State of Washington

Emergency Care Systems

Air Ambulance Service Plan

Initial Development and Implementation January 16, 2007

Revised October 2010

Revised January 2019

Office of Community Health Systems

State of Washington

Emergency Care Systems

Air Ambulance Service Plan

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Preface

RCW 70.168.010 states "It is in the best interest of the citizens of Washington State to establish an efficient and well-coordinated statewide emergency medical services and trauma care system to reduce costs and incidence of inappropriate and inadequate trauma care and emergency medical service and minimize the human suffering and costs associated with preventable mortality and morbidity."

The Department of Health (department) recognizes air ambulance services as having a distinctive role within the emergency care system. Aircraft have statewide flight range capabilities and logistical considerations that differ from ground services that require a strategic approach in managing resources and a coordinating a system of medical response.

This approach enables citizen access to the best patient care and transport capabilities. It works to mitigate an unsafe prehospital transport environment to the extent possible.

Air ambulances can provide a high level of out-of-hospital care, and rapid, expedient transport for critically sick and injured patients.

Strategic coordination, deployment, and quality assurance strategies for air ambulance services can improve outcomes in patient care.

For these reasons, our EMS and Trauma Care Steering Committee (EMSTC-SC) recommended the development of a statewide Air Ambulance Plan (plan). With oversight from the department, the air ambulance services workgroup (workgroup) and Prehospital Technical Advisory Committee (PHTAC) were tasked to develop and manage the plan.

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Washington State EMS and Trauma Care Steering Committee

Local and Regional EMS and Trauma Care Councils

Northwest Association of Aeromedical Responders

National Association of State EMS Officers

Aeromedical Accreditation Organizations

National Organization of State Offices of Rural Health

Page Contents

Purpose

The purpose of this plan is:

- To assess and analyze statewide air ambulance use in order to generate a strategic approach for coordinating and improving emergency care in the out-of-hospital setting.

- To provide peer-reviewed guidance about air ambulance asset use for emergency care system partners.

- To serve as both a planning resource for each EMS and trauma care region's (regional EMSTC) biennial plan for prehospital resources, and as a guideline for developing regional EMS patient care procedures (PCP) about air ambulance service use.

Executive Summary

The Washington State EMS and Trauma Care Steering Committee (EMSTC-SC) establishes the vision, mission and priorities of the emergency care system to support state strategic planning. Below are the vision, mission, and priorities for the 2018-2021 strategic planning period.

Vision

Washington has an emergency care system that reduces death, disability, human suffering, and costs from injury and medical emergencies.

Mission

We work to maintain and strengthen an accessible, efficient, high-quality, well-coordinated, statewide emergency care system.

Challenges

Rapidly changing healthcare environment, limited and declining resources, increasing demand, workforce shortages, barriers to quality assurance and improvement, unequal access, rapidly changing technology, drivers of public expectations, and sustainability of community collaboration.

Priorities

Quality, cost, access, data-driven decision making, education and outreach, improving integration and collaboration, resource and workforce development, regulatory adjustment.

The overarching goals of the Washington state emergency care system as reflected in the state strategic plan are to:

1. Increase access to quality, affordable, and integrated emergency care for everyone in Washington.
2. Prepare for, respond to, and recover from public health threats.
3. Promote programs and policies to reduce the incidence and effect of injuries, violence, and illness.
4. Promote and enhance continuous quality improvement of emergency care systems for Washington.
5. Work toward sustainable emergency care funding, enhance workforce development, and demonstrate impact on patient outcomes.

Strategies and objectives in the plan align with the vision, mission, and priorities established by the EMSTC-SC, and are designed to evaluate, advance and develop air ambulance service use across the state.

Introduction

This plan was developed and initially implemented in January of 2006 through the collaborative work and dedication of EMS and trauma care stakeholders. The department provided oversight, technical guidance, and support as needed. The first revision and current version of the Air Medical Plan occurred in October of 2010. This is the second revision. The need for future revisions will be evaluated biennially.

The plan provides a broad overview of air ambulance services planning and use in Washington state.

The plan includes a clear purpose and an analysis of air ambulance use for the planning period. That supports the development of goals to improve the air ambulance component of the EMS system as aligned with the state EMS plan. Measurable outcomes and achievable strategies for improving air ambulance use and out-of-hospital medical care are included.

The plan includes a historical snapshot of goals, strategies, and outcomes from previous planning cycles, and a review of the regulatory framework for air ambulance services.

The plan provides peer-reviewed recommendations for EMS use of air ambulance services that local and regional EMS councils use to develop operational guidance for EMS about air ambulance services use.

Regulatory Framework

This section provides a broad overview of Washington state regulations. It is not intended to be an all-inclusive list of the regulations that may apply to air ambulance services operating in the state.

RCW 18.73 requires the department to establish minimum standards for air ambulance services and equipment, and requires the department to issue an air ambulance license.

The goal of the statute is to:

- Ensure safe emergency medical care and transport by ambulance is provided to Washington state citizens.

The specific objectives of the statute are to:

- Establish minimum medical and clinical standards for air ambulance services to provide medical care to ill and injured citizens, and;
- Ensure consistent, high-quality, medical care can be delivered by air ambulance services in Washington State.

WAC 246-976-320 identifies the regulatory standards for air ambulance services.

The rule implements the goals and specific objectives of the statute by proposing minimum standards for:

- Completing a department-approved application for licensure and verification;
- Documentation to validate aircraft registration, operations specification, and airworthiness of fixed-wing and aeromedical helicopters;
- Documentation required to determine proof of insurance;
- Physician medical director oversight including quality management and a review of patient care data, and patient care protocols for medical treatment and care;
- Staffing by qualified medical personnel for all air ambulance services;
- Training and administration requirements for medical personnel for all air ambulance services;
- Aircraft configuration serving medical purposes under state purview that is specific to providing adequate medical care;
- Administration requirements, and minimum lists of medical equipment and medications that must be available for patient care.

Who We Are

We recognize that the air ambulance component of our EMS system needs an evidence-based, peer-reviewed, stakeholder-supported, and consistent approach to developing, monitoring, and evolving air ambulance services using specialized subject matter experts in the field.

Air ambulance subject matter experts from our state air ambulance services comprise the bulk of the statewide air ambulance workgroup. This includes department-appointed and certified EMS physician medical program directors (MPD) and their appointed physician delegates (MPDD). They provide physician oversight as needed to air ambulance services, nurses, paramedics, and other licensed air ambulance professionals, pilots, EMS regional executive directors, Department of Health EMS staff members, other first responders, and invested partners.

The workgroup is a subgroup of the Pre-Hospital Technical Advisory (PHTAC) Committee, whose role is to advise the Washington State EMS and Trauma Care Steering Committee (EMSTC-SC) on the provisions of EMS care.

How We Work

The workgroup led by the department meets regularly to develop, manage, and monitor success of this plan. Workgroup members collaborate to identify and analyze challenges, and to develop, prioritize, design, and implement goals, strategies and solutions. The group seeks relevant evidence-based guidance, peer-reviewed research, and best practices to update guidance for the use of air ambulance services. Yearly, the workgroup reports accomplishments to the PHTAC and EMS and Trauma Care Steering Committee (EMSTC-SC).

Why We Have a Statewide Air Ambulance Plan?

The Trauma Care Systems Act requires the department to implement mechanisms to determine distribution of pre-hospital resources to:

- Provide citizens access to high-quality EMS care.
- Prevent inefficient duplication of resources.
- Promote a healthy and experienced pre-hospital workforce.

The methods to determine distribution of ground EMS services are managed through the regional EMS and Trauma Care (regional EMSTC) planning process. The minimum and maximum number of services needed are identified and memorialized in the EMSTC regional plans.

The difference between the regional EMSTC plans and the air ambulance service plan is about the distinctive differences between air and ground vehicles. Those include time and distance capabilities, the overlay of federal aviation regulations, and state limitations in regulation of air ambulance services.

Unique critical influences affecting the distribution of air ambulance services in comparison to ground services include the market and capital cost of helicopters, airplanes, and specially trained clinical staff members.

The department evaluates and monitors statewide need and distribution of air ambulance services, and works collaboratively with air ambulance services to determine where air ambulance bases should be established.

To promote consistency in statewide EMS planning processes, this work is memorialized in this plan. It serves as the primary document that reflects the evaluation, monitoring, and outcomes of air ambulance use. This plan is managed biennially. Every two years the plan is reviewed, revised, and approved through the same process as the regional EMSTC plans.

Who We Reach

Although not exclusive, the primary audience for this plan includes the EMSTC-SC, regional EMSTCs, MPDs and delegates, designated and categorized medical facilities, licensed and verified EMS services, certified EMS personnel, and other emergency care system partners.

Secondary audiences include other state offices and professional associations such as the Northwest Association of Aeromedical Responders, National Organization of State Offices of Rural Health, National Association of State EMS Officers, federal agencies with air transport capabilities, and others.

