recent case counts, the evaluation team estimates that direct health spending for IHD and stroke for all payers in Washington State is upwards of $2.8 billion

annually (derived from the number of incident cases of IHD and stroke multiplied by the estimated cost per incident case). This estimate does not account for indirect health spending. The loss of productivity, as both patients and caregivers exit the workforce or reduce hours, and the informal and formal caregiving costs are not well captured but are estimated in the literature to be as much as 1.5- to 2-fold higher than the observed direct health spending.[6,7]

Importance of Ensuring Access to High-Value Care

Significant advances in cardiac and stroke therapies in the past decade make them some of the most effective in medicine. For example:

- For every 2.8 stroke patients treated with endovascular thrombectomy, 1 patient achieves increased functional independence after 90 days.[8]
- IV thrombolytics has been shown to increase disability-free survival by about 10% when provided within 3 hours.[9]
- One in *every 23 patients treated by Percutaneous Coronary Intervention (PCI) within 60 minutes are likely to survive. After 90 minutes, only 1 in 250 are likely to survive.* [10]

These studies also demonstrate the time-sensitive nature of these conditions. Patient outcomes are strongly tied to the swiftness in which a heart attack or stroke is recognized, diagnosed, and treated. Yet, as this evaluation shows, timely and appropriate care is not always accessible.

There have been strides; however, in recent years at the statewide level to help reduce the burden of cardiovascular disease from a prevention driven approach. The department has promoted the adoption of evidence-based quality measurement at the provider level (e.g., use dashboard measures to monitor healthcare disparities and the effectiveness of any activities implemented to reduce healthcare disparities). Engagement of physician and non-physician level team members as well as the Washington State Pharmacy Association in the management of hypertension and cholesterol in clinical settings is also occurring, along with the promotion of Medication Therapy Management (MTM) between pharmacists and physicians.

The department has also engaged community health workers (CHW) in their work to link diverse and underserved populations to health and social service systems by supporting the formation of the CHW Leadership Committee (CHWLC) to help reach those higher risk populations. Additionally, the department has engaged these higher risk populations in the use of self-measured blood pressure monitoring (SMBP) to help manage their symptoms. Even with these targeted efforts, reducing the burden of cardiovascular care in Washington remains a challenge.

History of the ECS System in Washington State

In 2010, the Washington State Legislature passed legislation (HB 2396) creating the state's ECS system. The original legislation called for the department to "endeavor to enhance" emergency cardiac care by:

- "Encouraging hospitals to voluntarily self-identify cardiac and stroke capabilities", with levels defined by the previous work of the Emergency Cardiac and Stroke Technical Advisory Committee (ECS TAC).
- Giving a medical facility "deemed status" and designating it as a primary stroke center if it is receiving a certification of distinction for primary stroke centers issued by the Joint Commission. When available, a facility must demonstrate its cardiac or stroke level through external, national certifying organizations.
- "Within the current authority of the department," adopting prehospital patient care protocols, procedures, and triage-tools.

Additionally, the legislation included provisions that hospitals electing to participate in the ECS system "shall":

- "Participate in quality improvement activities at the hospital, regional and state level."
- "Participate in a national, state, local data collection system that measures cardiac and stroke system performance from patient onset of symptoms to treatment or intervention."

Since the implementation of the ECS system in Washington, more than 90% of hospitals have been certified as a cardiac center and/or stroke center and nearly all EMS agencies have adopted state prehospital patient care procedures, suggesting a high level of buy-in across the state. Numerous challenges do remain that limit the effectiveness of this basic system.

Evaluation Objectives

The department contracted the University of Washington to conduct an evaluation of the ECS system in Washington state. The multi-phase, mixed-methods evaluation assessed the current systems of care for cardiac and stroke emergencies, including the associated data used to monitor and evaluate these systems. Data were collected through key informant interviews, self-administered surveys for Medical Program Directors (MPDs), Emergency Medical Services (EMS) agency leads, and Emergency Cardiac and Stroke (ECS) coordinators at Washington hospital facilities. The main objective of the evaluation was to identify persistent barriers that hinder the delivery of timely and high-quality care for emergent cardiac and stroke patients across prehospital and hospital settings.

Based on the findings, evaluators made recommendations on how to improve the systems of care for these emergencies and identified types of investments the state may consider to

monitor and evaluate progress towards high-quality care for all Washingtonians. The evaluation had four specific objectives:

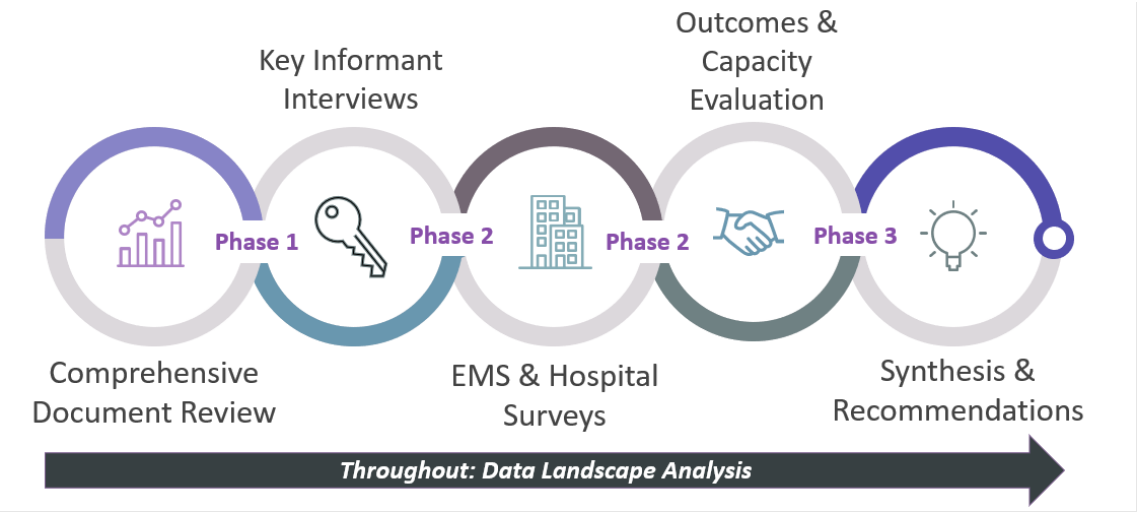
- Work with key stakeholders to better understand the optimal functions for the ECS system and illuminate concerns regarding the systems used to treat and evaluate acute cardiovascular events in Washington state.
- Assess barriers and facilitators of timely, high-quality care for cardiac emergencies and stroke across a wide array of prehospital and hospital settings.
- Inventory current data systems, identifying key metrics that are available, and look at the quality and availability of these data.
- Provide recommendations to the department on ways to better coordinate care and highlight investments for monitoring and evaluating care quality.

Methods

Summary

The evaluation was a 10-month, mixed-method process consisting of three phases to evaluate current systems of ECS care and associated data used to monitor and evaluate these systems (see Figure 2). The department convened the ECS workgroup to share insights related to the current ECS system, its functioning and potential gaps, and inform the development of the draft report. The UW evaluation team and the ECS workgroup had eight virtual meetings from September 2022 through April 2023.

Figure 2: Study Approach Schematic



Phase 1

In Phase 1, September 2022 to December 2022, the evaluators reviewed the literature on cardiac and stroke systems of care and examined ECS systems of other states to establish comparative references. The following document types were included in the review:

- National guidelines and policy statements for ST-elevation myocardial infarction (STEMI), non-ST Elevation Acute Coronary Syndromes (NSTEMI), cardiac arrest, and stroke systems of care from the American Heart Association (AHA) and Centers for Disease Control (CDC).
- Policy statements and guidelines for Emergency Medical Services (EMS), including rural EMS systems.
- Washington state reports, guiding documents, and relevant legislation, including those related to the state's trauma system, original ECS system evaluation and legislation, adopted prehospital destination procedures for EMS, among others.
- Evaluations of time-sensitive condition systems of other states (e.g., cardiac, stroke, trauma).
- Legislation and reports from other states regarding mandatory case reporting, incentives for data system participation, and level of care certification standards.
- Other medical literature on acute coronary syndromes and stroke.

The evaluation team also engaged in semi-structured, key informant interviews with stakeholders in Washington to identify the broad vision and successes and gain insights into the

barriers, bottlenecks, and challenges of the current ECS system. The team conducted interviews with additional leaders in other highlighted states for state-level comparisons and to identify opportunities to learn from other state programs. See appendices for interview guide.

Table 2: Stakeholders Represented in Key Informant Interviews

Medical Program Directors	American Heart Association Representative
Other EMS Representatives (Ambulance Association, Fire Department)	Washington State Hospital Association Representatives
City Leader (Mayor)	ECS system leadership From Other States (Arkansas, Virginia, Idaho)
Hospital QI administrators	Department of Health Personnel
Physician Leaders (cardiology, neurology, emergency medicine)	

Phase 2

During Phase 2, January 2023 to April 2023, the evaluators designed three tailored self-administered surveys for 30 Medical Program Directors (MPDs), 408 EMS agency leads, and 95 ECS coordinators in Washington state. Surveys were designed iteratively based on feedback from the department team and ECS workgroup and included both quantitative and qualitative items. Data collected included Likert-scale items to capture perceptions of timeliness, quality, adequacy, and capacity of local care experience, as well as open-ended questions about problems and potential solutions. Surveys were developed and distributed electronically via REDCap. The goal was to achieve full participation from MPDs and ECS coordinators and a select, convenience sample of EMS agency leads to use as a comparison to the MPD findings. Survey respondents were sent weekly email reminders (for four weeks) to enhance the response rates. The team also conducted follow-up emails and phone calls with a handful of respondents in cases where further explanation of a response or comment was necessary. See appendices for survey instruments.

Phase 3

In Phase 3, May 2023 to June 2023, the team analyzed state-level performance data on stroke and cardiac events to assess the quality of care statewide. The analyses focused on examining trends in incidence and mortality since creation of the ECS system for cardiovascular conditions. The three data sources were: the Comprehensive Hospital Abstract Reporting System (CHARS), the Washington EMS Information System (WEMSIS), and Washington Vital Statistics. Cardiac arrest data were obtained from the Cardiac Arrest Registry to Enhance Survival (CARES) registry. The team also assessed county-level trends and cross-sectional differences between counties. Additionally, to the extent possible, gender, racial, and rurality disparities were evaluated for the state as a whole. Disparities could not be evaluated for counties with small case numbers that are suppressed, per department guidelines.

The supply of ECS system inputs (specialty providers, hospital beds, Level I facilities, and EMS providers) was characterized. Physician licensing information was obtained from the Washington Medical Commission (WMC). Additional inputs were gathered from Kaiser Family Foundation (KFF) reports to compare Washington state supply quantities to other states of comparable size.

Finally, the team integrated key themes from all the data collected in the study and presented them to the ECS workgroup. The synthesis of findings included: thematic analysis of qualitative data from interviews and open responses on surveys, quantitative analysis of survey items, analysis of health outcomes over time since ECS system creation, and an assessment of system capacity. The team prioritized the identification of gaps and opportunities for improvement using the following questions to guide the gaps assessment:

- Where are systems inputs sufficient? What inputs/resources are inadequate?
- What are key stakeholders saying about the ECS system?
- How do available data from Phase 3 on observed health outcomes correlate with Phase 1 and 2 data on system capacity?

Preliminary findings were also shared in other venues, including an MPD quarterly meeting and the broader ECS Technical Advisory Committee. Through an iterative process, the evaluation team, in collaboration with the department and the ECS evaluation workgroup, developed policy recommendations for an optimally functioning ECS system.

Overarching activities

Data Landscape Analysis

This landscape analysis is a detailed inventory of the current data systems that support oversight and quality improvement of the ECS system, as well as other systems that may not be currently used. Data systems are critical to helping the system run smoothly, generate key

population-level estimates for performance metrics and health-outcomes, and identify and address disparities across Washington state. The evaluation team characterized key data elements for those systems and articulated the current access, i.e., who can access the data and what is needed for access. This work was done in collaboration with the department to ensure that the landscape of potential data sources was complete. Data sources reviewed included: CHARS, WEMSIS, and AHA's Get With The Guidelines (GWTG). The evaluation team examined whether the current data systems associated with the ECS system have the capacity to assess desired outcomes and whether these systems report data with the appropriate granularity to evaluate regional variability in health outcomes and system performance indicators. This assessment also addressed if data systems capabilities vary across state regions.

The assessment borrowed from CDC guidelines for evaluating surveillance systems (distinct, but related health information systems), to address the following seven data system domains: Usefulness, Simplicity, Flexibility, Quality, Acceptability, Representativeness, and Timeliness. Additionally, the evaluation team explored whether or not variability by race and ethnicity is possible with current data and reporting structures, as this is critical for addressing health equity and ensuring access and quality for Washingtonians.

Assessment From Other States

Throughout the assessment, the evaluation team reviewed key successes and crucial system components from ECS systems in other states. This included a literature review of peer-reviewed studies and grey literature from other state ECS systems. Initial findings helped populate interview guides and surveys to key stakeholders. The evaluation team summarized key findings from the literature for the department and ECS Workgroup to review. The team conducted an inventory of statewide stroke registry systems, and the extent to which data reporting is mandated in each state. Furthermore, the specific mechanisms employed for data sharing and the legislative approaches adopted by states with integrated registry systems were described. Finally, the evaluation team conducted discussions with representatives from other state ECS systems to identify elements that are critical for success.

Findings

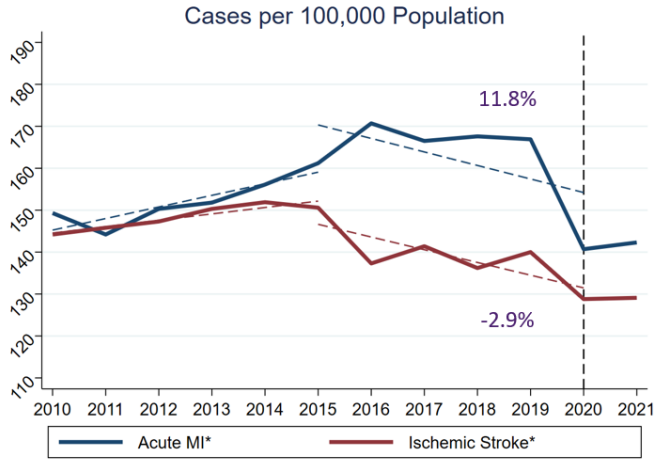
Outcome Trends

Incidence and Mortality

Using data from CHARS, WEMSIS, and state vital records, the evaluation team examined changes in the incidence and mortality rates of acute myocardial infarction (AMI) and ischemic stroke since the creation of the ECS system. The CARES registry was used to examine trends in outcomes related to out of hospital cardiac arrest (OHCA). While WEMSIS contains information on OHCA responses and transports, it does not have information on return of spontaneous circulation (ROSC) or survival. From 2010-2019, the incidence of AMI increased by 11.8%, from 149.3 to 166.9 per 100,000, whereas rates of ischemic stroke declined by 2.9%, from 144.2 to 140.0 per 100,000 population (Figure 3). The incidence of both conditions increased from 2010-2015, then declined between 2016 and 2019 through the start of the COVID pandemic. From 2010-2019, mortality for AMI decreased 24%, from a rate of 33.3 to 25.3 per 100,000 population (Figure 4). During the same period, mortality for ischemic stroke declined by 12.8%, from a rate of 21.8 per to 19.0 per 100,000 population. The decline has been steady over time for both conditions.

Figure 3: Incidence of AMI and Stroke in Washington State

WA Comprehensive Hospital Abstract Reporting System (CHARS), 2010-2021

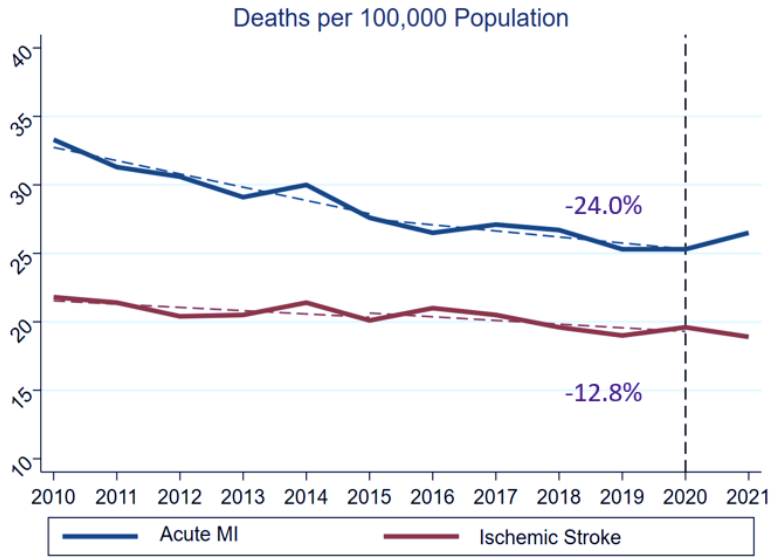


*Slope from 2010-2015 statistically significantly different from slope from 2016-2019 ($p<0.05$).

ROSC in-field and overall survival for OHCA remained largely stable over time (Figure 5). ROSC was achieved in 39% of cases in both 2012 and 2019. A total of 14% and 15% of patients with OHCA survived in 2012 and 2019, respectively. Both outcomes worsened slightly in 2020-2021 during the COVID pandemic.

Figure 4: Mortality for AMI and Stroke in Washington State

WA Vital Statistics Data, 2010-2021



Treatment Rates

Treatment rates for STEMIs and NSTEMIs have remained relatively stable over time (Figure 6). Over the past decade, approximately 3% of STEMIs in Washington were treated by thrombolytics and 82% of STEMIs with percutaneous coronary intervention (PCI). **Thus, 4 in 5 STEMI patients in Washington state receive some form of reperfusion therapy**. The proportion of NSTEMI cases treated with PCI has increased slightly from 34% in 2010 to 41% 2021. Thrombolysis and endovascular therapy (EVT) for ischemic stroke has steadily increased since 2010. The use of endovascular therapy increased from 1% to over 3% and thrombolytic administration increased from approximately 5% to about 11%.

Figure 5: Return of Spontaneous Circulation (ROSC) and Survival for Out of Hospital Cardiac Arrest (OHCA)

CARES Registry, 2010-2021

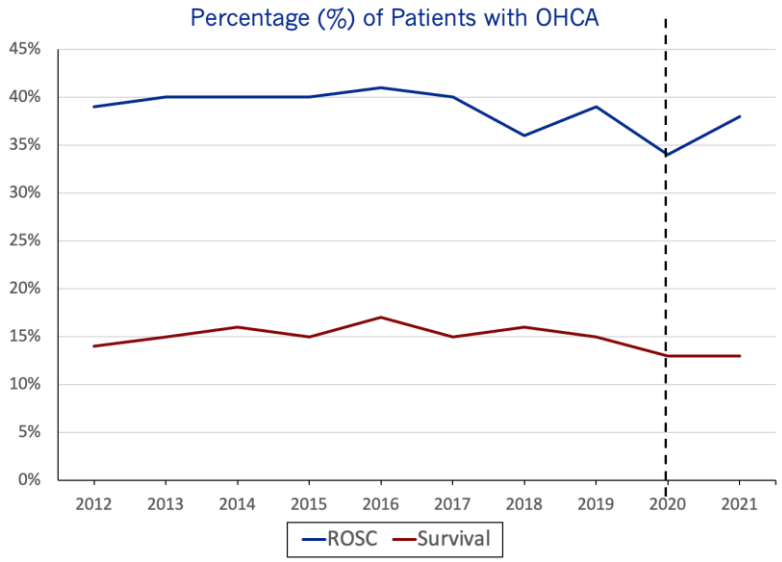
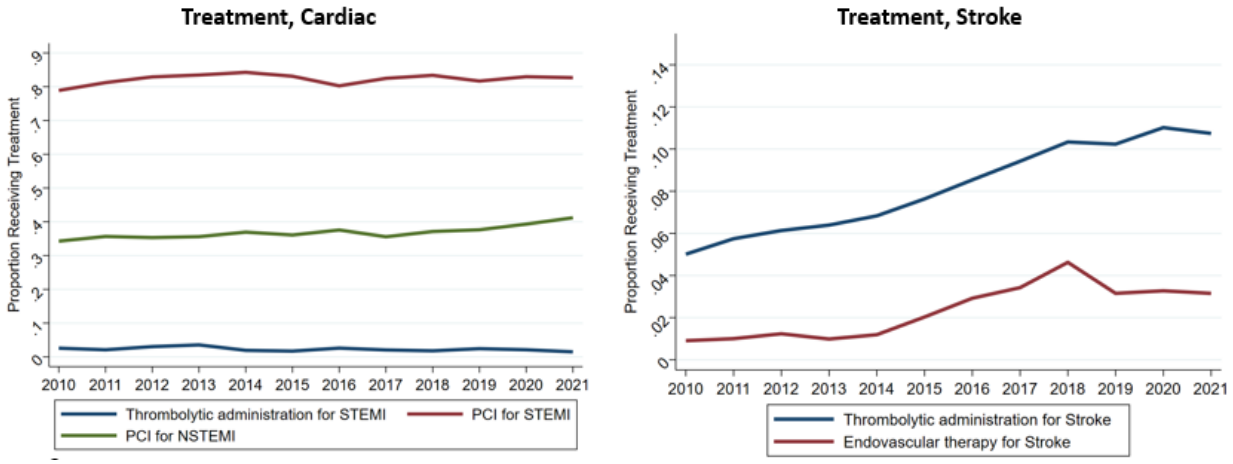


Figure 6: Treatment for Heart Attack and Ischemic Stroke, 2010-2021

WA CHARS Data, 2010-2021



Treatment rates for heart attack and stroke appear to be lower in Washington State than the United States as a whole, though current population estimates were difficult to find. In a large national study, the proportion of patients with STEMI receiving primary PCI increased from 82.3% to 96.0% of eligible patients.[11] However, this study only included patients who presented to a PCI-capable center or were transferred to a PCI capable center and does not capture those who were not transferred (thus, the denominator is different). In the same study, PCI for NSTEMI increased from 43.9% to 54.5%. Another study examining national rates of PCI for STEMI 2012-2015, found that Medicaid patients received primary PCI 88.9% of the time vs. 92.3% for commercially insured patients.[12] Thus, the overall rate of PCI across all payers will be lower than that reported for commercially insured patients alone.

For stroke, a large national study of commercially insured individuals found that the proportion of patients with ischemic stroke who received thrombolytics increased from 6.3% to 11.8% and those who received EVT from 1.6% to 5.7%.[13] In another study of 646 hospitals across 12 states participating in the Coverdell Stroke Program from 2008 to 2018 (which included Washington in 2016-2018), thrombolytic use increased from 6.4% to 15.2% and EVT increased from 0.6% to 4.0% of patients with ischemic stroke.[14]

These data suggest opportunities for Washington state to improve access to critical, life-saving treatments for heart attack and stroke to align with the national averages.

Geographic Variability

As previous reports have suggested, there is considerable variability in outcomes associated with cardiac emergencies and stroke across Washington counties. Variation in mortality rates can reflect differences in demographic composition, as well as differences in access to care. To compare variation across counties, Figure 7 shows the age-adjusted mortality rates per standard population as identified in state death records. To reduce year-to-year variability in mortality especially in smaller counties, rates were averaged over a 5-year period (2017-2021) for AMI and stroke. Age is the primary risk factor for cardiovascular outcomes, therefore being the most critical factor to account for with population comparisons given that different counties have different age distributions. The mortality rates were also averaged over 5 years to minimize annual fluctuations in rates that may skew estimation. Note that counties in grey do not have sufficient data for reporting purposes and robust calculation of key metrics. Death data were obtained from vital records and population estimates were provided by the Office of Financial Management (OFM).

There was a 9.9-fold difference in mortality rates for AMI across counties in Washington State. Average AMI mortality rates ranged from 16.0 deaths per 100,000 in King County, the state's most populated county, to 158.1 deaths per 100,000 in Lincoln County in Eastern Washington. In general, rural counties had higher mortality rates for AMI than urban counties.

However, there is still a 5.9-fold difference in AMI mortality between King County and the county with the next highest mortality, Pacific County.

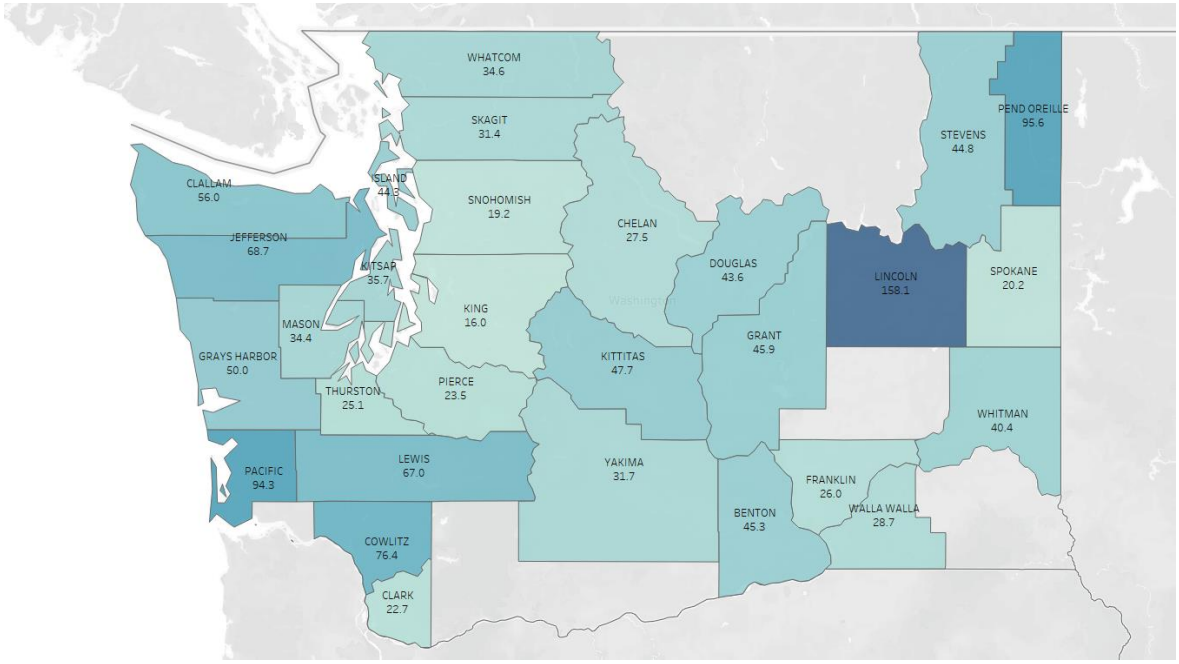
There was a 3.3-fold difference in mortality rates for ischemic stroke across counties in Washington state. Average stroke mortality rates ranged from 14.4 deaths per 100,000 in Franklin County, to 46.9 deaths per 100,000 in Pacific County on the coast. Similar with AMI, rural counties had higher stroke mortality rates than urban areas.

Variation in out of hospital cardiac arrest (OHCA) responses by county in WEMSIS data from 2019-2021 were also analyzed (Figure 8). While WEMSIS does not contain outcome information, the percentage of OHCA responses that were transported to the hospital in each county were examined. Transports would be expected to be inversely proportional to the percentage of patients who died in the field. As a result, we examined the percentage of OHCA responses resulting in transport to understand how the timeliness and quality of resuscitation may vary across counties (Figure 9). The percentage of OHCA responses that were transferred varied **2- to 3-fold** across most counties in the state.

Figure 7: Average Mortality Rate for AMI (top) and Ischemic Stroke (bottom) by Washington county

WA Vital Statistics Data, 2017-2021

PANEL A: AMI mortality rate per 100,000



PANEL B: Ischemic stroke mortality rate per 100,000

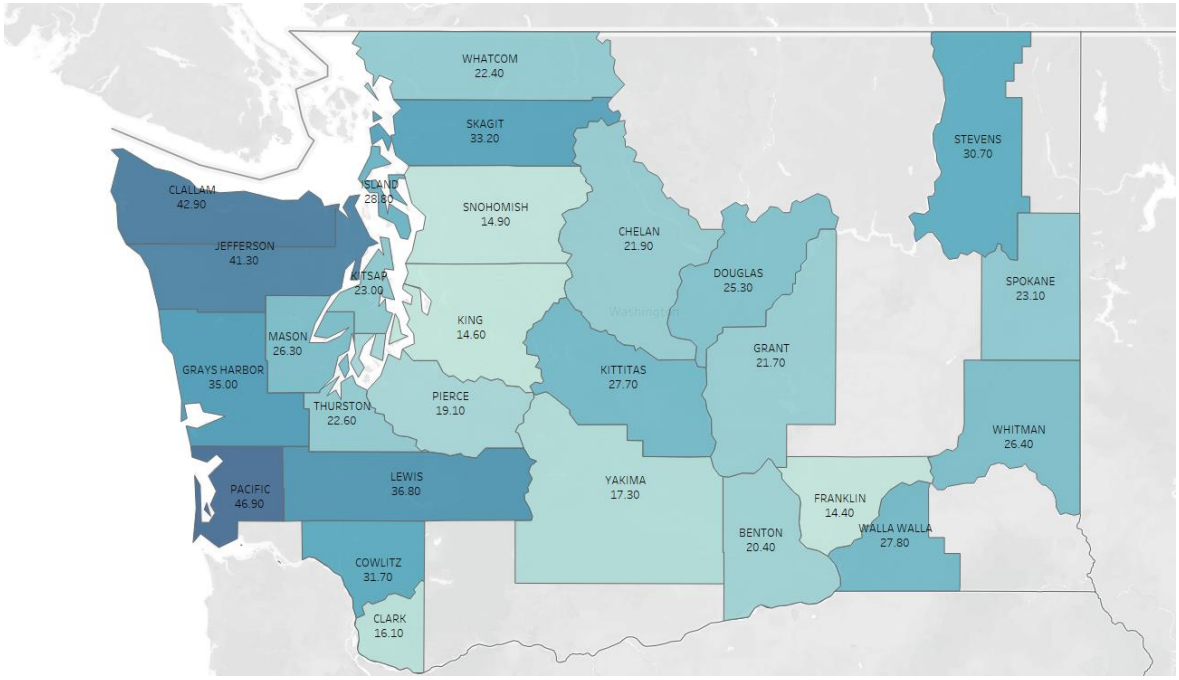
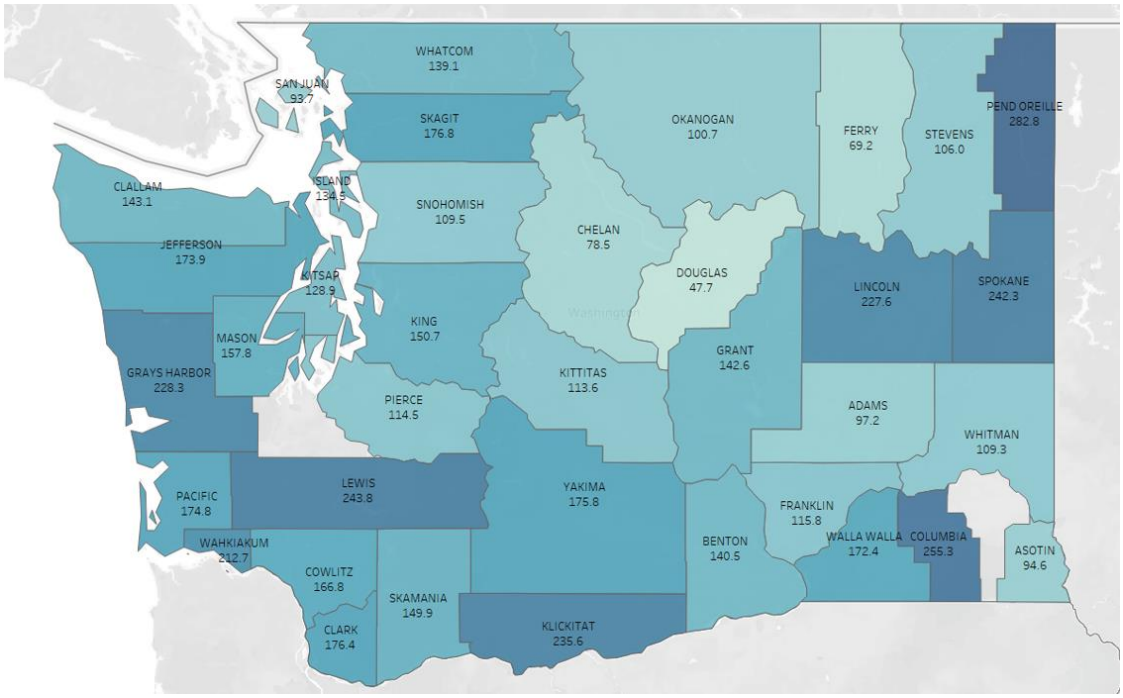


Figure 8: Incidence of OHCA responses per 100,000 by WA county*

WEMSIS, 2019-2021



*Thurston county rate is not reliable due to <30% of EMS responses reported in the county.