Statewide Analysis of Air Ambulance Services

Air ambulance utility is apparent in remote wilderness and rural areas of the state. Similarly, urban areas may be as close as 20 minutes from a major medical facility but are isolated due by large bodies of water. While ground ambulance transport is feasible using the state's ferry system, such transports result in significant delays. Traffic patterns and congestion in major urban areas must also be considered when discussing use of air ambulance services. Without the availability of air ambulances, the clinical outcome of many patients in these areas would be negatively affected.

Principles of air ambulance asset use are incumbent on the multi-regional and statewide flight range capabilities, along with logistical considerations for aircraft. Air ambulances can provide an advanced level of out-of-hospital care and rapid, expedient transport for critically sick and injured patients.

Safety must always remain at the forefront of any discussion about the use of air ambulance services in the state. Inclusion of safety-related concepts and the peer-reviewed recommendations identified in this plan must be reflected in all local, regional and state operational guidance documents (triage and destination tools, guidelines, patient care procedures, county operating procedures, MPD protocols, etc.) about the use of air ambulance services.

Limitations to our current analysis are primarily about challenges with data. Data about air ambulance use is collected from the state trauma registry, and is limited to patients treated and transported for trauma care. Trauma-designated facilities are mandated by law to report data to the trauma registry. Unlike trauma-designated facilities, EMS is not mandated to report data to our state EMS data registry (WEMSIS). This makes collecting and analyzing data about other aspects of our system challenging. The department and many other system partners are strategically addressing challenges with WEMSIS. Because of these challenges with data, there was limited review and use of patient and transport-related data in this current analysis.

For the purposes of this revision, our statewide analysis of air ambulance services includes an evaluation of the following components:

- Air ambulance assets
- Distribution of air ambulance resources
- Geographical coverage
- Response time to prehospital scene
- Response time to trauma, cardiac, and stroke-designated and categorized facilities
- Available data to review on air ambulance use
- Review of operational guidance documents about use of air ambulance

Air ambulance assets in Washington State as of the date of implementation of this plan are reflected in the **Table 1**.

Washington state and federal government air ambulance resources are listed in **Table 2** on page 13.

Each service uses aircraft of differing type, make and model. These aircraft have unique performance capabilities. All are configured to comply with state and national standards for patient transportation.

Table 1: Licensed and Verified Air Ambulance Services in Washington State as of date of publication.

Air Ambulance Service	License Type	Base Location Region	Base Location County	Base Location City / Town	Base Location(s) Border State(s)
Island Air Ambulance	AIRV	North	San Juan	Friday Harbor	None
Airlift Northwest	AIRV	Central	King	Seattle	None
		North	Whatcom	Bellingham	
		North	Snohomish	Arlington	
		West	Thurston	Tumwater	
		South Central	Yakima	Yakima	
Life Flight Network	AIRV	North Central	Okanogan	Brewster	Aurora, Oregon Pendleton, Oregon Warrenton, Oregon Lewiston, Idaho Sandpoint, Idaho
		South West	Clark	Kelso	
		East	Whitman	Pullman	
		North Central	Grant	Moses Lake	
		South Central	Benton	Richland	
		South Central	Klickitat	Dallesport	
		East	Spokane	Spokane	

Air ambulance services holding accreditation by a department-recognized accreditation body may provide specialized services such as neonatal care, transport of cardiac assist devices, and other such specialties. Local and regional EMSTCs are encouraged to work with air medical services within their region to identify specialized services available, and to coordinate accordingly.

Federal government air ambulance resources are exempt from state licensure in accordance with RCW 18.73.130. Federal services located in Washington state may provide limited services outside of the provisions of declared emergencies. During state emergency declarations, coordination with federal resources will occur through appropriate state and federal agencies. This list is current as of September 1, 2017.

Table 2: Federal government air ambulance resources

Government	Branch	Name	Region	County
Federal	Air Force	Fairchild Air Force Base	East	Spokane
	Army	Joint Base Lewis-McChord	West	Pierce
	Coast Guard	13th Coast Guard District	Northwest	Clallam
	Coast Guard	Columbia Sector	Southwest	Pacific
	Navy	Naval Air Station - Whidbey	North	Island
	Navy	Naval Station – Everett	North	Snohomish
	Navy	Naval Base – Bremerton / Bangor	Northwest	Kitsap
National Guard	Air	96th Aviation Troop Command – JBLM	West	Pierce
	Army	141st Fairchild Airforce Base - JBLM	West	Pierce
	Army	141st Fairchild Airforce Base – Spokane	East	Spokane

Distribution of resources is an important consideration in establishing, assessing, and monitoring citizen access to emergency medical care and transport services.

Factors and influences about distribution of air ambulances include: time and distance capabilities, the overlay of federal aviation regulations, and state limitations in regulation of air ambulance services. Critical influences for distributing air ambulance services include the market and capital cost of helicopters, airplanes, and specially trained clinical staff.

The department evaluates and monitors statewide need and distribution of air ambulance services in conjunction with the services in determining where air ambulance bases should be established. The principles that guide distribution discussions are to:

- Provide citizens access to high-quality EMS care.
- Prevent inefficient duplication of resources.
- Promote a healthy and experienced pre-hospital workforce.

- Provide transport by the highest level of service, in the most expedient fashion to the highest level facility that can manage the patient's condition.

The following method will determine distribution of air ambulance services. During this planning cycle this information will be used to identify unserved and underserved areas.

1) Identify and update the Emergency Care System GIS Map with the current number and locations of air ambulance bases in Washington state.
2) Update the projected response time model using a central point (air ambulance base) within a 360-degree buffer zone for 15-, 20-, 30-, 45-, and 60-minute intervals.
3) Develop a mechanism to estimate the percent of geography and population covered by each buffer zone.
4) Identify the designated and categorized facilities within each buffer zone.
5) Identify gaps, unserved and underserved areas.

Additionally during this plan period, the workgroup will:

1) Develop a strategy to identify baseline performance standards about access and response times.
2) Develop a strategy to assess performance about access and response times.
3) Evaluate the feasibility of establishing a minimum number of recommended air ambulance services needed to achieve access and response time performance standards.

Based on our current evaluation of air ambulance assets and base locations, current number of air ambulance bases by EMS region is identified below in **Table 4**.

Table 4. Number of verified air ambulance service bases with helicopters by EMSTC region at publication date.

EMSTC Region	Current number of AIRV Bases with Helicopters by Region
North	2
Northwest	0
Central	1
West	1
Southwest	1
North Central	2
South Central	3
East	2
Total statewide	12

Geographical Coverage

The measures of success and outcomes – historical snapshot for 2010-2016 section on page 23, shows the standards and outcomes of geographical coverage for the latest planning cycle.

Because of improvements in aircraft flying speed capabilities, we've updated the projected response time models using an air ambulance base at a central fixed point within a 360-degree buffer zone. The buffer zone calculations are based on how many nautical miles (1.15 miles = 1 nautical mile) are flown at average helicopter speed of 150 mph. Projected flight time and distance calculations in intervals of 15, 20, 30, 45, and 60 minutes are shown in **Table 5.**

Table 5. Projected flight time and distance calculations

15 Min	20 Min	30 Min	45 Min	60 Min
37.5 miles	50 miles	75 miles	112.5 Miles	150 Miles
32.61 NM	43.48 NM	65.17 NM	97.83 NM	43.48 NM

The updated maps in **Figures 1 through 5** shows the location of air medical service bases with the projected response times to the geographical area within the buffer zones for intervals of 15, 20, 30, 45, and 60 minutes.