Changes in Incidence Versus Case Fatality Rate by County

The evaluation team explored the relationship between change in the incidence of cardiovascular emergencies (as a proxy for demand for ECS services) and case fatality rate (CFR). The CFR is a ratio of the number of individuals who die of a given condition over the total number with that given condition. When comparing CFRs for the same condition across settings, smaller CFRs can indicate lower mortality due to better care quality; increasing CFRs can suggest a decline in care quality.

Figures 10 and 11 show the correlation between *change* in the incidence of AMI and ischemic stroke and the *change* in average CFR by county for AMI and ischemic stroke, comparing the average for a 5-year period spanning from 2012-2016 versus an average for a 5-year average spanning from 2017-2021. While there is no correlation between incidence and CFR across counties in the state for either condition, some counties have seen both an increasing demand for ECS services and worsening CFR. The data available is not granular enough to know the extent to which capacity constraints may be contributing to these differences. Further study is warranted, especially in light of the capacity challenges that were highlighted by stakeholders in other parts of the evaluation. Counties that show increasing incidence/disease burden and worsening CFR may need targeted interventions and support to ensure optimal outcomes.

Figure 9: Percentage of OHCA responses transported to hospital by WA county

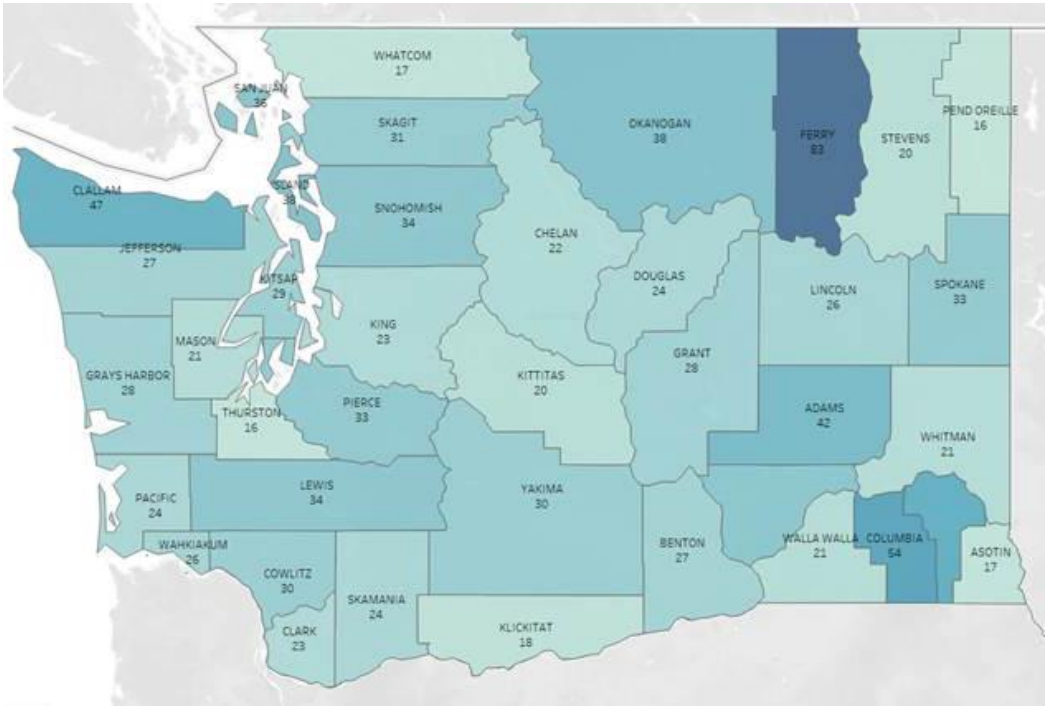


Figure 10: Association Between Change in AMI Incidence and Change in CFR by Washington County Comparing 2 Periods (2012-2016 vs. 2017-2021)

WA CHARS Data, 2012-2021

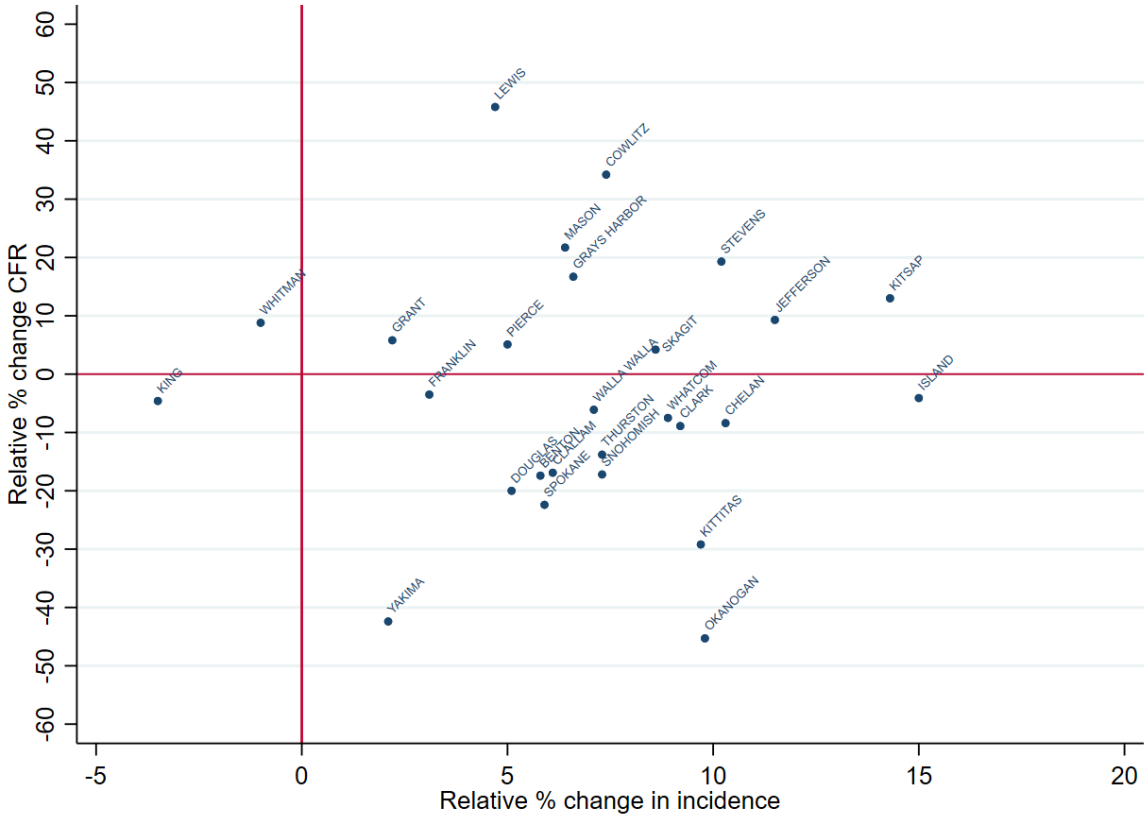
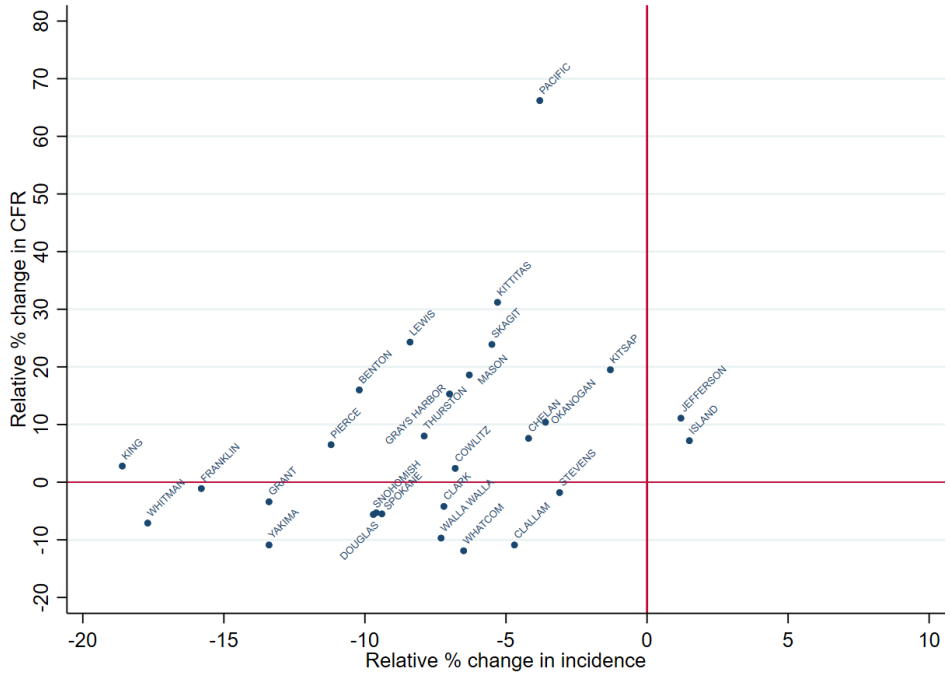


Figure 11: Association Between Change in Stroke Incidence and Change in CFR by Washington County Comparing 2 Periods (2012-2016 vs. 2017-2021)

WA CHARS Data, 2012-2021



Statewide Disparities in Cardiac and Stroke Outcomes

A prior study by department staff using CHARS data from 2013-2015 found significant disparities in rates of PCI for patients with STEMI by sex, rurality, and payer. Notably, women had a 13.6% lower rate of receiving PCI during a STEMI compared with men (39.7% vs. 53.3%; OR 0.58; 95% CI 0.55-0.60). Medicaid enrollees had a 9% lower rate of PCI during STEMI compared to those with commercial insurance (54.2% vs. 63.2%; OR 0.69; 95% CI 0.63-0.76). Individuals from rural areas had a 2% lower rate of PCI compared to those from urban areas (48.1% vs. 50.1%; OR 0.92; 95% CI 0.87-0.98).

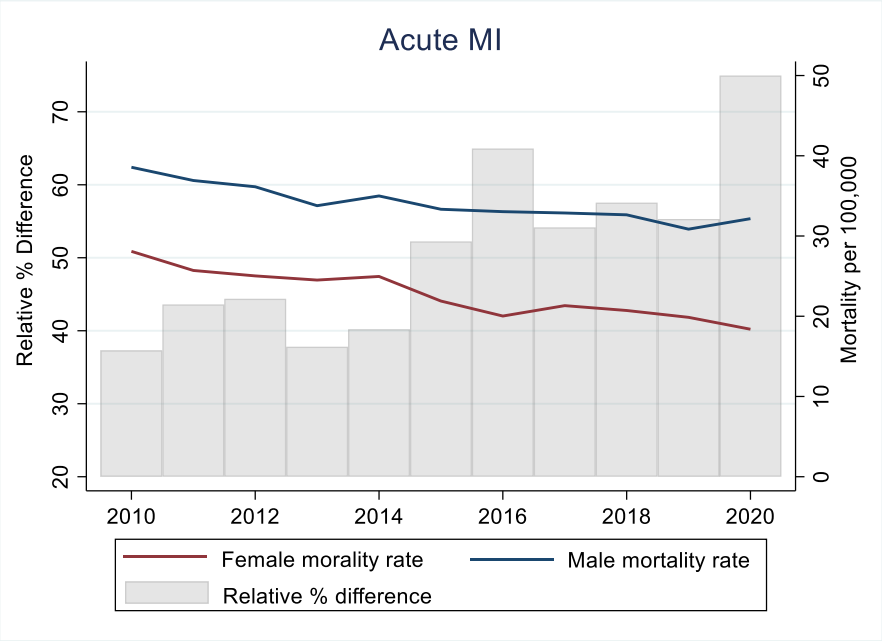
Given the state's equity goals, the evaluation team undertook a further examination of disparities by sex, race, rurality, and payer. Despite the earlier study showing lower treatment rates, data suggests that women have experienced lower mortality for AMI (both STEMI and NSTEMI) compared with men over time (Figure 12, Panel A). Men had persistently higher rates of mortality from AMI compared with women, and these disparities increased over time. For ischemic stroke, women experience slightly higher mortality rates compared to men, but this disparity has been slowly narrowing over time (Figure 12, Panel B). Again, women have seen

reduced stroke mortality over time in the state.

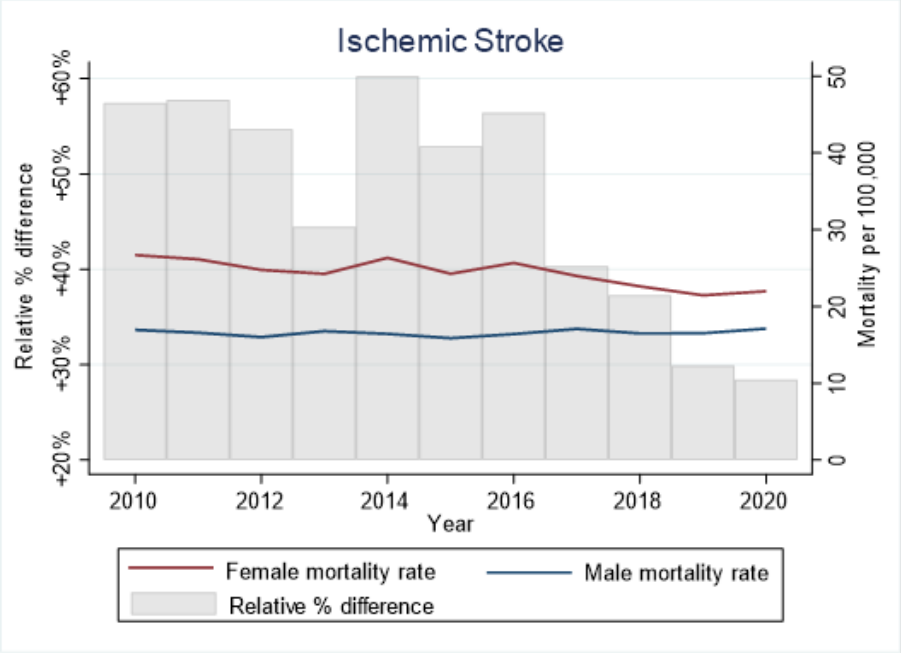
Figure 12: Disparities in Mortality Rates for AMI (top) and ischemic stroke (bottom) for Men and Women in Washington State

WA CHARS Data, 2011-2020

PANEL A: AMI

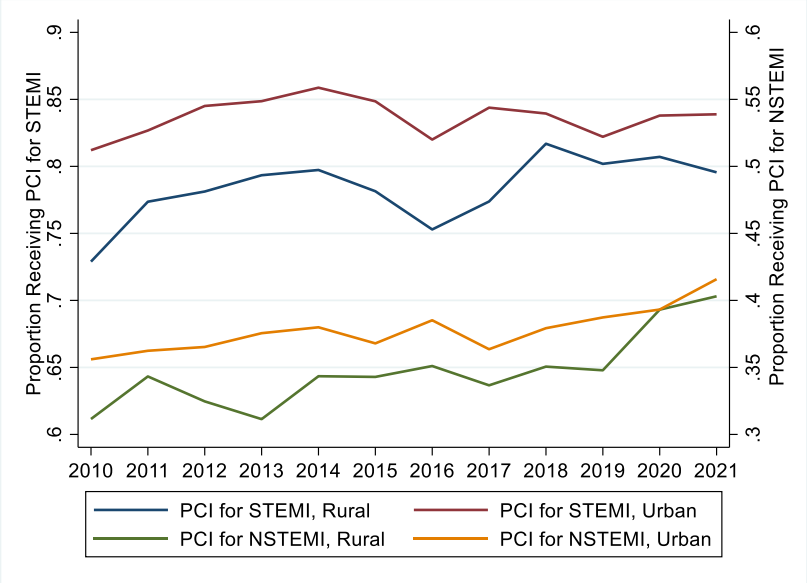


PANEL B: ISCHEMIC STROKE



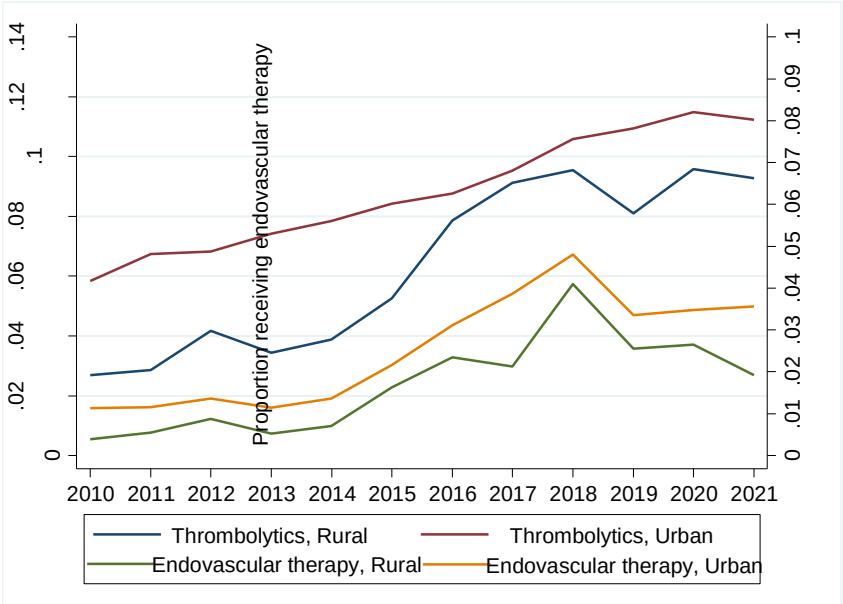
Patients in rural counties continue to receive PCI for both STEMI and NSTEMI at lower rates than their urban counterparts (Figure 13). Between 2011 and 2021, on average, 78.4% of rural STEMI patients received PCI versus 83.7% of urban patients. For NSTEMI, 37.8% of rural patients and 34.7% of urban patients received PCI. Note, like the older study presented above, these are unadjusted rates, and thus, the disparities would likely narrow after accounting for age, sex, and comorbidities. The gap in PCI for STEMI has been narrowing over time, and as of 2020, the treatment gap for NSTEMI was effectively closed with comparable treatment rates. However, an important caveat is that data does not account for the timing of these interventions. Current state data is inadequate to determine the extent to which rural patients may be receiving PCI at later dates following their heart attack relative to their urban counterparts, which has significant implications for subsequent outcomes.