Helicopter/Rotor Wing

Figure 1. Geographical Coverage from Air Ambulance Base 15 Minute Response Time

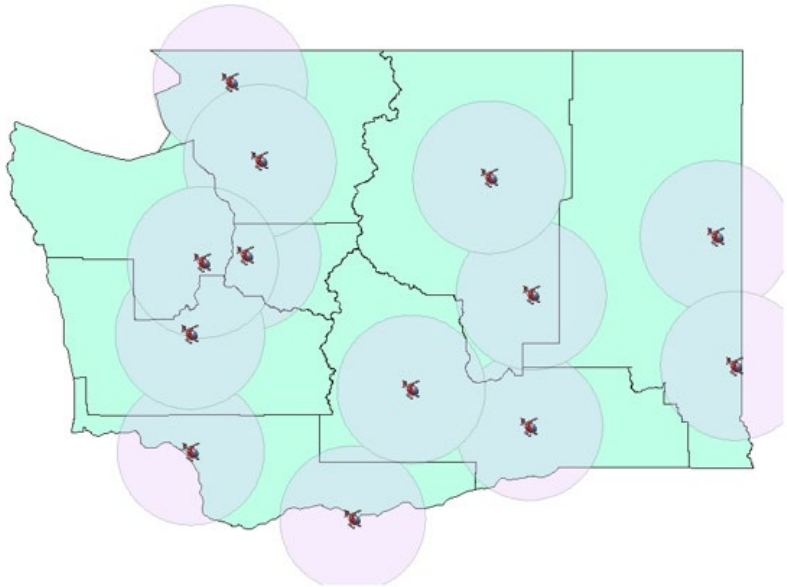


Figure 2. Geographical Coverage from Air Ambulance Base 20 Minute Response Time

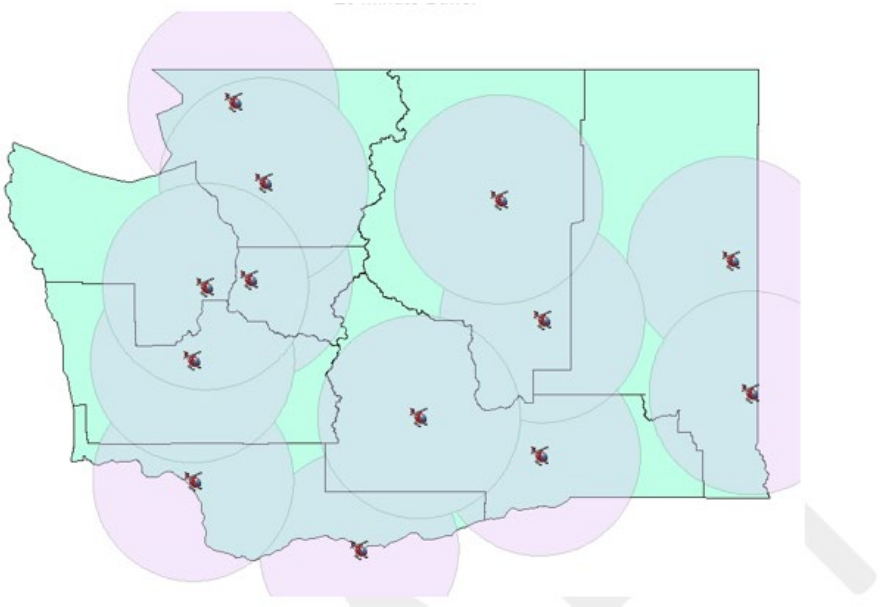


Figure 3. Geographical Coverage from Air Ambulance Base 30 Minute Response Time

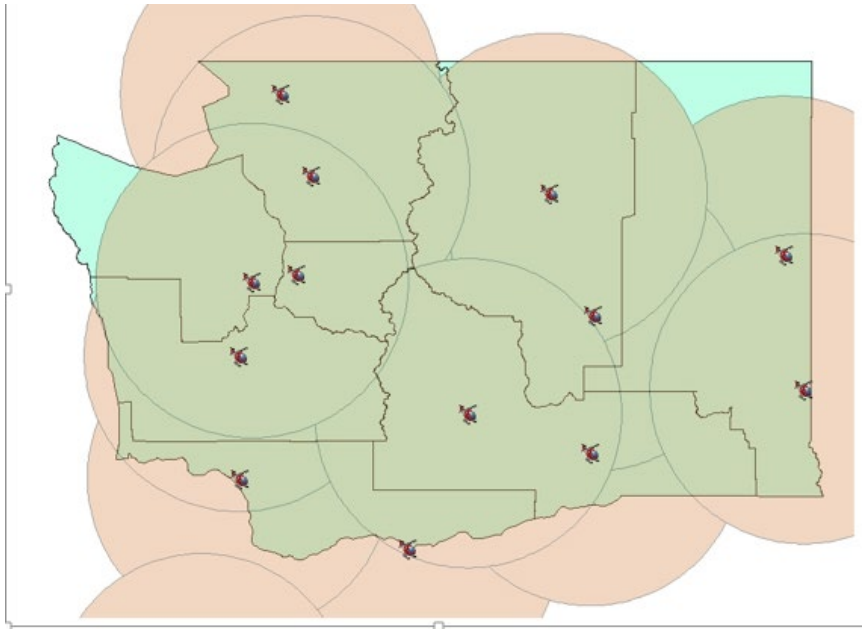


Figure 4. Geographical Coverage from Air Ambulance Base 45 Minute Response Time

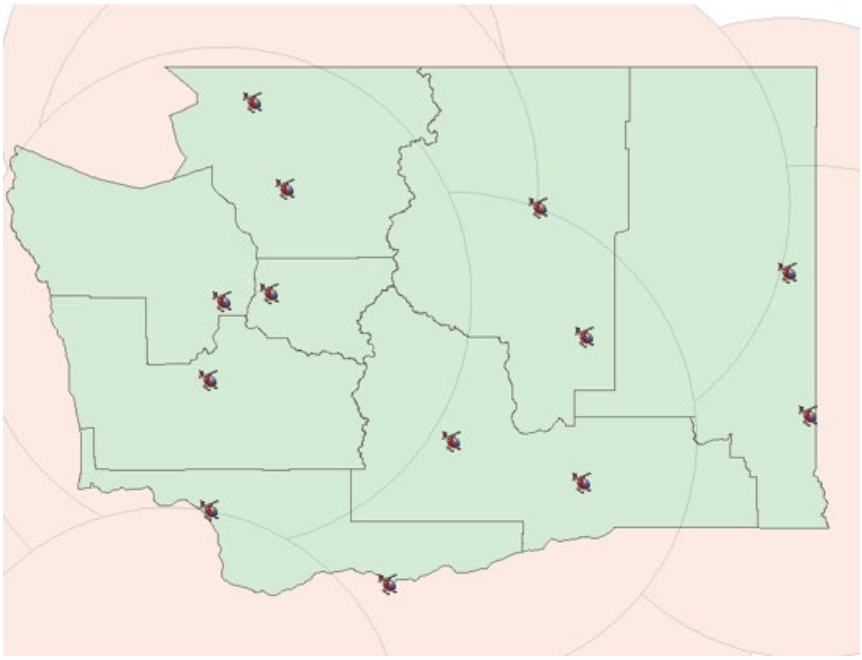
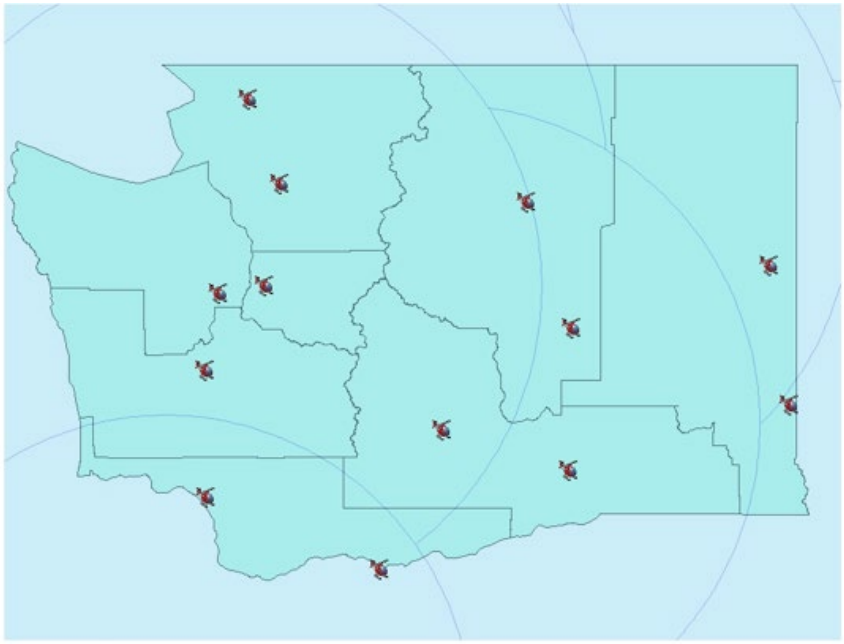


Figure 5. Geographical Coverage from Air Ambulance Base 60 Minute Response Time



Airplane / Fixed-wing

Washington state has historically used helicopters only for prehospital transport from an emergency scene. However, some air ambulance services also have fixed-wing aircraft that are used for inter-facility transports. Between 2010 and 2017, the use of fixed-wing aircraft for prehospital transport from an emergency scene was prohibited because of concerns about patient safety, including the following:

- Fixed-wing aircraft landing zones (runways) have limited and fixed locations. Rotor-wing aircraft can land at the scene of an emergency and directly at a hospital landing pad.
- Fixed-wing transports require rendezvous with a ground ambulance service to transfer the patient from the aircraft landing area to and from the scene and treatment facility.

These and other factors were believed to increase the total out-of-hospital time for the patient.

Changes in federal regulations during the previous plan cycle limited state authority over some aspects of air services.

During this plan revision process, a review of published literature and other state regulations provided little evidence to support the limitation of fixed-wing services based on the above concerns. Additionally, the use of established fixed-wing services in the islands and in rural areas of our state may have some benefit.

Washington has one fixed-wing service that applied and was granted verified trauma status in 2017 serving the San Juan Islands.

The use of fixed-wing aircraft for prehospital transport from an emergency scene is a new standard. Therefore, performance measures must be established to monitor fixed-wing use and performance for prehospital emergency incidents during this planning cycle.

Because fixed-wing aircraft are rarely used for transport from an emergency scene in a prehospital environment, our goals for geographical coverage of fixed-wing services in this plan, were limited to identifying the location of existing fixed-wing bases and possible airports with landing capabilities, which are depicted in **Figures 6 and 7.**

Figure 6. Fixed-wing Air Ambulance Bases

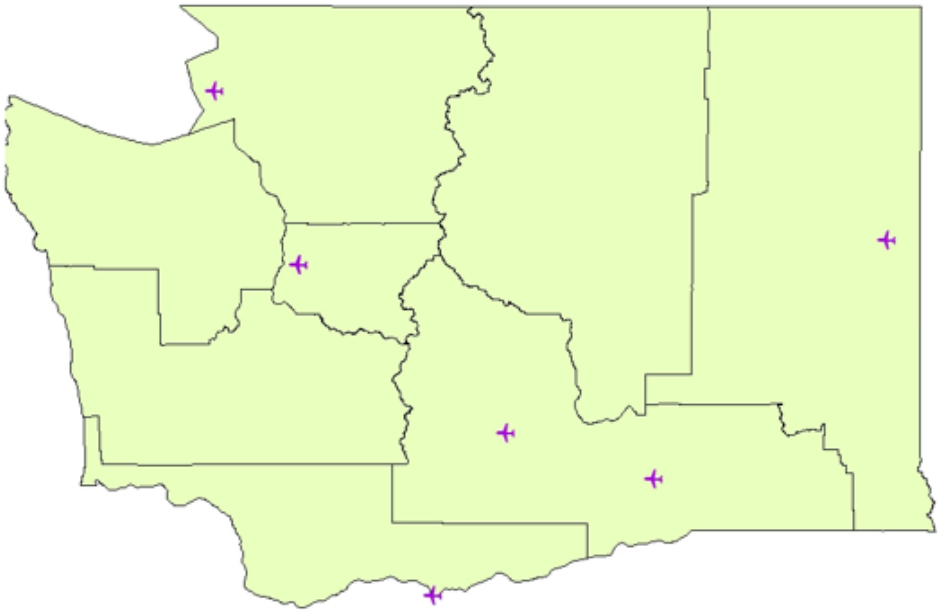
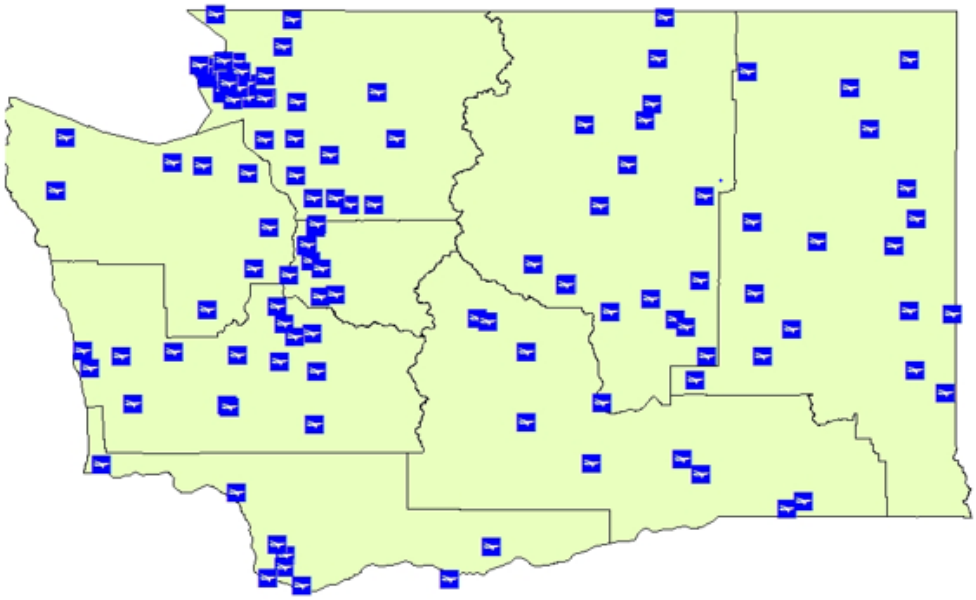


Figure 7. Washington State Airports
(Reflects only the possibility of use by fixed-wing air ambulance services and may not be an all-inclusive list).



Response Time to Prehospital Scene

WAC 246-976-390(12) states: "Verified air ambulance services must meet minimum agency response times as identified in the State Plan."

The measures of success and outcomes – historical snapshot for 2010-2016 section on page 23, shows the standards and outcomes for response time to prehospital scene for the latest planning cycle.

Limitations in data, as discussed on page 11, inhibited a comprehensive statewide analysis of air ambulance response times to prehospital scene. Improving data is a primary goal for the air ambulance workgroup.

Historically, the standards prescribed in previous plan cycles for response times to scene were calculated from the time the air ambulance service receives a request for service to when the helicopter arrives on scene. Because of our current work around improving data collection and analysis, this standard may be updated as our capabilities with data evolve.

Safety of patients, ground EMS personnel and air ambulance personnel are of primary concern. Therefore, exceptions to response time standards will include those times when weather or other factors preclude the air ambulance from safely flying to an EMS scene.

The updated maps in **Figures 1 through 5** (page 15-17) show the location of air medical service bases with the projected response times to the geographical area within the buffer zones for intervals of 15, 20, 30, 45, and 60 minutes.

Response Time Standards to Trauma, Cardiac and Stroke Facilities

Air ambulance services are subject to requirements of the Washington State Pre-hospital Triage Destination Procedures for trauma, cardiac and stroke related care.

The measures of success and outcomes – historical snapshot for 2010-2017 section on page 23, depicts the standards and outcomes of response time standards to trauma facilities for the latest planning cycle.

Limitations in data, as discussed on page 11, inhibited a comprehensive statewide analysis of air ambulance response times to prehospital scene. Improving data is a primary goal for the air ambulance workgroup.

However, updated maps that show projected response times from air ambulance buffer zones to trauma, cardiac and stroke facilities are in the appendices of this plan (pages 40 through 52, **Figures 8 through 32**)

Review of Operational Guidance for Use of Air Ambulances

RCW 70.168.060 authorizes and directs the DOH to establish minimum standards and guidance for developing facility and prehospital EMS patient care protocols, and regional EMS patient care procedures. State guidance for protocols and procedures are almost always developed through collaborative work with stakeholders in ad hoc committees, or existing technical advisory committees (TAC).

Four major categories of operational and clinical guidance documents exist and influence treating and transporting patients in the emergency care system. Each document is defined in statute and rule, and has a prescribed purpose. They are:

- Washington State Prehospital Trauma, Cardiac, and Stroke Triage Destination Procedures (state triage tools)
- Regional EMS Patient Care Procedures (PCP)
- County Operational Procedures (COP); and
- DOH-approved Medical Program Director EMS Patient Care Protocols (Protocols)

In the 2010-2017 plan cycle, a goal was established and achieved to develop regional PCPs for using air ambulance resources. However, no statewide standard or guidance was developed. That resulted in developing inconsistent standards about use of air ambulance services across the EMS regions.

During this plan cycle, the air ambulance workgroup will evaluate regional patient care procedures, and will establish peer reviewed statewide recommendations for air ambulance use for future revisions of regional EMS PCPs. These recommendations will be included as a part of this plan.

Data Collection and Analysis, and Quality Assurance

Because of challenges in data collection and analysis in the previous plan period, our ability to analyze air ambulance use and patient outcomes has been difficult.

In 2013, the department reviewed air ambulance service data in the trauma registry, Our trauma epidemiologist provided a report to the EMSTC-SC about statewide use. In summary the data revealed the following:

1. During 1995-2011, the number of ground EMS transports from the scene had a four-fold increase and the inter-hospital ground transports had a 12-fold increase, while there was no appreciable increase in the number of air transports.
2. The overall EMS volume stayed stable during 2006-2011.
3. People with motor-vehicle related injuries are likely to be transported by air. Any decline in motor vehicle trauma is likely to negatively affect the use of air ambulance services. To some extent, the recent decline in air ambulance transports could be attributed to declining motor vehicle trauma, and to rising elderly falls.
4. The central and east regions attract most air transports from the scene and transferring hospitals. This is because Harborview Medical Center, the state's only level I trauma

center, is in the Central Region, and Providence Sacred Heart Medical Center is the only level II trauma center in the East Region.

5. Data from 2007 through 2011 clearly illustrate that demand for air ambulance services has remained consistent. There has been no appreciable increase in demand during this period.

During this plan revision process, the department trauma epidemiologist evaluated available data about air ambulance services, provided a summary, and made recommendations on how to improve air ambulance data collection and quality. This summary and any completed work was reported to the EMSTC-SC in September of 2018.

Summary of Statewide Analysis of Air Ambulance Services

The intent of our analysis is to assess if Washington has adequate air ambulance services that are accessible to our citizens, and are used appropriately to transport patients to definitive care and improve patient outcomes.

The assessment should help identify gaps such as unserved or underserved areas, and provide information for the workgroup to develop recommendations for goals, standards and outcomes for the next plan cycle.