Figure 13: PCI treatment by rurality (2011-2020)



Similar to acute coronary conditions, there are disparate treatment rates for stroke when comparing urban and rural patients (Figure 14). On average, 6.3% of rural ischemic stroke patients received thrombolytics versus 8.8% of urban patients. The use of thrombolytics has increased for both rural and urban areas over time, with the gap narrowing in more recent years. Endovascular therapy was provided for 1.7% of rural patients and 2.5% of urban patients. The gap between rural and urban patients has been consistent over time.

Figure 14: Stroke treatment by rurality (2011-2020)



There is slight variation in cardiovascular and stroke treatment rates across healthcare payers in the state. For cardiovascular treatment (Fig. 15-A), commercially insured individuals have higher rates of PCI for STEMI (87.3%) compared to other federal, state, and individual payment mechanisms (77.4%, 84.7%, and 85.6%, respectively) when considering average treatment rates between 2017-2021. The rates for PCI for NSTEMI were also variable, with Medicare and Medicaid beneficiaries receiving PCI 34.4% and 38.9% of the time, compared to 44%-45% if covered by other payers. Thrombolysis for ischemic stroke had some variability by payer (Figure 15-B), but to a lesser degree than for cardiovascular treatments. The 5-year average rates of thrombolysis ranged from 9.5% for Medicare beneficiaries to 12% for commercially insured individuals.

As observed with variation by geographic rurality, these data do not account for the timing of these interventions and represent unadjusted rates, which do not account for age, sex, and comorbidities. Disparities by payer type cannot be fully assessed without risk-adjustment due to known differences in severity between the groups. One would expect the differences to increase with risk adjustment which would account for selection into the various payer categories, such as those with a higher burden of comorbidities often cannot work and/or become eligible for other insurance programs aside from employer sponsored healthcare.

Figure 15: Treatment by payer (2017-2021)

Figure 15-A: Acute Myocardial Infarction

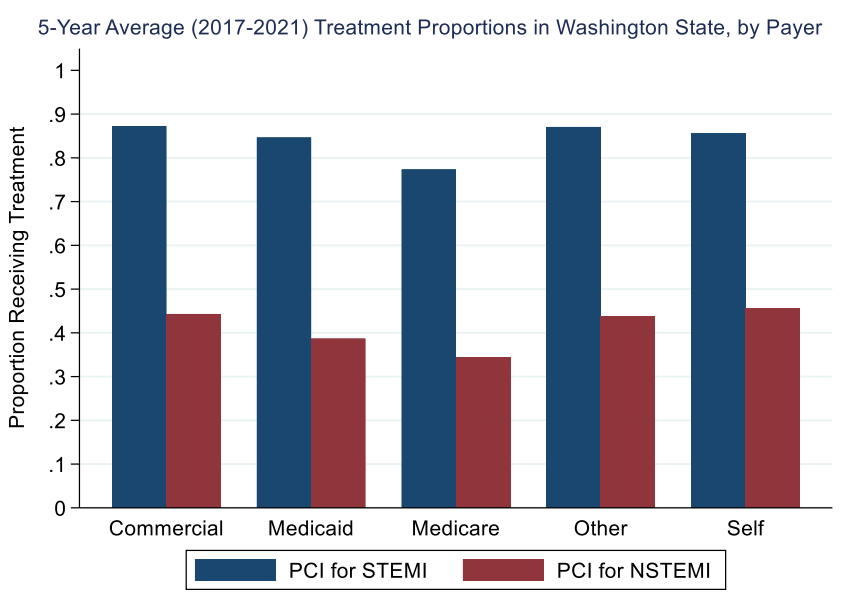
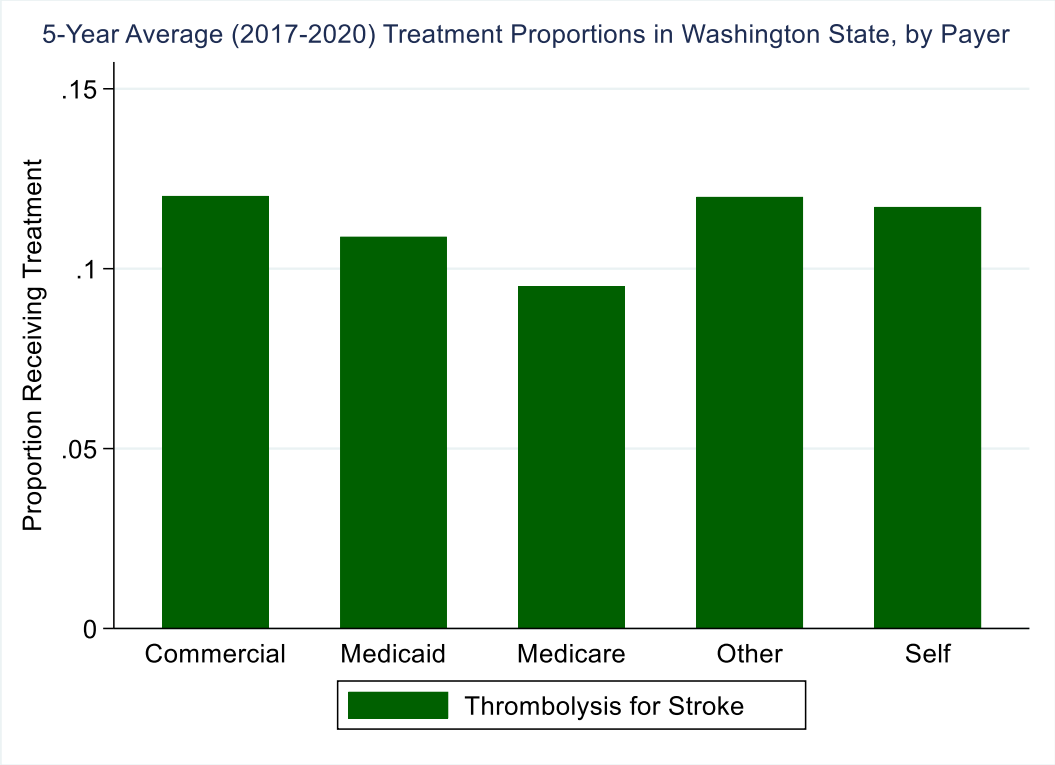


Figure 15-B: Stroke



The evaluation team conducted a preliminary analysis of racial disparities at the state level, and this did not show significant disparities. Without individual level data, this analysis is inadequate because racial and ethnic communities tend to be concentrated within certain geographic areas with differential resources and the evaluation team could not adjust for those with the available data. Activities to improve the ECS system should prioritize a monitoring and evaluation strategy that facilitates a robust assessment of potential health disparities.

Summary of Themes Emerging from Key Informant Interviews

Since 2010, Washington state has made tremendous strides in the advancement of an organized system of care for cardiac and stroke conditions. The main successes identified by the key informant interviewees were:

- The creation of a basic framework for identifying centers of excellence and levels of hospital resources for stroke and cardiac diseases.
- The generation and dissemination of standardized EMS triage tools.
- The creation of an ECS Technical Advisory Committee (TAC), which has broad stakeholder engagement that has improved sharing of best practices.

Nearly all hospitals in the state have at minimum a basic level of certification for cardiac and stroke (Table 3), meaning they have at least developed some protocols and procedures for early

management and transfer of these patients, and engage in some training and educational activities. The state has created a set of Prehospital Cardiac and Stroke Triage Destination Procedures, which assist EMS providers with the risk-stratification of potential stroke and heart attack as well as guidelines on when to bypass the closest facility for a higher-level stroke or cardiac center. It appears that these procedures have been widely adopted throughout the state. Additionally, the state has developed clinical guidelines for EMS providers to help standardize care.

Table 3. Current Cardiac and Stroke Certified Centers in Washington

	Cardiac		Stroke	
Level I	34	40%	8	9%
Level II	52	60%	32	38%
Level III	-	-	45	53%
Total	86	100%	85	100%

Despite the gains and improvements to the ECS system since 2010, key informants highlighted significant deficits that are currently inhibiting the ECS system from making further gains in terms of patient outcomes, efficiency, and costs. According to key informants, these concerns fall under the following domains:

- Of foremost importance to stakeholders is that the system remains largely unfunded. This has hampered the development of a truly robust ECS system in Washington state. Cuts in funding in past years have hampered capacity as well as the adoption of best practices by less resourced/rural EMS systems, impairing their ability to handle time-sensitive emergencies.

  In addition to the allocation of resources for infrastructure related to the ECS system at the state level, the evaluation team heard comments about the need for additional funds that could be directed to specific high-value programs supporting rural EMS agencies and hospitals to ensure capacity, training, and quality improvement activities. These programs were felt to be critical elements to realize improvements in the system's effectiveness and resultant health outcomes. Specific high-value programs that were identified by stakeholders include:

  - Stipends to hospitals for ECS coordinators.
  - Grants to EMS agencies for capital investments and training, especially to defray costs of equipment, and training and educational requirements for rural and volunteer agencies.

- Engagement grants or other monetary incentives to hospitals for quality improvement, such as reporting/sharing data, quality improvement initiatives, participation in regional and other interdisciplinary forums.
- Enhanced stipends for MPDs and other EMS quality improvement activities.
- Technical assistance to hospitals and EMS agencies to establish robust quality improvement activities.
- Public health awareness campaigns to improve awareness around cardiovascular emergencies and stroke and the use of 911.

❖ Key informants perceived a lack of oversight and accountability across the system, stemming from inadequate capacity for program administration, coordination, and data management at the department level. Many stakeholders felt that Washington state's process for certifying stroke and cardiac centers is weak and lacks ongoing accountability, leading to significant variability in the quality of services and system engagement across hospitals. Specific examples where greater oversight is desired include:

- A more rigorous certification process that includes site visits, chart abstraction, and confirmation that stroke and cardiac centers have adequate processes in place to optimally care for patients and are regularly engaging in quality improvement activities. This would require statutory changes to provide the department with authority to institute such a certification process.
- The need for the department to regularly track hospital performance and quality in stroke and cardiac disease and address poor performance.

❖ There was also a distinct desire for more active coordination by the department in activities related to the ECS system. Stakeholders would like to see:

- A dedicated director and clinical lead for the ECS system within the department (and ideally leads dedicated to each of stroke and cardiac programs).
- The department facilitate opportunities for quality improvement, data sharing, and dissemination of best practices, such as annual stroke/cardiac conferences and regular reporting. Stakeholders noted the value of state-wide stroke conferences held during the Coverdell Program.
- The department better track EMS and hospital capacity for stroke and cardiac patients in individual communities. A more robust categorization process can help champion greater resources and ensure population level supply of resources to treat ECS conditions.
- Active partnership between department ECS staff (ideally with a clinical background) with individual hospitals and EMS agencies to assist with solutions

to problems, and link them to other resources in the state, or help share best practices.

- Finally, stakeholders expressed there is a notable lack of a data infrastructure to support continuous quality improvement and policymaking. This lack of data prevents adequate quality improvement and impedes the appropriate targeting of resources to ensure the state's equity goals. The department does not have sufficient capacity to engage in a regular program of data linkage between EMS and hospital data with existing data sources. Stakeholders noted there is a lack of real-time feedback to providers. Key informants generally felt that there should be some level of mandated reporting of ECS conditions for hospitals with better feedback to providers within the system. Specifically, stakeholders would like to see:
  - The development of a statewide registry for stroke and cardiac conditions that can link data across the continuum of patient care (including linking prehospital data with hospital data).

    As of May 2023, the evaluation team found that 37 out of 50 states (74%) have state legislation in place to support data collection for stroke and/or cardiac events. Among these 37 states, 28 (56%) have an active statewide registry specifically for stroke or both stroke and cardiac events. Eight states (California, Hawaii, Idaho, Maryland, North Dakota, Oregon, South Carolina, and Utah) have implemented mandates requiring all hospitals to contribute data to the stroke or cardiac registry. The team's investigation also identified five states that have implemented integrated registry systems encompassing stroke, cardiac, and trauma data, including Idaho, Michigan, Missouri, Utah, and Virginia. As specific case-studies, the evaluation team highlights the following states which demonstrate different strategies Washington state could undertake to collect stroke and cardiac data:

  - **Idaho** has developed a Time Sensitive Emergencies (TSE) registry that is managed by the Idaho Hospital Association and requires reporting on stroke, STEMI, and major trauma by all hospitals in the state. Nearly half the hospitals in the state are rural and critical access hospitals. Leaders in the Idaho Department of Health & Welfare have not found the reporting requirements for stroke and STEMI to be significantly burdensome for these hospitals due to their low case volumes and the minimal number of data elements referring hospitals are required to report.
  - **Missouri** has also created a Time Critical Diagnosis (TCD) system but does not have an integrated registry. Instead, the state has clear regulations for STEMI- and stroke-certified hospitals that include requirements for hospitals to submit data on a limited number of key quality measures. Most hospitals report data through

participation in GWTG or other national registries, which are then passed to the state.

- **Virginia** has recently launched a model statewide stroke registry in 2022. In the process of developing the stroke registry, the state contracted with a large ePCR vendor to house the state's EMS registry, trauma registry, and the new stroke registry on a single platform. The platform provides interoperable, bidirectional data exchange between EMS agencies and hospitals in real-time and makes use of other advanced features like automatic extraction of specific data elements into the record and data analytic capabilities. Virginia is in the process of incorporating cardiac data into the integrated registry and plans to incorporate data from post-acute care settings in the future.
- **Arkansas** was highlighted by our AHA stakeholders as having built an especially effective stroke registry and system of care. The Arkansas Department of Health uses GWTG-stroke as the platform for its statewide stroke registry. The Department relied on aggressive coalition building and a variety of incentives to get near universal participation of hospitals on the GWTG platform. Specifically, the state reimbursed hospitals that elected to participate in GWTG for their annual user fees. Arkansas actively utilizes its registry for continuous quality improvement. Specifically, the Arkansas Department of Health conducts program reviews of performance measures with hospitals in the state, including providing regular report cards and benchmarking on each hospital's performance with the data they submitted.

Key informants pointed to the need to align the ECS system with the trauma system with respect to administration, governance, data collection and quality improvement. As Washington state considers policies to improve on the current ECS system, key informants articulated a clear vision for the ECS system, that the state should move towards a unified Time Sensitive Emergency (TSE) system that encompasses cardiac, stroke and trauma care with balanced attention, synonymous processes, and proportional resources given to the systems of care under its umbrella.

Key findings from the EMS surveys

The survey completion rates were 76.7% for 23 Medical Program Directors (MPDs) and 17.7% for 72 EMS agency leads with representation from rural and urban counties in the state. Most EMS systems in the state are funded by local tax levies that have been relatively stable over the past 2 years. As most counties in Washington are considered rural, challenges associated with rurality are common across the state. The primary challenges identified from the surveys to MPDs, and EMS agency leads converged around four main themes: EMS capacity, hospital overcrowding, EMS-Hospital Collaboration, and Quality Improvement (summarized in figure

14). Quantitative results are presented along with illustrative quotes from open-ended questions in the survey.