The following summary and recommendations are based on the information presented in the previous sections.

The assessment of distribution of resources and geographical coverage – during this plan revision, air ambulance service locations were updated and added to the Emergency Care Services GIS map. We are able to identify the air ambulance assets available statewide; however, there is insufficient information, data, and evidence based methodology available to determine what the minimum recommended air ambulance services for Washington should be. Additionally, states are limited in regulating air ambulance services about distribution of resources. No requirement or formal mechanism is in place for air ambulance services to notify the department of changes or additions in air ambulance bases and assets across the state. Often, air ambulance services will add or change a base without consulting with the department.

The assessment of response times to prehospital scene and trauma, cardiac and stroke facilities revealed that there is insufficient data collection, preparation, and analysis to evaluate air ambulance services' response time performance. During the plan revision, we updated the calculation used to project response times to the scene and to trauma facilities. We revised the maps showing projected response times within a buffer zone to designated trauma facilities within that buffer zone, and added maps for cardiac and stroke facilities.

The assessment of available data for analyzing air ambulance use revealed that there is insufficient data, information, and quality assurance processes in place at a local, regional and statewide level to evaluate the effectiveness of air ambulance service use and care statewide.

The assessment of review of operational guidance documents about air ambulance use revealed that operational guidance does exist, and is inconsistent across the state.

Measures of Success and Outcomes

Historical Snapshot 2010-2017

The goals, standards and outcomes for the air ambulance component of the EMS and trauma care system from 2010-2016 included:

Goal One	To support a system of air ambulance response providing safe and expeditious transport of critically ill patients to the appropriate designated trauma service.
Standard	To provide 70 percent of the state population access to air ambulance service within 30 minutes or less and 100 percent of the state population access to air ambulance service within 60 minutes or less.
Outcome	When assessing access of air ambulance services, the amount of geographical coverage air ambulances provided increased to 93 percent of the land area of the state and 99 percent of the residential population.
Standard	To provide 70 percent of the state population access to designated services within 30 minutes or less and 100 percent of the state population access to air ambulance service within 60 minutes or less.
Outcome	Distribution of level I and II trauma, cardiac, and stroke designated and categorized services affect the ability to deliver patients in a timely manner to the higher-level trauma services, even by air. Geographic gaps in the 30-minute response time buffer zones are consistent with the lack of level I or II trauma, cardiac, and stroke designated and categorized services.

Goal Two	Regional EMS Patient Care Procedures (PCPs) for the use of air ambulance resources are included in approved regional EMSTC plans.
Standard	No standards for PCPs were established.
Outcome	Regional EMSTCs developed and adopted patient care procedures for the response of air ambulance resources in most regions; however, inconsistent standards about air ambulance use in patient care procedures exist statewide.

Goal Three	Air ambulance resources throughout Washington state provide optimal coverage while avoiding costly and inefficient duplication of resources.
Standard	To provide 70 percent of the state population access to air ambulance service within 30 minutes or less and 100 percent of the state population access to air ambulance service within 60 minutes or less.
Outcome	Distribution of resources provides coverage for 68 percent of the state's land area and more than 90 percent of the residential population within a 30-minute response time from air ambulance bases to scene.
Outcome	100 percent of the state's population can receive air ambulance service in 60 minutes or less.
Standard	Arrival within 30 minutes of receiving a request for service, 80 percent of the time.
Outcome	There is insufficient statewide data to accurately measure and report on this standard.

Other accomplishments during this plan cycle included:

- Revision of the air ambulance rules WAC 246-976-320 to modernize standards.
- Updates to the department's Emergency Care Services GIS Map to include air bases, their assets and updated buffer zones.

Recommended Goals and Strategies for 2018-2021 Plan Period

Recommended goals within the scope of this workgroup for this plan cycle include:

- Assess and improve air ambulance data submission and quality to the trauma and EMS (WEMSIS) data registries.
- Identify and implement a methodology to better assess and monitor citizen access to air ambulances, response time to prehospital scene and definitive care.
- Identify baseline performance standards about access and response times.
- Evaluate the feasibility of establishing a minimum number of recommended air ambulance services needed to achieve response time performance standards.
- Assess performance and outcomes.
- Identify and improve quality assurance activities at local, regional, and state levels to monitor patient outcomes and the effectiveness of using of fixed-wing ambulances to prehospital events.
- Improve local, regional, and statewide guidance for air medical use.

Specific suggested strategies to achieve these goals that are reflected in the PHTAC EMS strategic plan.

Statewide Recommendations for EMS Use of Air Ambulance

Purpose

The purpose of this section is to establish minimum standards and guidance in accordance with RCW 70.168.060 for developing facility and prehospital EMS patient care procedures and protocols about use of air ambulances.

Background

The department recognizes air ambulance services as having a distinctive role in the emergency care system. The multi-regional and statewide flight range capabilities along with logistical considerations for aircraft are factors that require a coordinated system of medical response and a statewide strategic approach in managing emergency medical services (EMS) resources. This approach enables citizen access to the best patient care and transport capabilities, and works to mitigate an unsafe prehospital transport environment to the extent possible. Air ambulances can provide the highest level of out-of-hospital care, and rapid, expedient transport for critically sick and injured patients. Strategic development, deployment, and quality assurance strategies for air ambulance services can improve outcomes in patient care.

For these reasons, our EMS and Trauma Care Steering Committee (EMSTC-SC) recommended the development of a statewide Air Ambulance Strategic Plan (plan). With oversight from the department, the Air Ambulance Services Workgroup (workgroup) and Prehospital Technical Advisory Committee (PHTAC) were tasked to develop and manage the plan.

In 2000, the statewide aeromedical workgroup identified strategic initiatives that were memorialized in the 2010 Washington State Air Ambulance Plan, to develop, adopt, and implement guidance for air ambulance response using evidence-based practices to ensure high-quality patient care, as well as the safety of the public, flight and ground response teams. The intent of this guidance is for local and regional EMS and trauma care councils (EMSTC) to adopt evidence based recommendations for the activation and use of air ambulance services into regional EMS and trauma care plans, regional patient care procedures, and local county operating procedures across the state.

The following pages provide statewide peer-reviewed guidance for activating and using air ambulance services.

Determination of Medical Necessity for Air Ambulance Transport

Goal

To promote the development of consistent guidance for determining the medical necessity for air ambulance transport.

Background

General principles for making a determination for the mode of transport include:

- Patients requiring clinical interventions should be provided those interventions in the most expeditious manner possible.

- Patients who are stable should be transported in a manner that best addresses the needs of the patient and the system.

- Patients with critical injuries or illnesses resulting in unstable vital signs require transport by the fastest available means, and with a transport team that has the appropriate level of care capabilities, to a center capable of providing definitive care.

- Patients with critical injuries or illnesses should be transported by a team that can provide intra-transport critical care services.

- Patients who require high-level care during transport, but who do not have time-critical illness or injury, may be candidates for ground critical care transport (i.e., by a specialized ground critical care transport vehicle with the level of care exceeding that of local EMS) if such service is available and logistically feasible.

Recommendations

The use of air ambulance transport should be considered when:

- The patient's clinical condition requires minimization of time spent out of the hospital environment during the transport.

- The patient is located in an area that is inaccessible to ground transport.

- The patient requires critical care life support (e.g., monitoring personnel, specific medications, and specific equipment) during transport, which is not available with ground transport options.

- The use of local ground transport would leave the local area without adequate emergency medical services coverage.

- If local ground transport is not an option, explore whether the patient's and system's needs can be met by an available regional ground critical care transport service.

- Patient meets trauma, cardiac, or stroke triage criteria and the scene time plus ground transport time to the closest designated trauma hospital exceeds the estimated time of arrival (ETA) of air ambulance service or ground ALS intercept.

- The scene time, plus ground transport time to local hospital, is less than air ambulance service or ALS intercept arrival time to the scene. Consider initiating ground transportation and diverting the air ambulance service or ALS intercept to the destination hospital for continued patient care or if transport to a definitive care hospital will be necessary and applicable.

- Transport time to the appropriate facility may be reduced by more than 15 minutes.

Relative Contraindications to Air Ambulance Transport

Goal

To identify potential contraindications to air ambulance transport to minimize time spent on determining the most appropriate transport resource for patients.

Recommendation

In general, potential contraindications to air ambulance transport will fall within the following categories:

- Hazardous materials
- Highly infectious disease (such as Ebola)
- Weather
- Patient weight (aircraft dependent)

Air ambulance services should be contacted to assist in determining whether they can transport should a situation that falls within one of the above categories be present at the scene of an emergency.

If any of the four conditions listed above are present, consider initiating ground transport and identifying a rendezvous location if air ambulance confirms the ability to transport.

Standards for EMS Activation of an Air Ambulance Service

Goal

To provide guidance to EMS and trauma care councils and medical program directors for developing patient care procedures, county operating procedures, and patient care protocols about who may activate and cancel air ambulance services.