EMS Capacity

Funding constraints were an issue reported by both MPDs and Agency Leads, predominately from rural areas where about one-third reported notable staff and equipment deficits. Human resource constraints posed a barrier to meeting the ECS needs of the community, particularly for rural counties. More than half of MPDs disagreed or strongly disagreed with the statement "*My county's EMS system had enough funding to meet demand*" and MPDs from rural regions were 4 times more likely than MPDs from more urban regions to disagree with the statement, "*My county's EMS system was adequately staffed to meet demand*". Approximately 80% of MPDs reported that difficulty with recruiting volunteers has increased in the past year; volunteer staff comprise substantial portions of many rural agencies.

"Difficult to recruit, and not enough funding to hire personnel. "

- EMS Agency Lead

"Most agencies in our area have not been able to keep pace with the growth that drives a higher demand for service."

- EMS Agency Lead

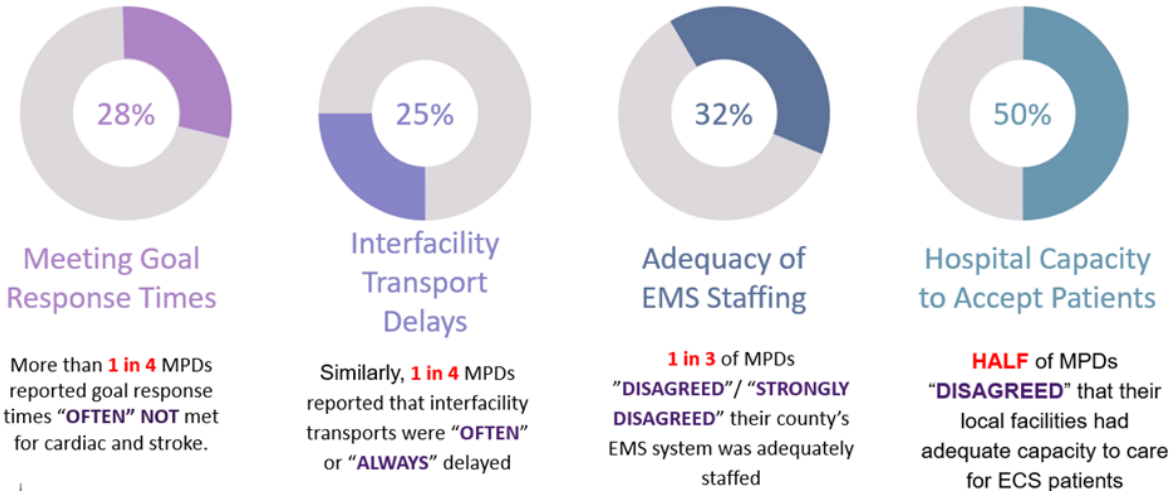
MPDs reported a greater reliance on Basic Life Support (BLS) in rural areas compared to urban areas, though Advanced Life Support (ALS) was reported to be available if indicated in most settings. However, some areas still lack appropriate ALS rigs and personnel to staff those rigs. Positively, MPDs note that the systems do a good job of empowering available care teams to provide care when higher level care is not available. Private ambulance services are commonly used transport modalities to first point of care. This suggests a need to consider these companies, in addition to local fire departments, when developing written transportation agreements or interfacility transport protocols as reliance on private companies may be greater in areas with fewer resources for the municipal fire departments.

We often do not have crews for interfacility transports. During high call volumes, ALS resources are stretched thin."

- Medical Program Director

Figure 16 describes MPD perceptions of capacity challenges in the state. Almost one-third (28%) of MPDs stated that goal response times were often not met (20% for urban, 31% for rural) and another third of MPDs (0% urban; 46% rural) did not know about how well their county was performing on response times. About 25% of emergency cardiac and stroke responses had on-scene times that exceeded 20 minutes, well beyond the recommended response target. These challenges extended into the patient care trajectory, including transportation to the first point of care as well as interfacility transports.

Figure 16: Perceptions of Capacity Challenges by MPDs



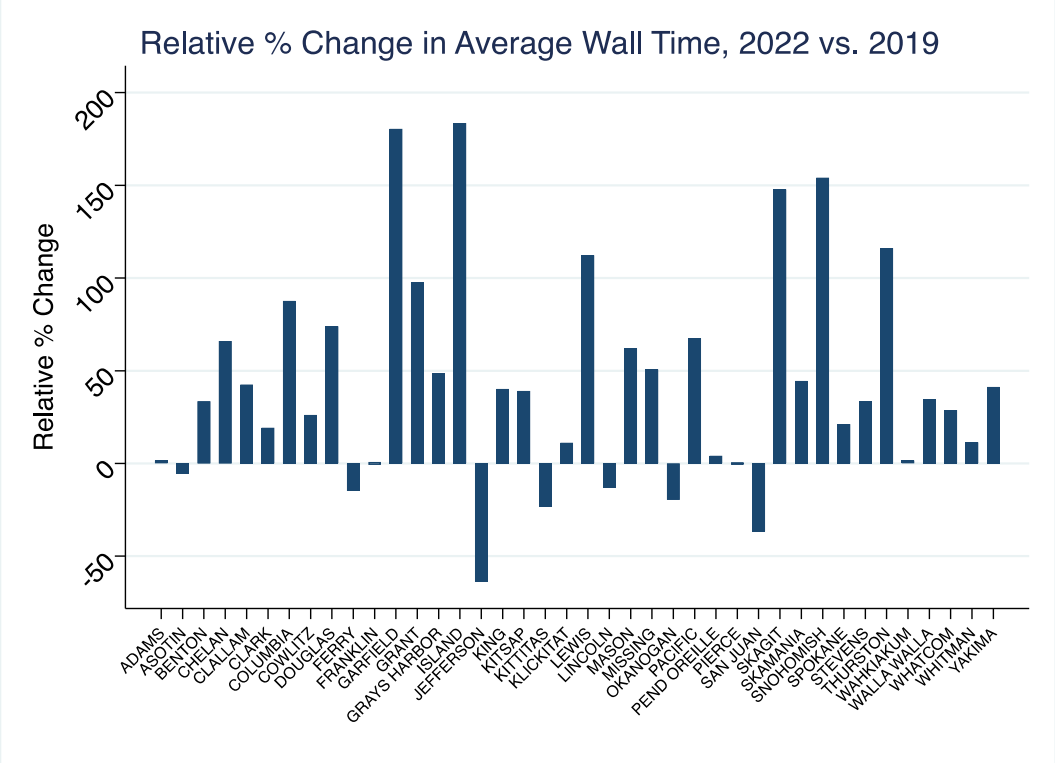
Approximately one-quarter of MPDs (40% urban; 20% rural) reported that interfacility transports were often or always delayed for stroke or cardiac patients due to lack of personnel or specialty transport unit. Approximately half of MPDs and 37% of agency leads reported they have increasingly had to rely on secondary or tertiary response units or mutual aid agreements over the past year for EMS responses in their jurisdiction.

Hospital Overcrowding

EMS services are not the only part of the ECS system to be hindered by capacity issues. Hospitals have experienced increased levels of crowding, resulting in long waits in the Emergency Department (ED) to find space for new arrivals. Just in the past few years, average wall times have risen significantly in most counties across the state (Figure 17; analysis from WEMSIS data).

Figure 17: Change in average wall time, by county

WEMSIS Data, 2019-2022



Half of MPDs disagree that local and regional facilities have capacity to care for cardiac and stroke patients (33% urban; 57% rural) and about one-fifth say that patients are often unable to go to the most appropriate facility due to capacity constraints (0% urban; 27% rural). Almost half of MPDs stated that diversions had increased in the past year (33% urban; 53% rural) suggesting this challenge is affecting most areas in the state.

"ED and hospital overcrowding has produced unacceptable challenges for EMS and patient access. "

– Medical Program Director

EMS-Hospital Collaboration

There are clear opportunities for improvement in collaboration between EMS agencies and local hospitals as noted by many respondents in the EMS survey. Many MPDs and agency leads reported minimal or suboptimal collaboration with their regional hospitals. Most MPDs disagree that local hospitals offer education to EMS service providers. This was particularly notable for rural regions. MPDs from rural regions were twice as likely than MPDs from more urban regions to disagree with the statement, "*Hospital and local EMS agency collaborate closely and have ongoing patient improvement measures* ".

"Our local hospital has no leadership and there is zero collaboration between EMS and the hospitals."

- EMS Agency Lead

The local hospital does not offer education for EMS at all - it has been perhaps 15-20 years since EMS providers were regularly invited to participate in hospital sponsored training locally."

-EMS Agency Lead

There appears to be a desire for increased collaboration and training opportunities, though there is no clear guidance or set of standards as to how this collaboration can and should take place. Categorization applications for Level I & II Cardiac Centers require, "Assistance *with training and clinical education of EMS in coordination with the EMS Medical Program Director, as needed";* this requirement does not appear to be met in some regions and for some facilities.

Quality Improvement

MPDs reported high level of physician involvement, council engagement, and frequent review of WEMSIS Key Performance Indicators (KPIs) and cardiac and stroke outcome data. Less than half of MPDs reported seeing reports about their region's performance in terms of cardiac and stroke outcomes relative to other regions in the state. Many EMS agency leads did not identify any robust quality improvement infrastructure in their region.

"We are not aware of a county-wide QI process. "

– EMS Agency Lead

Adoption of best practices varied across the state. The creation of pre-hospital triage tools was seen as a key success of the early ECS system to improve care quality and were used (at least in a modified form) in most regions. According to MPDs, pre-hospital electrocardiogram (ECG) are available in all units for only 52% of regions and the modified Thrombolysis In Myocardial Infarction (TIMI) score is not implemented in making triage decisions in 71% of the reporting regions. 100% of MPDs state that their counties use the FAST (Face, Arms, Speech, and Time) assessment to screen for stroke and 86% report the implementation of the Learning Activity Management System (LAMS) tool to identify high severity patients likely to benefit from thrombectomy.

The most common issue for quality improvement programs reported by MPDs and agency leads was the lack of systematic sharing and tracking of data across a patient's care trajectory. 41% of MPDs disagree that hospitals share outcomes data. There are some successful local processes for quality improvement work, but additional efforts are needed for regional improvement and collaboration.

"There is no systematic linking of data for EMS and hospitals for stroke and STEMI patients. EMS tracks and reviews hospital care and outcomes for cardiac arrest patients on their own. Repeated efforts to engage hospitals to create a stroke registry have not been successful.

– Medical Program Director

"There is not enough effective exchange of data. There is not nearly enough financial or personnel support for adequate quality management."

- Medical Program Director

There are some considerations when interpreting data from the EMS surveys. A notable finding was greater than expected challenges for the MPDs in accessing quality improvement data. Some MPDs reported that they lacked easy access to the necessary quality improvement data to answer some of the survey items, stating that it would be burdensome to extract and analyze the data themselves. Basic volume data such as 911 calls, strokes, or acute coronary syndrome (ACS) cases were not readily available for many of the reporting MPDs. This suggests an opportunity for a more efficient data infrastructure that would allow MPDs more seamless data access and automatic reporting for evaluating EMS performance.

Key Findings from the Facility Survey

The survey completion rate for ECS coordinators was 52.7%, representing f50 coordinators from hospitals across the state. The first notable finding was the high turnover of ECS coordinator positions at hospitals. Identifying coordinators to respond to the surveys was challenging and the study team had some difficulties finding those currently in this role at some hospitals. Among those who were able to respond to the study survey, rich information emerged around the adoption of best practices, difficulties in transferring patients, limited hospital capacity, delays in interfacility transport, and challenges with participating in robust quality improvement programs.

Adoption of Best Practices

Pre-hospital activation of appropriate care teams is not available or consistently used across the state. On average, 55% of hospital STEMI activations occurred pre-hospital in Cardiac Level I hospitals. Stratified by rural/urban, 33% STEMI activations occurred pre-hospital in rural, and 64% in urban. About half of reporting hospital's stroke activations occurred pre-hospital. Prehospital activation is key to leveraging limited resources at facilities wisely and efficiently.

Difficult Transfer Process

A common challenge reported in the facility surveys, corroborated by sentiments expressed in several key informant interviews was difficulties around transferring patients to the most appropriate care facilities. Hospital staff often spend ample time and resources to identify a receiving facility for their patients and have at times had to transfer patients to hospitals in

neighboring states to receive care. Nearly two-thirds (64%) of respondents stated the difficulty in transferring patients has increased in the past year. Among non-Level 1 hospitals, approximately 1 in 4 of coordinators stated that an interfacility transport unit was frequently unavailable or delayed when they attempted to transfer the patient.

Around 1 in 4 respondents reported difficulties in transferring STEMI patients, whereas two-thirds reported difficulties in transferring NSTEMI patients. Just under half reported challenges in transferring stroke patients. In many hospitals, cardiac and stroke patients awaiting transfer have no access to specialty care and may be admitted, sometimes for days, before transfer to a hospital less optimally equipped to handle their care.

Many Level II stroke centers (41%) report that it was moderately or very difficult to transfer stroke patients to the usual receiving hospital in the past year. For Level II cardiac centers, about one-quarter (22%) of facilities rated that it was moderately or very difficult to transfer STEMI patients to their usual receiving hospital; this jumped to two-thirds (65%) of facilities for non-ST-elevation (NSTE)-ACS or high-risk cardiac patients. Over half of ECS coordinators stated that it had been more difficult to transfer NSTE-ACS and other high-risk cardiac patients in the past year. This suggests an opportunity for promoting more transfer agreements and extending protocolized transfers of high-risk ACS patients.

"NSTEMIs unable to transfer due to bed availability, declining condition, ultimately transferred from our dept that would have likely benefitted from earlier evaluation by cardiology."

These difficulties stem from a lack of capacity at receiving facilities, as well as the availability of teams to transport patients between facilities. 1 in 8 coordinators stated that their usual receiving hospitals were frequently unable to accept their stroke and STEMI patients.

"[It] takes hours and 20+ phone calls to find a bed."

"Bed availability is always a challenge and patients often are boarding in the ED for many days before transfer."

"We frequently have to transfer patients to Boise or Missoula"

Hospital Capacity

Notable challenges in capacity included: staffing challenges, bed capacity, and a lack of capacity to view or access critical clinical data in a timely manner.

Diversions for STEMI, emergent PCI, and stroke were common across facilities. Approximately 55% of all reporting Level I cardiac centers and 33% of all stroke facilities had to go on diversion in the past year, averaging four diversions annually. This was observed in both urban and rural facilities. Inadequate staffing and limited bed availability were the commonly cited reasons for the diversions. ECS coordinators reported increasing frequency of patients needing to be sent out of state to Idaho, Montana, and/or Utah for care. Hospital capacity was a major contributor to these diversions.

Access to specialty providers were highly variable across the state. The availability of specialized providers is crucial to providing timely, high-quality care for ECS patients. Among Level II cardiac centers, 83% have no cardiologist on staff available for ED consultation of cardiac emergencies. Among the Level II facilities that did have a cardiologist available, 25% of them were not available 24/7. The access to providers for addressing stroke is more comprehensive. The majority (81%) of Level II and III stroke centers did have a neurologist available for ED consultation of stroke. Of these, about two-thirds participate in a tele-stroke program and the rest have neurologists on staff.

Persistent issues around timely imaging (CT/CTA) or reads for stroke patients still exist for many facilities. These challenges are primarily around long radiology read times on evenings and weekends.

"We have had troubles with [CT angiogram] readings – especially on nights and weekends. This is due to a radiologist shortage by our contracted group."

"We are recently experiencing longer radiology read times; we are told this is a staffing issue."

Delays in Interfacility Transports

Delays in interfacility transport was a significant concern for most ECS coordinators, especially for those in rural areas. For lower level cardiac and stroke centers, 29% do not have standing written agreements with an interfacility transport agency for patients who need to be transferred to a higher-level center. Written agreements were about twice as likely for urban facilities than for rural ones. Additionally, written agreements did not include all potential cardiac and stroke patients. For example, of those facilities with written agreements for STEMI patients, 23% of these did not extend to non-STEMI patients.

ECS coordinators were frustrated with the current transport challenges and offered many suggestions for how to improve the transfer process. These suggestions included a state-prescribed system for movement of patients from rural centers to primary centers as well as resources to facilitate this movement. Coordinators also expressed a desire for state guidance on EMS time-frame measures to prioritize ECS patients.

Quality Improvement

Over two-thirds (76%) of ECS coordinators stated that their hospital board or administration put cardiac and stroke quality improvement programs as moderate or high priority. There appears to be a significant will by hospitals to participate in quality improvement programs, but time, personnel constraints, and a lack of a standardized quality improvement process impede engagement. Most stated that it was moderately or very important to obtain certification of cardiac and stroke centers from a national accrediting body (59%) and promote universal hospital participation in statewide stroke and cardiac registries for quality improvement (88%). Key stakeholders may need encouragement for QI program participation and concerns around existing cost of certification and IT/data costs to implement would need to be addressed, especially for smaller facilities.

Most (90%) non-Level I facilities report that they do have at least some mechanisms to receive data or feedback on patient outcomes from higher-level hospitals for patients who were transferred from their facility. These mechanisms range from less frequent, higher-level summaries like quarterly reports, to monthly meetings, to daily, specific cases sent via email as needed. Most facilities (88%) attest to comprehensive review of STEMI, cardiac arrest, and stroke cases; many already participate with GWTG, but fewer for cardiac cases. The process for review is highly variable by facility and there are no standardized mechanisms or processes across facilities.

Washington state health facilities have stated additional supports from the department that would support their care of patients with emergency cardiac conditions and stroke include: a system for tracking hospital capacity for transfers, increased funding to rural facilities and EMS,

fiscal and personnel support for data infrastructure and technical assistance for this infrastructure, and additional oversight of state quality improvement processes with standardized performance metrics.

It should be noted that the response rates to the facility surveys was not as high as anticipated. The study team documented several possible reasons for the sub-optimal responses, especially the high turnover rate of ECS coordinators. Additionally, in most rural hospitals, ECS coordinators were ED Registered Nurses (RNs) with their primary responsibilities focused on direct patient care. Responding to the survey was not their top priority as they were often occupied with shifts and providing patient care.

Capacity evaluation

To conduct this analysis, the team analyzed physician licensing information from the Medical Commission Database for Washington state, peer-reviewed medical literature, and reviewed relevant data from KFF's dataset. The team examined the available care providers and hospital capacity to gain a broad understanding of Washington state's ability to provide timely, high-quality care for cardiac and stroke patients.

Population Growth

Washington state has consistently experienced greater population growth than other states across the United States. Since 2010, Washington state's population grew 14.8% from 6.7 to 7.7 million in 2021.[15] For comparison, the population in the U.S. grew 7.3% during the same period. Individuals over 65 years of age comprised the fastest growing population growing from 12.4% of the total population in 2010 to 16.2% of the total population in 2021, a 50.5% relative increase.

Hospital Beds Per Population

In 2021, Washington state had 1.6 acute care beds per 100,000 population compared to 2.37 in the U.S. as a whole, and similar to Oregon's 1.66 beds per 100,000. In general, states in the Western U.S. had fewer beds on average compared to those in the East or South.[16] While all states have experienced declines in the number of hospital beds per capita, the decline has been greater in Washington state compared with other states despite an overall growth in the number of hospitals. Between 2015 and 2021 the number of acute care beds declined 4.2% in Washington state versus 2.5% nationally. This suggests a potential challenge in adequately meeting the healthcare needs of the current population in Washington state. Of note, around a quarter of all licensed hospital beds are unstaffed in the state and between 10-20% of hospital

beds are taken up by patients who no longer require hospital care awaiting long-term care placement.

Number of Hospitals

As of 2021, Washington state has a total of 88 non-federal acute care hospitals that treat adult cardiac and stroke patients. Washington hospitals are categorized based on their level of specialization in cardiac and stroke care. In terms of cardiac care, Washington has 34 hospitals categorized as Cardiac Level I facilities, accounting for 39% of the total facilities. There are 52 hospitals categorized as Cardiac Level II facilities, representing 59% of all hospitals. Washington has eight hospitals categorized as Stroke Level I facilities, constituting 9% of total facilities, 32 hospitals categorized as Stroke Level II facilities, accounting for 36% of the total, and 45 hospitals designated as Stroke Level III facilities, representing 49% of all hospitals. The number of cardiac and stroke centers in Washington is proportional to that of the United States.

A national study in 2015 predicted the 60-minute ground/air access if converting potential primary stroke centers (PSCs) to certified stroke centers (CSCs) by state. If Washington were to have 11 CSCs, the researchers predicted that 65.8% of the population in Washington would have 60-minute ground access. Washington has seven CSCs, which indicates opportunity for improvement regarding timely access for stroke patients.[17]

Workforce

Washington state's number of emergency physicians, cardiologists, and intensivists fall below the national averages and are comparatively lower as compared to other states with similar population sizes. While the total number of medical doctors (MD) per capita has increased over time the number of emergency physicians and cardiologists has remained relatively stable from 2016 to 2021 (Figure 18). With increasing numbers of Washingtonians entering the ECS system, there is concern that the supply of specialty care providers is not sufficient to meet this growing demand. There has also been a decrease in the number of EMS personnel per capita over time (Figure 19), potentially contributing to the increased response times and transportation delays reported by MPDs and ECS coordinators.

Figure 18: Physician supply over time in WA State

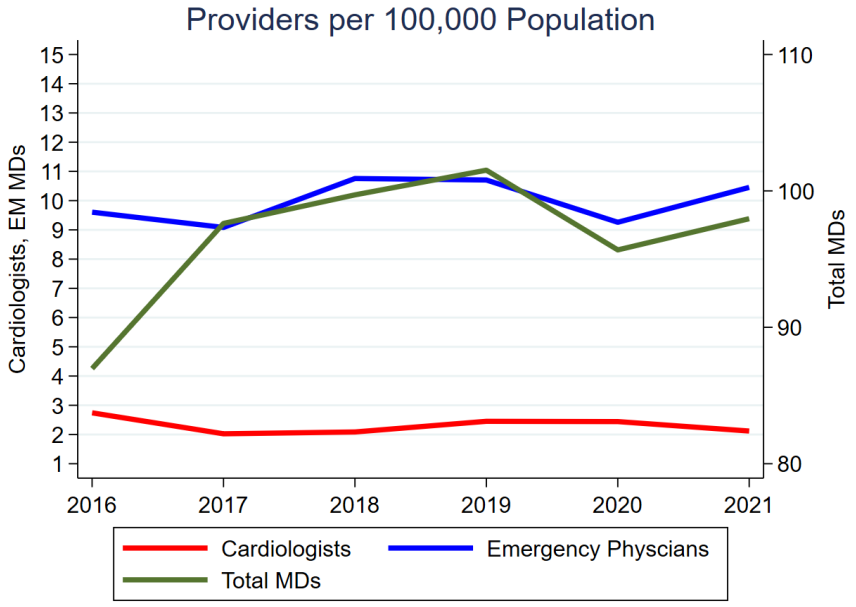
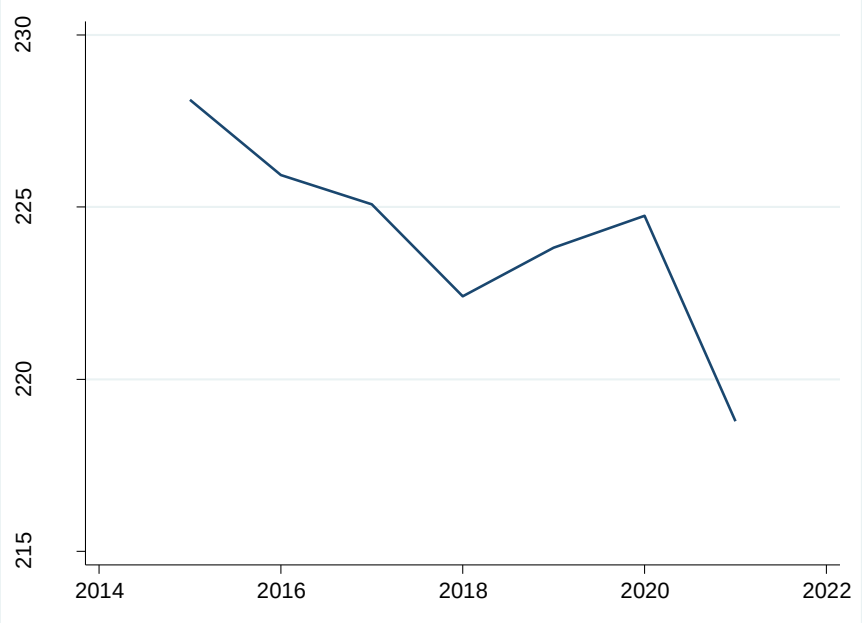


Figure 19: EMS personnel supply over time in WA State



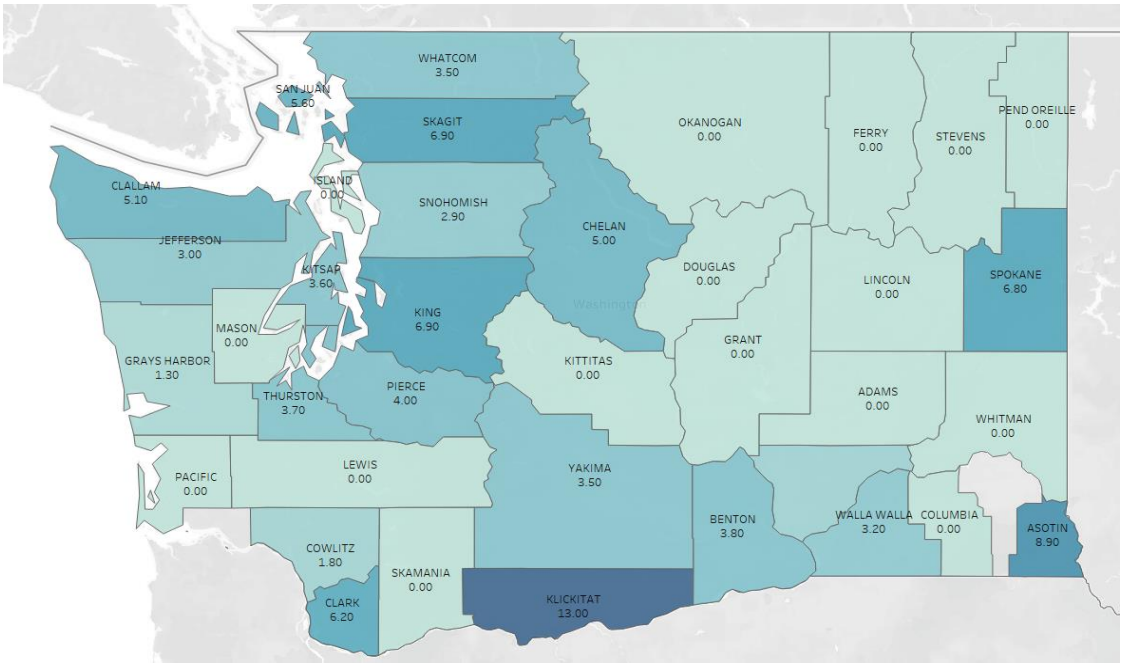
Most counties in Washington have no cardiac and stroke specialty physicians (Figure 20). Although specialists may not be necessary in every county, a well-functioning ECS system is critical to connect residents to appropriate care and the necessary providers of that care.

Beyond physicians, ensuring a robust health care workforce to effectively care for patients with time sensitive conditions is critical. Health care workforce shortages are associated with poor patient outcomes, especially for time sensitive conditions. The COVID pandemic was particularly detrimental to the emergency health care workforce.[18] As many as 18% of health care workers left their profession during the COVID pandemic.[19] Health care workforce shortages are associated with poor patient outcomes, especially for time-sensitive conditions.[20] Fortunately, a recent analysis by the consulting firm Mercer, found that Washington state is expected to have a steady stream of new workers entering the health care market.[21] This does mean that the health care workforce is likely to be younger and less experienced as in the next decade, which has implications for the effective care conditions of stroke, heart attack, and cardiac arrest. The state will likely have to invest in greater efforts to promote coordination and dissemination of best practices in a system with greater turnover.

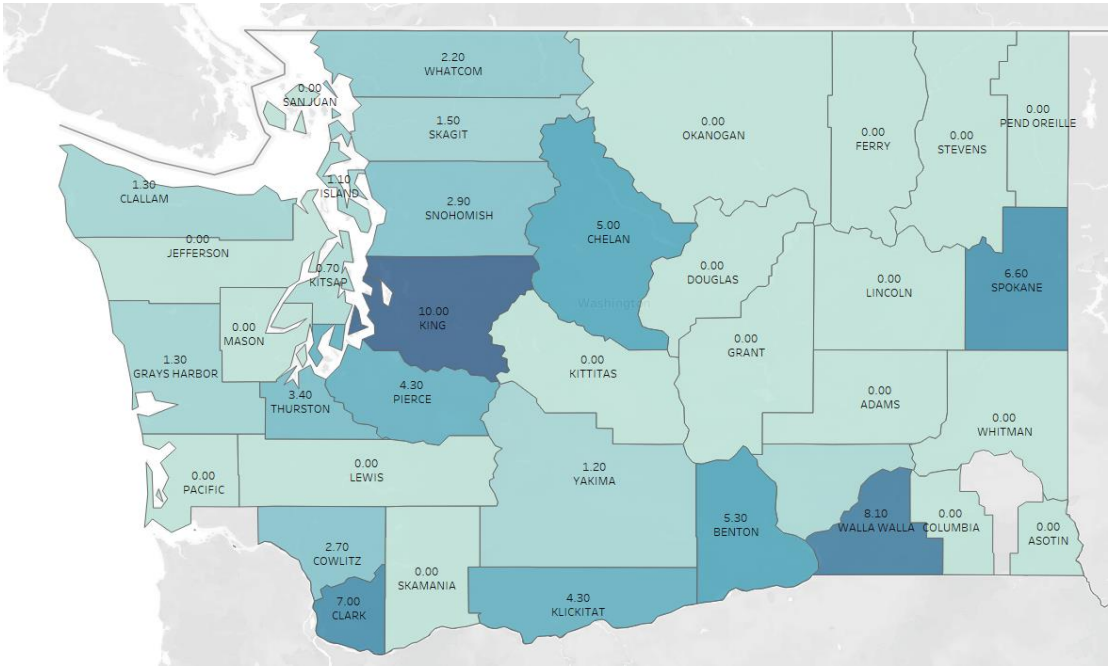
Figure 20: Physician supply by county for cardiologists (top) and neurologists (bottom)

WA Medical Commission Data, 2021

PANEL A: Cardiologists per 100,000 residents



PANEL B: Neurologists per 100,000 residents



Data Landscape Analysis

A high-level snapshot of the data challenges in Washington state are described in Figure 3 in the Appendix. Current data on stroke and cardiac conditions is fragmented across several data sources and platforms that are not interoperable and limited in their ability to link patient data across the continuum of care for quality improvement activities. Datasets that feasibly could be linked, such as WEMSIS and CHARS, require significant labor and backend processing to do so. As a result, to identify outcomes related to a single event, the departmental team must rely on probabilistic linkage using a variety of data elements and patient identifiers contained in WEMSIS and CHARS data. A recent report by the department suggests that this probabilistic strategy only successfully links 36% of all EMS transports in WEMSIS to a hospital record in CHARS.[22] Moreover, no strategy to assign a unique identifier to patients prospectively exists to facilitate better data linkage in the future, though the technological capability exists.

Other existent data sources in the state are disease-specific voluntary registries including GWTG – Stroke and Coronary Artery Disease (CAD), the CARES registry, and the Care Outcomes Assessment Program (COAP) registry. The two GWTG platforms are national registries hosted by the American Heart Association. They are well respected sources of quality metrics related to the hospital care of stroke and cardiac disease. The department has a super utilizer account for GWTG which allows the department to access de-identified data from participating hospitals

and can allow for a fairly robust set of analyses using data aggregated at different levels to evaluate and report out on the quality of care. However, the use of these registries to assess ECS system performance has been limited due to the lack of comprehensive data. Currently, 61 (69%) hospitals in Washington state participate in GWTG-Stroke and only 9 (10%) participate in GWTG-CAD. Additionally, for the state to get individual, deidentified records, hospitals must elect to share their data with the state, and some have not agreed to do so. Consequently, the department is limited to analyses of data aggregated at the county, hospital, or hospital certification level. Finally, GWTG cannot be linked with other data sources like WEMSIS, CHARS, or vital statistics to assess care across the continuum.

The CARES registry is a national registry that collects data on OHCA and is a grant funded initiative in Washington state, led by King County EMS. Care Outcomes Assessment Program (COAP) is a quality improvement consortium of hospitals that provide PCI or cardiac surgery and collects data on various quality metrics related to these procedures. The department currently does not have access to either of these datasets as the data is owned by member EMS agencies and hospitals, respectively; however, the CARES and COAP teams have been willing to share aggregated data reports with the state when requested. Stakeholders involved in the CARES and COAP registries indicated they would welcome a closer partnership with the department in assessing the quality of cardiac care across Washington state.