Recommendations

Any public safety personnel, medical or nonmedical, may call to request on-scene air transport when it appears necessary.

The highest level of certified pre-hospital personnel on scene may cancel the air ambulance response if they determine the patient condition does not warrant air transport.

Procedures

1. The call should be initiated through dispatch services. The caller should:
   a. Provide the location using latitude and then longitude
   b. Identify the frequency for operation
   c. Identify the point of contact on ground

2. The air ambulance communication staff will provide an approximate launch time and flight time, and will advise "when lifted" to the dispatchers requesting air ambulance service.

3. The dispatching agency will provide the air ambulance service with the correct radio frequency to use for contacting EMS ground units.

Early Activation of an Air Ambulance Service

Goal

To encourage early activation procedures that could minimize time to definitive care.

Background

Before arrival of first responders, an air ambulance service provider may be launched based on information from dispatch indicating a high likelihood that an air ambulance will be necessary. This will expedite arrival should first responders confirm the need for air transport.

Recommendations

Medical program directors, and local and regional councils, should identify in their procedures who may initiate early activation or cancel air ambulances. Consider the following:

- Any public safety personnel, medical or nonmedical, may call to request on-scene air transport when it appears necessary. This may include law enforcement, EMS providers, fire personnel or other first responders. Medical facilities can call air ambulance services as needed.
- The first arriving on-scene personnel with the highest level of EMS certification should determine whether air ambulance should continue or be canceled.

First responders will identify if there a high index of suspicion that air ambulance services will be required. The local dispatch center should notify responding ground crews that an air ambulance has been activated. Criteria to consider include:

Transport considerations:

- Prolonged pre-hospital time (i.e. prolonged extrication, transport time, and/or extraction from wilderness environment).
- Distance to a designated trauma center or categorized facility is greater than 30 minutes away.

Mechanism of injury - considerations:

- Death in the same vehicle
- Ejected from vehicle
- Anticipated prolonged extrication: greater than 20 minutes with significant injury.
- Long fall: greater than 30 feet for adults, 15 feet for children.
- Sudden or severe deceleration
- Multiple casualty incidents

Patient characteristics – considerations:

- Glasgow Coma Scale (GCS) less than or equal to 13
- Patient was unconscious and not yet returned to GCS of 15
- Respiratory rate less than 10 or greater than 29 breaths per minute
- BP less than 90 mmHg or clinical signs of shock
- Penetrating injury to the chest, neck, head, abdomen, groin or proximal extremity (above the knee or elbow)
- Flail chest / unstable chest wall fractures
- Major amputation of extremity
- Burns second-degree > 20 percent
- Burns third-degree >10 percent
- Facial or airway burns with or without inhalation injury
- Third-degree burns involving the eyes, neck, hands, feet or groin
- High voltage electrical burns
- Paralysis / spinal cord injury with deficits
- Suspected pelvic fracture
- Multi-system trauma (three or more anatomic body regions injured)

Communication Standards for EMS and Air Ambulance Services

Goal

To promote consistent practices, and to improve communication between air and ground ambulance services.

Recommendation

Regional EMS and trauma care councils are encouraged to establish a pre-coordinated communication procedure to identify the correct, compatible frequencies, and applicable collaborative communication processes between air and ground EMS services and E911 centers.

The procedure should encourage terminology that promotes understanding and safety between air and ground EMS services, and consider the following:

- Do not use 10 codes when communicating with air ambulance services.
- The standardized method of providing GPS coordinates is to provide the latitude and then the longitude.
- The procedure should describe and direct how ground EMS services should wave a helicopter off or advise the aircraft to abort landing.
- Nationally recognized incident management language and procedures such as an incident command system (ICS) should be used.
- Air ambulance personnel will contact the receiving hospital as soon as possible after liftoff from the scene.

Safety of Ground Crews around Aircraft

Goal

To promote safety of all personnel around aircraft.

Recommendations

Local and regional EMSTCs should encourage and advocate training between EMS, and air and ground ambulance services.

Written procedures should direct ground EMS crews:

- Not to approach the aircraft until directed to do so by flight crews.
- Not to approach the tail of the aircraft.
- To use situational awareness while operating around aircraft.

Landing Zone Considerations for Helicopters

Goal

To promote safe consistent practices for EMS and air ambulances for managing landing zones for helicopters.

Recommendations

Written procedures should direct ground EMS crews to:

1. Select a location for the landing zone that is at least 100 feet by 100 feet (generally the length of a basketball court and double the width). The pilot of the aircraft is the decision-maker about landing zones.
2. Assure that the landing zone location is free of loose debris.
3. Assure that the approach and departure paths are free of obstructions, and identify to the pilot hazards such as wires, poles, antennae, trees, etc.
4. Provide air medical services with the latitude and longitude of the landing zone. Avoid using nomenclature such as "Zone 1."
5. Mark night landing zone with lights. Cones may be used if secured or held down. Do not use flares.
6. Establish security for the landing zone for safety and privacy.
7. Avoid pointing spotlights and high beams toward the aircraft. Bright lights (such as scene lights) should be dimmed as helicopter approaches.
8. Not approach a helicopter unless escorted by an aircrew member.
9. Consult with aircrew members before loading and unloading. Loading and unloading procedures will be conducted under the direction of flight personnel.

Hospital Destination Decisions for Patients Transported by Air ambulance Services

Goal

To direct to EMS services to use state-approved triage destination procedures for trauma, cardiac, and stroke patients.

Procedure

Air ambulance services must adhere to and comply with the State of Washington Prehospital Trauma Triage and Destination Procedures when identifying the most appropriate receiving facility for trauma, cardiac, or stroke patients.

These procedures are at the links below or you can email HSQA.EMS@doh.wa.gov to request a copy be sent to you.

Prehospital Trauma Triage Destination Procedure
https://www.doh.wa.gov/Portals/1/Documents/Pubs/530143.pdf

Prehospital Cardiac Triage Destination Procedure
https://www.doh.wa.gov/Portals/1/Documents/Pubs/346050.pdf

Prehospital Stroke Triage Destination Procedure
https://www.doh.wa.gov/Portals/1/Documents/Pubs/530182.pdf

Inter-facility Transports

Goal(s)

To promote efficient coordination for inter-facility transports using air ambulances.

To encourage local and regional familiarity with air ambulance services and their specialized capabilities.

To promote standardization in information provided to air ambulances when requesting inter-facility transport of patients.

Background

Air ambulances transport patients in a pre-hospital and inter-facility setting. Air ambulances may provide care to special populations such as neonates, or patients with specialized equipment such as intra-aortic balloon pumps.

Becoming familiar with capability of local and regional air ambulance resources and establishing standardized request processes for inter-facility transports could decrease inefficiencies and improve time to definitive care.

Recommendations

Regional EMS and trauma care councils and medical program directors should work with air ambulance services in their region to identify what specialized care air medical services can provide.

Patient care procedures about inter-facility transport should include a provision for the minimum information air ambulance services will need to make arrangements or referrals for inter-facility transports. Consider the following information as a minimum standard:

- Physician to physician referral and destination
- Patient weight
- Special equipment (intra-aortic balloon pump, isolette, cardiac assist devices, etc.)
- Additional rider (at the discretion of the pilot)

Use of Fixed-wing Service in the Pre-Hospital Setting

Goal

To assist in determination of which mode of air transport is best suited to meet the patient's needs in the pre-hospital setting.

Recommendations

Relative comparative considerations for air transport modes:

Characteristic	Rotor-wing (Helicopter)	Fixed-wing (Airplane)
Response time	Decreased response time to the patient (up to about 100 miles depending on logistics such as duration of ground transfer leg).	Decreased response time to patients when transport distances exceed about 100 miles. Requires landing at airport, with two extra legs between airports and the patient origin and destination.
Out-of-hospital transport time	Decreased out-of-hospital transport time.	In comparison with ground transport, decreased out-of-hospital transport time. Requires landing at airport, with two extra legs between airports and the patient origin and destination.
Weather	In comparison with fixed-wing, more susceptible to weather constraints (e.g. icing conditions, weather minimums).	In comparison with rotor-wing, less susceptibility to weather constraints.

Factors that department-approved medical program directors may use to determine what mode of air transport to use may include:

- Is it time critical
- Medical necessity
- Service availability
- Membership

Other factors to consider include:

- When the closest most appropriate rotor-wing service has been contacted and reports that it is unavailable.

- When weather prohibits rotor-wing to fly.
- In remote location where rotor-wing cannot safely fly or land
- If transport will require a distance of greater than 100 nautical miles (o nautical mile equals about 1.15077945 miles on land).
- If using rotor-wing service for BLS transport will leave the 30-minute air ambulance response buffer zone without adequate rotor-wing coverage for critical patients.
- If the expected arrival of a rotor-wing ambulance will take 60 minutes or greater.

Appendices

A	Projected response times from buffer zones to trauma facilities
B	Projected response times from buffer zones to cardiac facilities
C	Projected response times from buffer zones to stroke facilities
D	Definition of Terms Used

Appendix A

Projected response time from air ambulance base to trauma designated facilities within buffer zone.