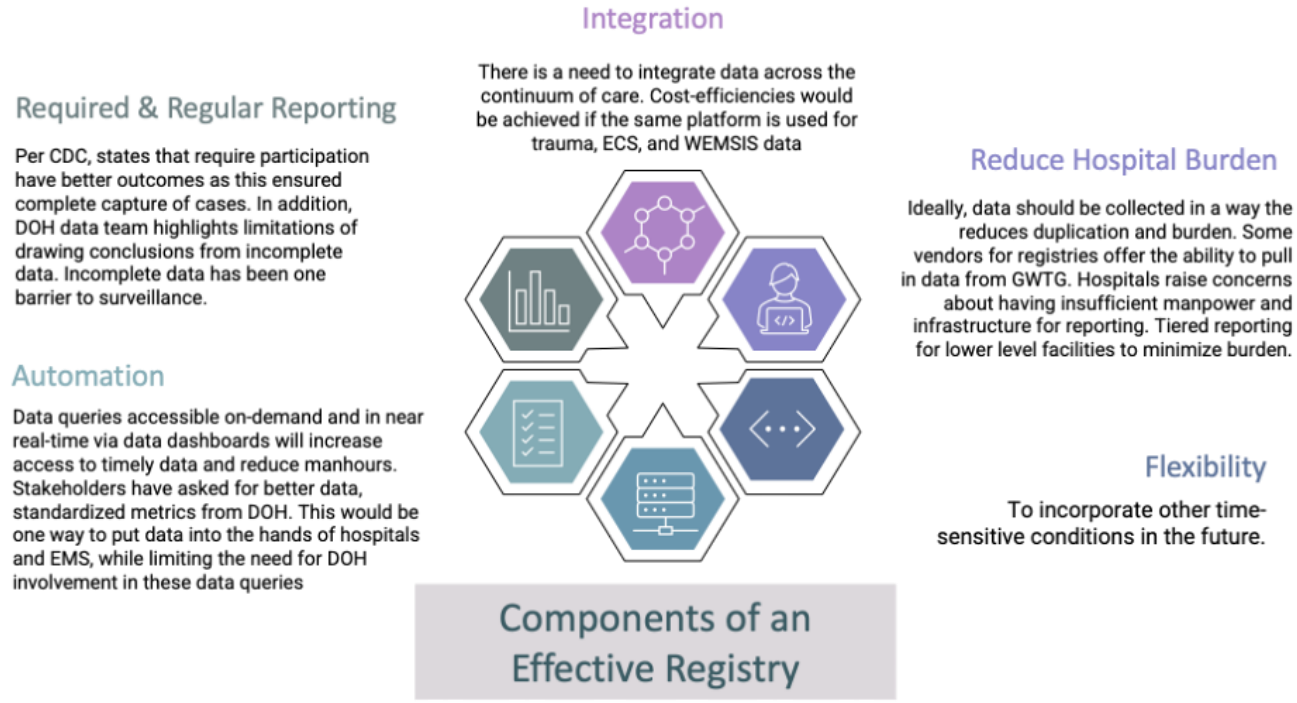
There is minimal data exchange between the department and other entities within the system for providers to benchmark their performance. One Regional Trauma & EMS Council Strategic Report identified a lack of feedback on trauma and other system data as a persistent gap limiting quality improvement activities.

A well-designed statewide registry can address many of the challenges highlighted in the current evaluation, yielding better outcomes via the following mechanisms:

- Ease the burden of quality improvement for hospitals by providing accessible performance and benchmarking.
- Improve data sharing and feedback between EMS and hospitals.
- Reduce labor and improve efficiency to link data at the state/department level if sufficiently automated.
- Improve data completeness and quality.
- Track system performance, areas for improvement, and targeting of resources for state policymaking.
- Better understand capacity challenges and threats to patient safety.

Through a synthesis of literature, state strategy, and stakeholder comments, the evaluation team identified five key features of a well-designed registry: integration, reducing hospital burden, flexibility, automation, and required and regular reporting. These are described in greater detail in Figure 21.

Figure 21: Features of a Well-Designed Registry



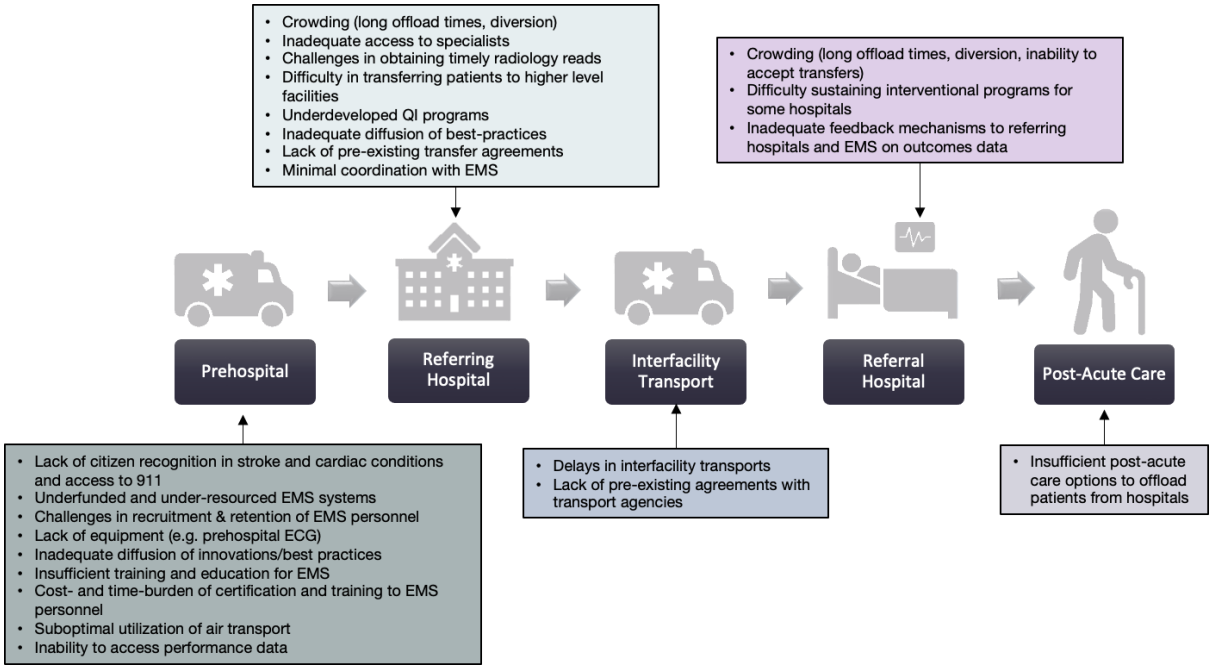
Conclusion

High functioning cardiac and stroke systems of care can reduce variation in health outcomes, narrow health disparities, and improve patient safety. While Washington state has had an ECS system for more than 12 years, it remains a voluntary self-attestation system without independent verification of capabilities or compliance with national standards. Additionally, the system lacks access to data, infrastructure, and system planning to achieve optimal outcomes. Current treatments for heart attack and stroke are some of the most effective in medicine when performed within a short period of time from symptoms onset, yet Washington state falls behind many other states and the U.S. in timely access to these interventions. The findings in this assessment suggest numerous opportunities for Washington state to improve the health of its residents by investing in a robust and sustainable ECS system. To realize these improvements, it is necessary to address the gaps in system capacity, administration, infrastructure, and monitoring of system performance.

Gaps/Challenges and Recommendations

The gaps identified throughout the course of the evaluation are summarized in Figure 22 with further synthesis of the main overarching challenges and priorities to address these gaps listed below. Several system-wide gaps foundational to the success of the ECS system were identified.

Figure 22: Summary of Gaps and Challenges in the ECS System



I. Gap/Challenge: Lack of Data Infrastructure for Quality Improvement

Processes to evaluate the performance of the ECS system and direct resources accordingly is critical to supporting a high-quality and well-functioning ECS system. This includes, but is not limited to, the regular tracking of population outcomes, timely access to care and evidenced-based treatments, health care costs, and the quality of services provided, including disparities in care. A robust data infrastructure would support quality care and quality improvement work.

The lack of an overarching strategy for routine evaluation of ECS system performance remains a gap, limiting the overall effectiveness of the system. The 2010 ECS system legislation included language that hospitals voluntarily seeking stroke or cardiac certification "shall participate in a national, state, or local data collection system that measures system performance from onset of symptoms to treatment and intervention." While more than 90% of hospitals in Washington state are currently certified as cardiac and stroke centers, the comprehensive collection of data into a repository capable of assessing performance across the care continuum has not been realized. A key reason for this is that the lack of requirements for hospitals to report stroke and

cardiac disease data, similar to reporting requirements in other states or for the state's trauma system. Because there are no enforceable requirements for hospitals to submit cardiac and stroke data, no standard set of measures has been defined to characterize ECS system performance and no routine program of surveillance of ECS outcomes exists.

Recommendations:

1. **Establish and maintain a process for the statewide collection and dissemination of cardiac and stroke data to ensure system oversight, quality improvement, and future policymaking. This would ideally be supported by defining a standard set of measures for system performance and identifying a sustainable and integrated clinical data repository that supports the mission to improve cardiovascular health and reduce disparities, quality improvement and future policymaking.**

   There is a critical need to collect ECS data at a centralized and state level to support ongoing quality improvement and monitor system performance. Such activities cannot be accomplished without processes and procedures for the regular surveillance of relevant conditions and a clinical data repository to support data collection and analysis. Of all the priorities articulated and suggestions made by stakeholders throughout this evaluation, developing a comprehensive statewide data collection system with active participation from all sectors involved in the continuum of care was felt to be one of the most, if not the most, critical step. While Washington state is often looked to as a leader in providing high-quality and timely care, Washington is in the minority of states (25%) that lack state statute supporting a comprehensive statewide data collection system for stroke and/or cardiac events.

   Rather than develop a separate ECS data collection system; however, there would be significant cost- and time-efficiencies achieved by investing in an integrated time-sensitive emergency condition data collection system that combines hospital data for multiple conditions including cardiovascular emergencies, stroke, and trauma with prehospital data on a single platform. The department manages the EMS and trauma data on two separate data platforms and is exploring options to consolidate data collection into a single platform for time sensitive conditions.

   An integrated data collection system that included ECS data would yield benefits such as cost savings, reduction in reporting burden for hospitals and integrated data systems for both the state and care providers.

2. **Until an alternative exists, develop a statewide data strategy that maximizes the use and utility of currently available sources of ECS data for a routine program of system monitoring.**

   While the data are imperfect, there is much that could be done to utilize and improve on existing data resources. Given the capacity and other resource constraints listed above, there currently is no routine data collection, analysis, or benchmarking for ECS system performance. The first step is to ensure the WEMSIS, CHARS, vital statistics, GWTG, and other data sources existent in the state are regularly collated, analyzed, and developed into reports that are meaningful and used to direct programs and policies. These data sources shed light on disparities in care, improving or worsening outcomes in specific areas, the effects of policy change, among others. Stakeholders, such as Regional Council leaders, MPDs, members of the ECS TAC, among others, desire data for decision-making.

   Second, in addition to maximizing the use of existent data, there is a need for a comprehensive data strategy that enhances the utility and quality of ECS data going forward. There is significant attention on improving the quality of WEMSIS data in recent years, which is one source of ECS data. National guidelines suggest that best practices for a stroke or cardiac system of care is to have a data system capable of linking data across the care continuum. A next possible step would be to implement a mechanism to expand data interoperability in a way that provides EMS, hospitals, and state agencies with data from across the care spectrum. Solutions may include data linkage tools and interoperability mechanisms such as Health Information Exchange (HIE), Master Patient Index (MPI) and automated unique identifiers. Such solutions could enable real-time feedback for care providers, data insights for state and national agencies and improved data for outcomes and quality improvement analysis.

   Other strategies could include encouraging hospitals to share outcomes data with local EMS providers and providing technical assistance to establish processes to do so, moving towards use of a single or limited number of ePCRs that can effectively integrate hospital data to support bidirectional, real-time feedback of data between EMS and hospitals, or expanding participation in national registries like GWTG statewide. While numerous other processes could be implemented, what continues to be needed is an overarching near- and far-term strategy with respect to ECS data in the state, such as the example given in Figure 21 below.

II. Gap/Challenge: Lack of Quality Improvement Standards and System Infrastructure

No Requirement for National or State Certification for ECS Centers: National certification or clear state standards are highlighted by the CDC as two of the most effective policies states can undertake to ensure robust stroke systems of care and play a crucial role in improving quality and patient outcomes. Nationally certified Primary Stroke Centers – which are similar to Level II Stroke Centers in Washington state – are the backbone of the stroke system. Also, there is emerging evidence that national certification or state standards for Comprehensive Stroke Center Hospitals (Level I Stroke Centers in Washington) and Acute Stroke Ready Hospitals (Level III Stroke Centers in Washington) improve patient outcomes as well. This is achieved by following standardized best practices so health care providers can ensure consistent and effective health care delivery and reduce variations in treatment that could otherwise impact patient outcomes.[30]

Standards and certification also emphasize patient safety, reducing the risk of medical errors and adverse events, and regular monitoring and evaluation by certification bodies ensures adherence the quality standards and provides opportunities for improvement. Certification and standardization often involve the collection of patient data which can be used for research and analysis, helping to identify trends and best practices. Quality improvement initiatives are often encouraged by certifying bodies as well, motivating providers to analyze their practices and outcomes continually, leading to ongoing efforts to enhance patient care. While no similar state policy evaluation exists for cardiac systems of care, it is likely that complementary policies for cardiac center certification would yield similar benefits in improving patient outcomes.

Washington state's ECS system does not require a national or state certification, and the department's authority is limited to encouraging hospitals to self-identify which level of cardiac or stroke certification they meet. Many other states require national certification as a pre-requisite for state certification of cardiac and stroke centers or have a clear set of regulations specifying the standards that cardiac and stroke center certification. There is a need for processes or procedures to ensure that stroke and cardiac centers in the state are following a set of uniform standards, supported by a clear regulatory framework. Audits in other states, such as that in Massachusetts, found deficits in several areas related to appropriate staffing, processes and procedures for stroke care, and quality assurance among certified stroke centers.[31] Identifying these deficits is necessary for system improvement and enhancing quality of care.

There is no funding to carry out the expanded activities outlined in the ECS legislation of 2010. Sustainable funding is a critical component of system infrastructure. This lack of funding has limited the development of necessary infrastructure for all levels of the system, including administration, data collection and surveillance, and support to hospitals and EMS agencies, including technical and financial support to ensure the implementation of best practices and quality improvement.

Recommendations:

1. **Strengthen accountability in the process by which cardiac and stroke centers are certified**

To reduce morbidity and mortality for cardiac and stroke events, require all cardiac and stroke centers to obtain designation from a national accrediting body or from the state through a more rigorous process ensuring hospitals are following nationally recognized standards of care with periodic site surveys and medical record reviews. This approach would be similar to the state's trauma care system and designation structure in addition to other areas where national accrediting bodies or the state designates/credentials licensed entities to help ensure a minimum standard of care.

2. **Develop a statewide plan to better track and address ECS system capacity, including establishing metrics to identify when capacity is insufficient to meet demand.**

Sufficient capacity to care for stroke and cardiac patients is a critical element of ECS system performance. Currently, Washington state hospitals are experiencing a capacity crisis; however, the extent to which this is impacting the care of ECS patients is unknown. For example, there is no systematic tracking of capacity measures like rates of diversion, difficult or prolonged transfers, declined transfers, etc. across the state. Moreover, real time data on ECS system capacity is not available to system providers through comprehensive data dashboards.

There is a need for infrastructure to monitor regional capacity in the ECS system and a process to bring stakeholders together to address any identified challenges. This includes establishing a set of benchmarks to determine when capacity in a community/region is insufficient to meet demand.

A model for Washington state would be to implement a system like the Oregon Capacity System (OCS).[35] The OCS was developed as a solution to provide real-time hospital bed and other resource data during the COVID pandemic. The OCS automatically pulls and integrates data from the electronic medical record of all hospitals in the state into data dashboards that allow providers to see which hospitals have bed availability in the state, and what types of beds and specialty resources are available. Similar real-time data dashboards for EMS capacity are being implemented in many communities in the US as well to assist with EMS decision-making. Rural and less resourced hospitals would benefit from greater engagement in identifying solutions to improve the ease and timeliness of transfer when capacity is constrained. There may also be a role for the Washington Medical Coordination Center (WMCC) to assist with movement of ECS patients through the system.

3. Resources Needed to Strengthen the current ECS system.

The ECS system needs to be expanded to ensure patients have access to care. Many of the components of the system are in place but need more resources to lead system administration. Developing a more robust infrastructure including the development and execution of a strategic plan for the system, coordination and direction of stakeholders, technical support to hospitals, EMS and other providers involved in caring for these patients would benefit all. Key informants and stakeholders expressed a need for ECS system administration and infrastructure and a centralized data structure and program for monitoring system performance.

- **Nevada** (NRS 439.5295 through 439.5297) requires its Division of Public and Behavioral Health (DPBH) to not only establish and maintain a stroke registry, but to: "encourage and facilitate information, conduct data analysis and sharing, and adopt and carry out procedures to utilize the data to analyze the response to and treatment of strokes in Nevada." In addition, the DPBH will use the data analysis to identify potential solutions for the treatment of stroke.
- **Virginia** (§ 32.1-111.15:1) specifies that the "Department shall be responsible for stroke care quality improvement initiatives in the Commonwealth" including "implementing systems to collect data about stroke care", "facilitating information and data sharing and collaboration among hospitals and health care providers to improve the quality of care", "establishing a process for continuous quality improvement for the delivery of stroke care".

4. Use monetary and non-monetary incentives to encourage hospitals to engage in quality improvement activities.

While clear rules for cardiac and stroke centers can help define what activities hospitals are expected to engage in, including those related to quality improvement, a suite of incentives to encourage robust participation in local and regional quality improvement initiatives is needed. Incentives can be targeted to enhance coordination, improve data exchange with EMS, engaging in training and educational activities with EMS, support data abstraction, or the adoption of evidenced based care processes, among others, with the overall goal of improving system engagement and performance. Specific incentives may include:

- Participation/engagement grants for hospitals.
- Stipends to ECS coordinators and other quality leads.
- Public recognition and awards for high-performing hospitals (e.g., Gold, Silver, Bronze status).

- Confidential performance feedback benchmarked to the state and similar hospitals ideally paired with technical assistance to address challenges to optimal care.

III. Gap/Challenge: Limited Hospitality Capacity and Access to Specialists

Hospital Capacity: Health care system capacity was an issue prior to the COVID-19 pandemic, was exacerbated by the pandemic, and now seems to be further strained as facilities experience ongoing staffing and supply chain issues. Lack of hospital capacity has specific consequences for the performance of stroke and cardiac systems of care. Washington state has long lagged behind other states in the availability of acute care beds and specialists per population, and with the substantial growth in the population experienced by the state over the past decade, capacity is more constrained today than it was when the ECS system was created. Strategies to address hospital crowding and workforce shortages will remain a critical need for the state in the foreseeable future and are closely tied to the performance of the ECS system.

Hospital crowding has increased the rate of emergency department diversions, cardiac catheterization lab diversion, and increased offloading times for EMS providers. Studies have demonstrated that ED diversion is associated with higher mortality from AMI.[24,25] When hospitals go on diversion, EMS crews may have to transport patients longer distances to less optimal facilities, which can impact outcomes for patients needing immediate care.

For rural and other referring hospitals, crowding creates bottlenecks in transferring patients leading to delays in care and greater mortality and disability. Some cardiac and stroke centers in the state appear to be struggling with their ability to accept appropriate transfers. Lack of beds at referral centers leads to patients boarding at lower-level facilities that may be poorly equipped to manage a sick cardiac or stroke patient. For example, while the patient waits, they may not have access to cardiology or neurology consultation and may not get early evidenced-based care.

Access To Expert Consultation and Sharing of Best Practices: Gaps in access to neurologists, cardiologists, and radiologist consultation exist throughout the state. Currently, 19% of rural and referring hospitals in Washington do not have a neurologist on staff nor participate in a tele-stroke program. While tele-stroke programs are available for hospitals who do not have a neurologist on site, these programs are underutilized. The use of tele-stroke is an evidenced-based, Class I intervention by the AHA that has been shown to increase early thrombolytic use and improve functional outcomes.[27,28]

Many hospitals in Washington state report difficulty with timely radiologist reads of CT angiograms (CTA) for stroke. CTA is the primary mechanism by which a large-vessel occlusion, and thus a patient who may be a candidate for Endovascular Thrombectomy (EVT), is diagnosed. Patients with large-vessel occlusions need to be expeditiously transferred to a thrombectomy-capable stroke center. Many hospitals use virtual radiology services for their CTA reads; however, according to stakeholders these services may not be adequate systemwide to ensure timely evaluation of patients with stroke.

Stakeholders identified an issue with early consultation with cardiologists. While referral pathways are generally well defined for STEMIs, a much larger number of patients are diagnosed with non-ST elevation acute coronary syndromes (which includes NSTEMI and unstable angina). Current guidelines suggest that patients in this latter category with high-risk features undergo angiogram within 24 hours, and sometimes sooner,[29] which necessitates timely transfer to a PCI-capable facility. Unfortunately, the vast majority of Level II cardiac centers in Washington state do not have a cardiologist available for patients with cardiac emergencies. In addition, many of these facilities are experiencing substantial delays in transferring cardiac patients and find it especially difficult to transfer patients with non-ST elevation acute coronary syndromes.

RECOMMENDATIONS:

1. **Expand access to early expert consultation for cardiac emergencies and stroke among rural and other referring hospitals.**

   Facilitating strategies to ensure timely expert consultation is a vital component of the statewide plan and coordination of the ECS system. The state should focus on strategies to ensure that all patients have access to early specialist consultation, which has been shown to facilitate diagnosis and rapid treatment decision-making and increase the use of evidence-based treatments. Specific strategies could include:

   - Ensuring all hospitals that do not have a neurologist on staff are participating in one of the state's tele-stroke services to assist providers with rapid treatment decision-making and to facilitate timely transfer to an appropriate Level I or II stroke center.
   - Ensuring adequate supply of radiologist services to support hospitals in making timely diagnoses of large-vessel occlusions, especially during nights and weekends.
   - Developing guidance around the timeliness of radiology reads and ensuring that hospitals have implemented processes to meet these best practices.

- Ensuring effective health information exchange so that consulting tele-stroke neurologists can visualize CTAs at other hospitals.
- Expanding software to better identify the amount of salvageable brain tissue in a large-vessel stroke (e.g., identify the ischemic penumbra) to optimize transfer decisions.
- Implementing more rigorous certification standards, use of tele-stroke and the timeliness of radiology reads could be components evaluated in the verification process.
- Ensuring that EMS agencies can obtain and transmit ECGs to facilitate real-time assessment and, if necessary, teleconsultation with a cardiologist.
- Exploring innovations in telecardiology solutions, akin to those for stroke, to enhance timely cardiologist consultation for patients with cardiac emergencies.

2. **Develop mechanisms to facilitate the sharing and adoption of best practices for stroke and cardiac emergencies across the system.**

   There is an opportunity for creating avenues for sharing of best practices and providing technical assistance to hospitals to enhance the robustness of quality improvement. Cardiac and stroke triage destination procedures are well disseminated and utilized by most agencies in the state, though there appear to be additional opportunities to expand the use of evidence-based practices in the prehospital setting such as ensuring the consistent use of prehospital risk stratification tools for stroke and cardiac disease, expanding prehospital notification of stroke and STEMI, use of prehospital ECG other technologies (e.g. Pulsara) that facilitate notification of hospitals and coordination between EMS and hospitals.

   Currently, the lack of routine monitoring of hospital data quality is a lost opportunity for identifying gaps in performance and offering assistance with improving care by sharing best practices, guidelines and technical assistance. A clinical leader (nurse coordinator) who maintains relationships with hospital clinical leads and can help hospitals identify and implement best practices needed for the ECS system. Less resourced hospitals would benefit from having a clinical expert to help coordinate the adoption of ECS best practices, troubleshoot local quality improvement challenges and create avenues for sharing solutions across hospitals facing similar challenges.

3. **Engage stakeholders in solutions to overcrowded EDs, ambulance diversion/offloading delays and discharge to rehabilitation facilities.**

Beyond general strategies to reduce hospital crowding, focused efforts to address increasing ED diversion and offloading delays throughout the state will free up already taxed EMS resources and expand EMS capacity. Diversion and offloading delays are specific problems that impact patient safety. The California Hospital Association in conjunction with the California Emergency Medical Services Authority has created a toolkit to reduce ambulance patient offload delays that could be adapted for Washington state.[36] Recommendations within this document suggest creating standard definitions of an offloading delay, tracking offloading delays including sentinel events when offloading delays are extreme, as well as creating action plans to address offloading delays. There are many stable patients transported by EMS that could safely be triaged to the waiting room, rather than have EMS personnel wait in a hallway. Clear policies are needed to support efficient triage of patients, including guidance when it is safe for EMS to sign out to a triage nurse and leave patients in the waiting room. Implementing programs that allow EMS to transport certain patients to alternative destinations other than crowded emergency departments will free up emergency department beds for higher acuity patients.

Ambulance diversion is used as a temporary strategy for emergency departments to cope during periods of high volume. However, while diversion may relieve congestion in one hospital, it can increase congestion at neighboring hospitals and lead to more delays in care overall for patients in the system. Thus, from a systems perspective, diversion often harms more than it helps. Many states have moved towards policies that limit the use of diversion. These include implementing regional agreements on when to invoke diversion, use of technology like the capacity data dashboards described above to distribute resources, and increasing staffed beds in a community.[37] Massachusetts banned hospital diversion completely in 2007; the ban did not appear to worsen emergency department crowding, and, in fact, average ED throughput in the region increased.[38] Additionally, better visibility into real-time bed capacity for acute and post-acute settings would help address hospital capacity issues while providing data to inform future policy discussions.

IV. Gap/Challenge: EMS Capacity and Workforce Challenges

EMS remains underfunded and lacks access to basic equipment and training for cardiac and stroke care in much of the state. This is demonstrated in data related to reliance on volunteers, poor response times and EMS agencies' inability to participate in quality improvement activities. Prehospital resource constraints impair their ability to provide optimal care and can be especially detrimental for time-sensitive conditions like cardiac arrest, heart attack and stroke. In particular, the evaluation team heard substantive difficulties in hiring adequate personnel and maintaining services in rural counties that continue to rely heavily on a declining population of volunteers.

As health systems have become more consolidated and regionalized, an increasing number of EMS response services now bypass local hospitals or provide interfacility transport services, which has tended to increase transport time and overall demand for services. Timely interfacility transports remains a significant challenge for EMS agencies throughout the state and often stem from lack of trained personnel or units to respond to these calls. Delays in interfacility transport can significantly impact patient outcomes and the availability of treatment for patients with time-sensitive conditions. Patients undergoing interfacility transport are a unique group of patients that often require critical care services that are outside the training and scope of many EMS personnel. For example, patients may be unstable, receiving infusions of thrombolytics or multiple medications that decrease or increase blood pressure, or require ongoing changes to ventilator settings. Thus, interfacility transports are often provided by specially trained teams at private EMS agencies. For rural areas, interfacility transports are typically provided by air ambulance companies that have critical care nurses performing the transports. However, air transport is also weather-dependent, necessitating ground transport as backup.

Finally, quality improvement efforts by EMS across counties are highly variable, with some more resourced counties providing additional monetary support to MPDs and county quality leads to facilitate robust quality improvement efforts and less resourced counties have difficulty accessing even basic metrics of performance to act on.

Recommendations:

1. **Undertake a study to determine how best to address EMS workforce needs and fund EMS systems in Washington state, including identifying optimal delivery and reimbursement strategies for rural and volunteer agencies.**

   The challenges around EMS workforce and financial viability are myriad and stretch beyond the scope of the current ECS evaluation. These challenges are not unique to Washington state. For example, New York undertook a recent comprehensive assessment of EMS capacity in the state and has many recommendations that are relevant to Washington state.[34] While suggestions for increased grant funding to EMS agencies for training and capital investments will be helpful, these small investments are unlikely to address the fundamental challenges facing many rural, less resourced and largely volunteer EMS systems. In addition, the gaps in access to training and equipment were not as large as expected, at least among the agency leads responding to the survey. There are likely innovative strategies and focused investments the state could implement to ensure adequate access to prehospital care that may come to light with a focused evaluation of EMS funding and capacity in the state.

2. **Develop a plan to reduce delays in interfacility transport for patients with time-sensitive conditions.**

   There is a need for the state to ensure a reliable system of interfacility transports as part of the overall planning of the ECS system. Ideally, the state should ensure that there are adequate EMS resources in a community to ensure interfacility transports of potentially critically ill stroke and cardiac patients, that scope of practice and skillsets for EMS providers conducting critical care transports are clearly defined, and that referring hospitals have existing contracts with an interfacility transport agency. Having a hospital partner or contract is necessary for many commercial ambulance companies to stay financially viable. As a result, there would be bidirectional benefits if the state were to ensure that all hospitals have existing transfer agreements with an ambulance company. Regular review to ensure the appropriateness of interfacility transports in quality improvement programs would also ensure that limited transport resources are maintained for patients who truly need them.

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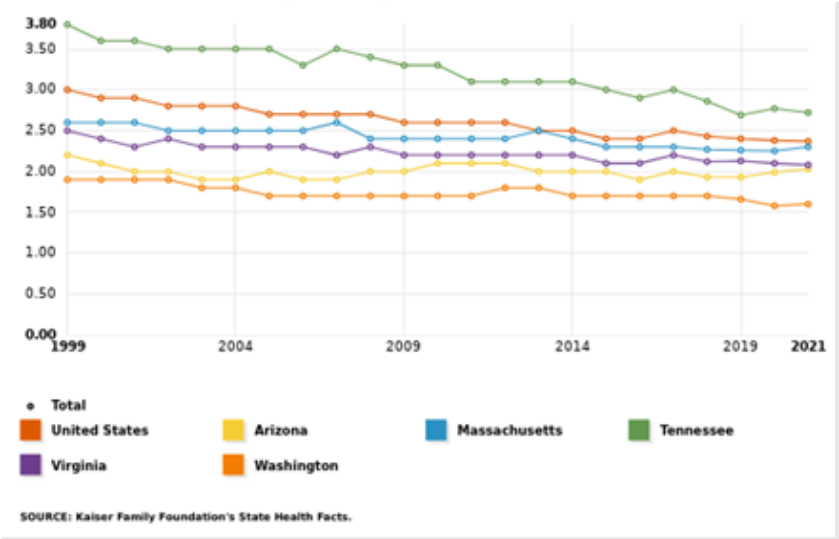
Appendices

Key Information Interview Guide (Semi-structured)

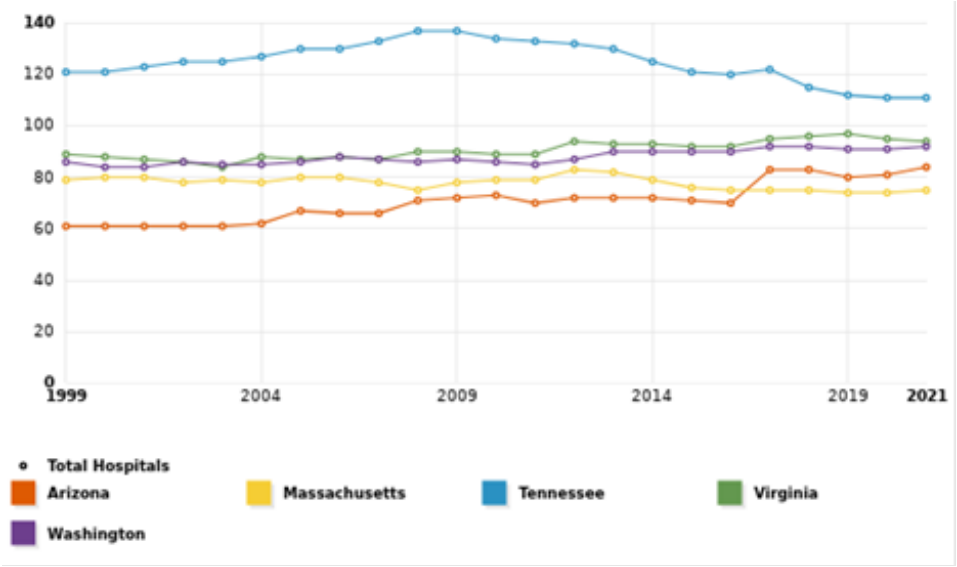
1. What is your role and how does your role interface with the ECS system?
2. The current ECS system was established in 2010 via legislation. The goal is to improve health outcomes for patients. Given the system that was implemented, what do you think is working well or see as strengths of the system?
    a. Prompt: What have you seen as successes in the past decade? What interventions has Washington, or your region, implemented that has improved outcomes?
3. What are the challenges or problems that persist in the current system?
    a. Prompt: administrative, legislative, clinical care, access to care, resources such as personnel, infrastructure, public health
4. We would like to discuss what you think the optimal system looks like. If you could fix one thing, what would be your top priority for improving the system?
    a. Prompt: What entity would best support this change; What do you think the department, Legislature or local leaders could do to address this?
5. Are there any other critical priorities that you would like to see addressed?

EMS Survey: MPD
EMS Survey: Agency Lead
Facility Survey: ECS Coordinator

Appendix Figure 1: Hospital beds per 1,000 population



Appendix Figure 2: Total hospital faciltiies



Appendix Figure 3: High-Level Data Landscape Summary