Figure 8. Projected 15-minute response time from air ambulance base to level I and II designated trauma facilities within the buffer zone.

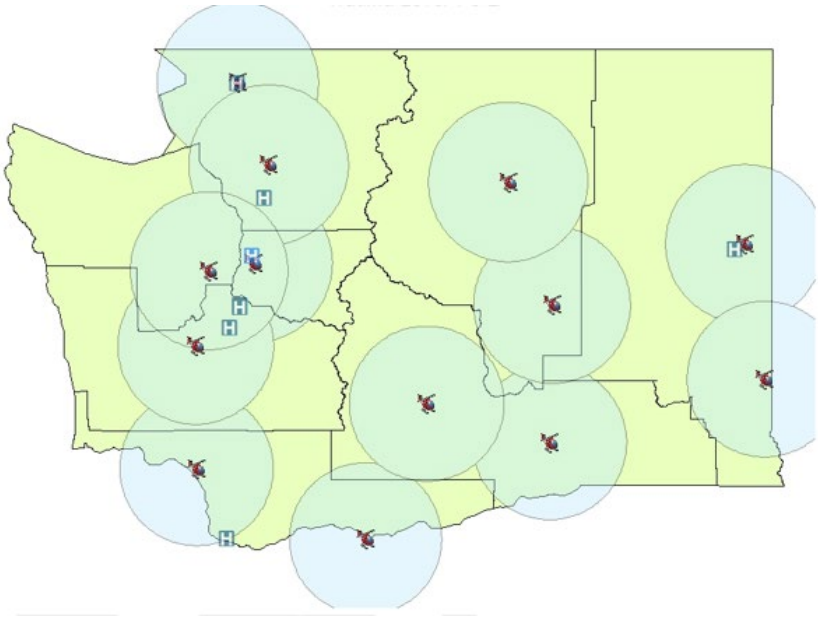


Figure 9. Projected 20-minute response time from air ambulance base to level I and II designated trauma facilities within the buffer zone.

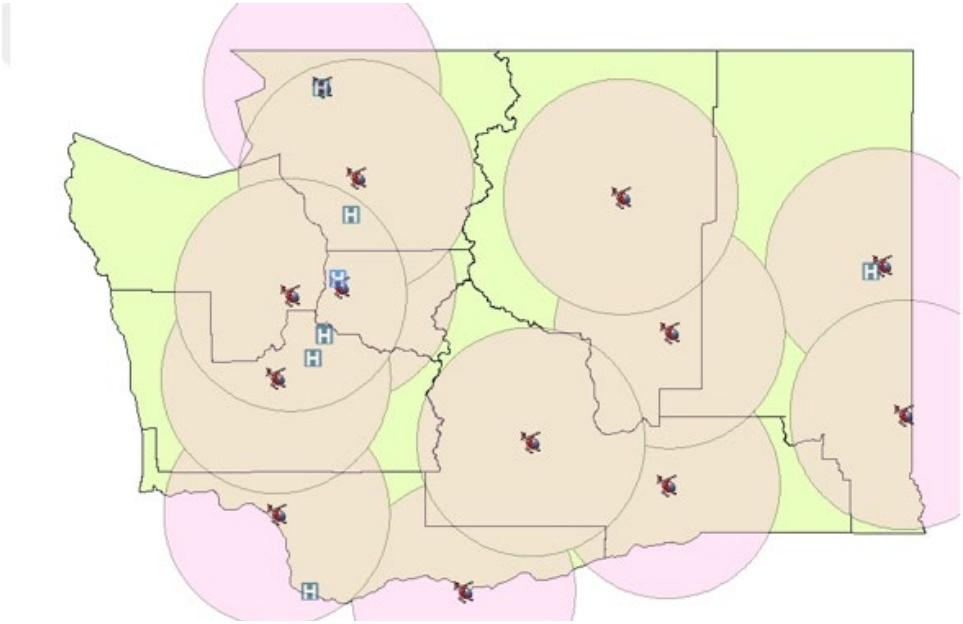


Figure 10. Projected 30-minute response time from air ambulance base to level I and II designated trauma facilities within the buffer zone

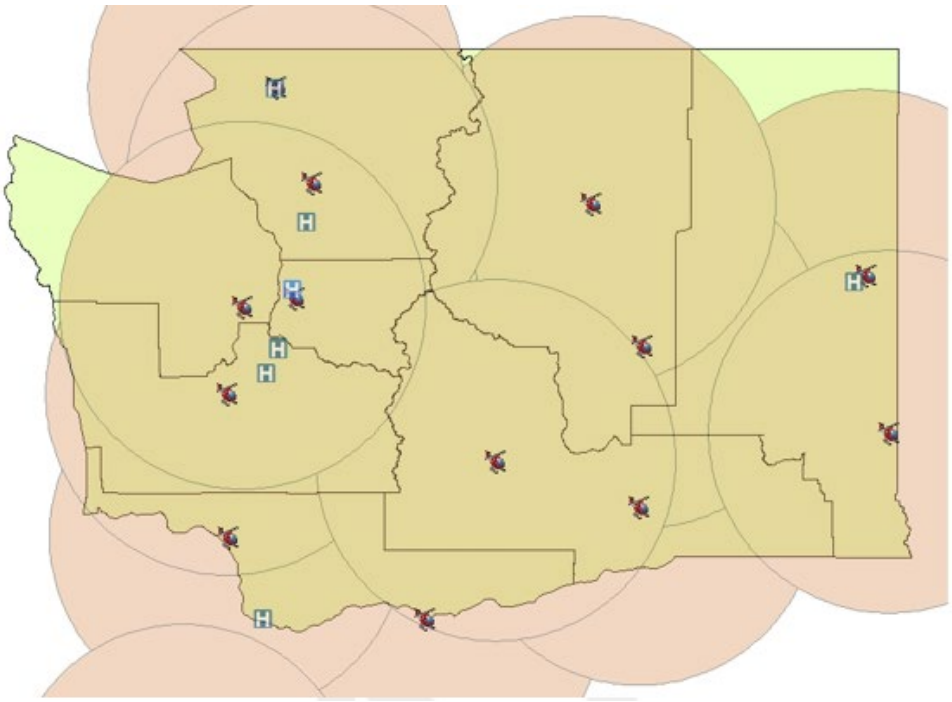


Figure 11. Projected 45- minute response time from air ambulance base to level I and II designated trauma facilities within the buffer zone

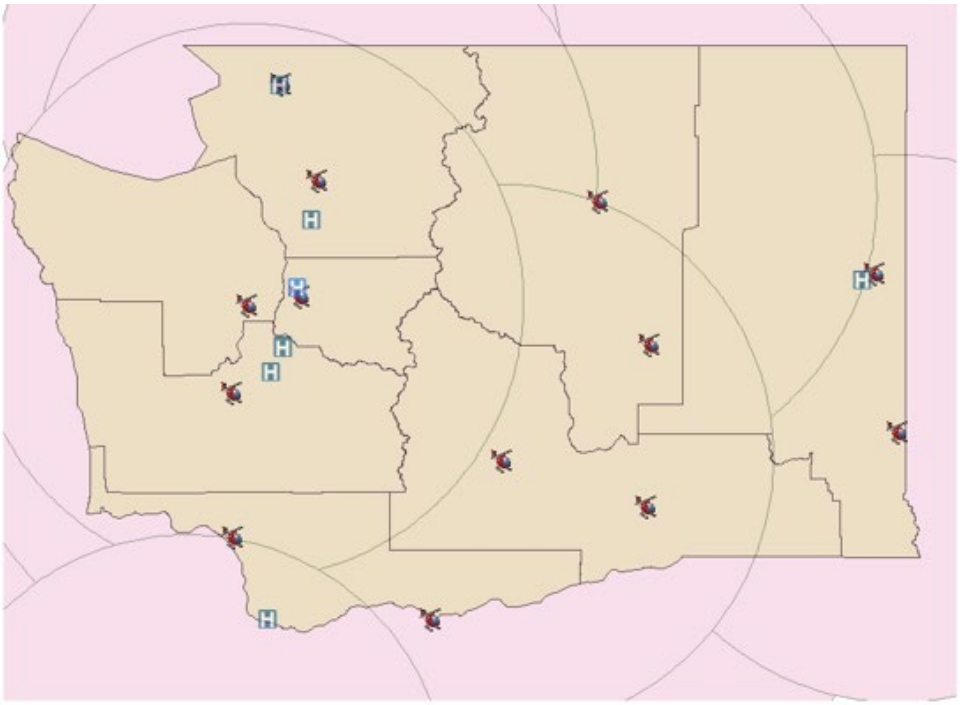


Figure 12. Projected 60-minute response time from air ambulance base to level I and II designated trauma facilities within the buffer zone

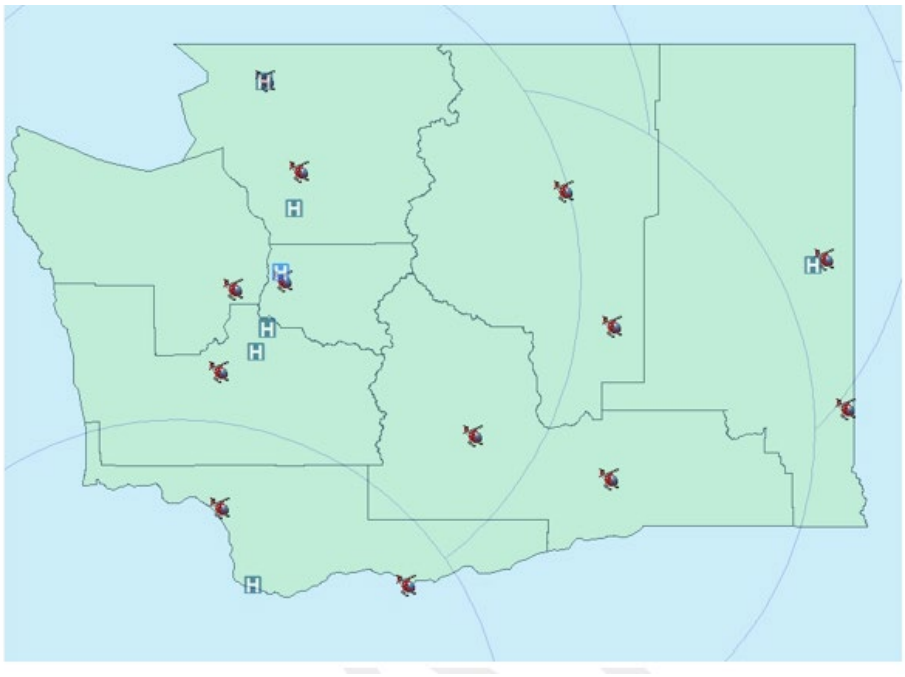


Figure 13. Projected 15-minute response time from air ambulance base to level III, IV, V designed trauma facilities within the buffer zone

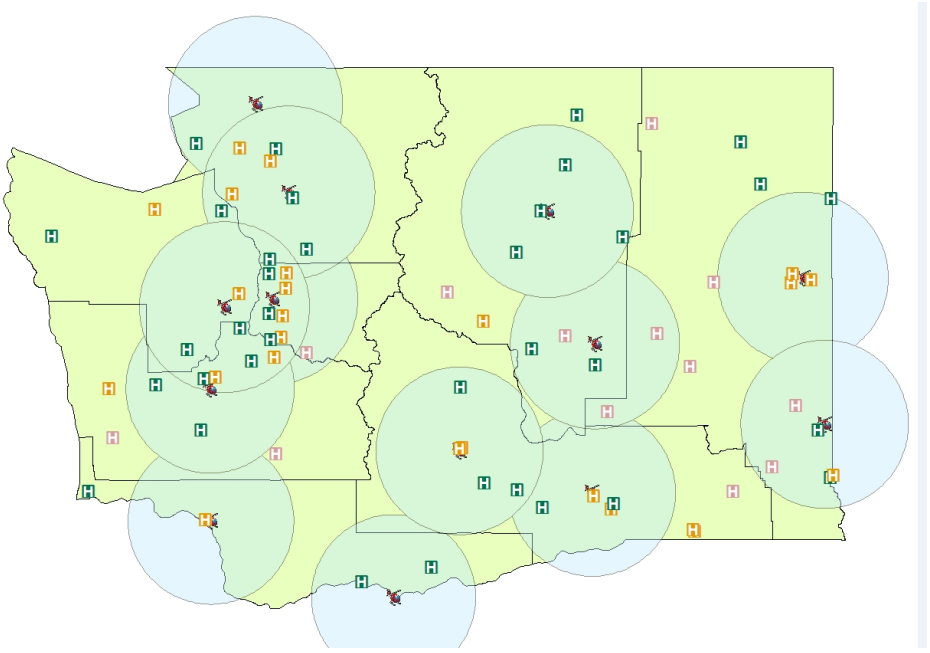


Figure 14. Projected 20-minute response time from air ambulance base to level III, IV, V designed trauma facilities within the buffer zone

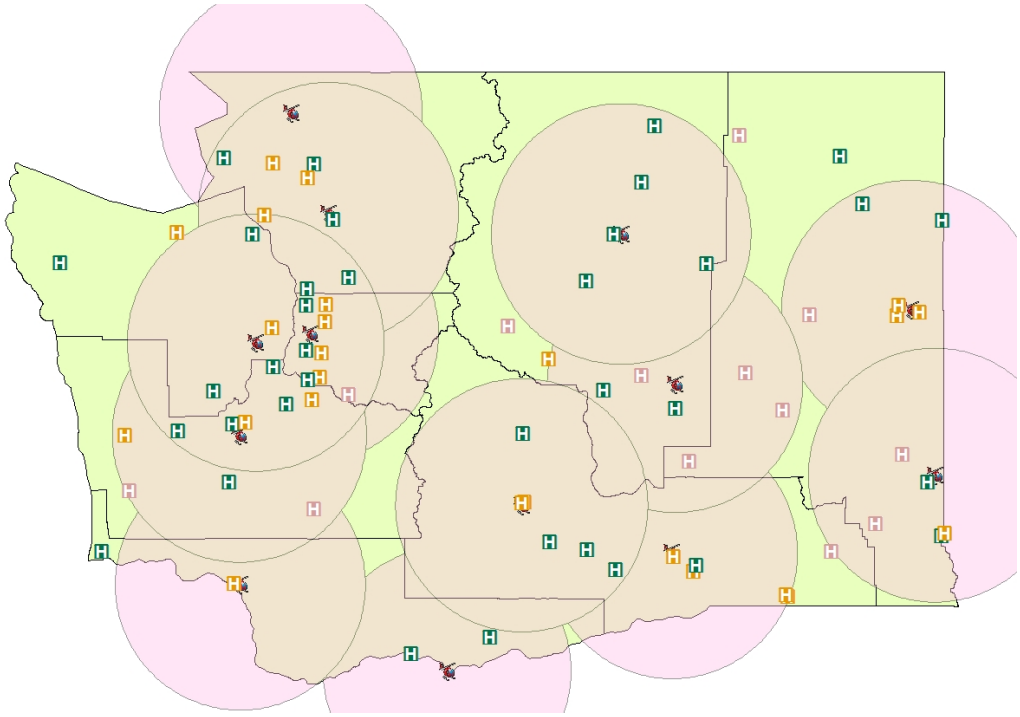


Figure 15. Projected 30-minute response time from air ambulance base to level III, IV, V designed trauma facilities within the buffer zone

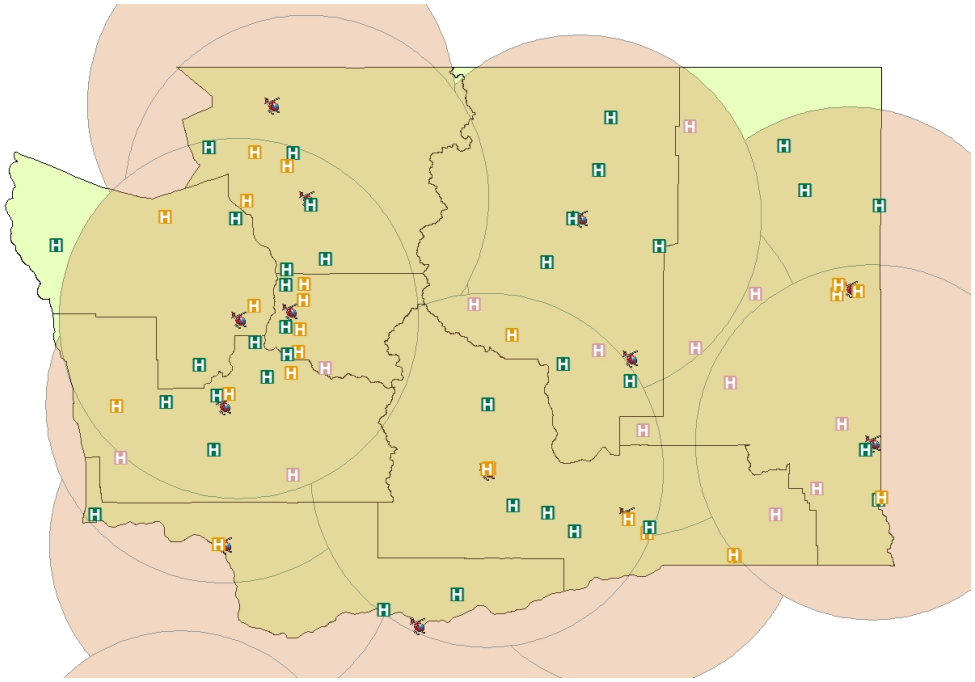


Figure 16. Projected 45-minute response time from air ambulance base to level III, IV, V designed trauma facilities within the buffer zone

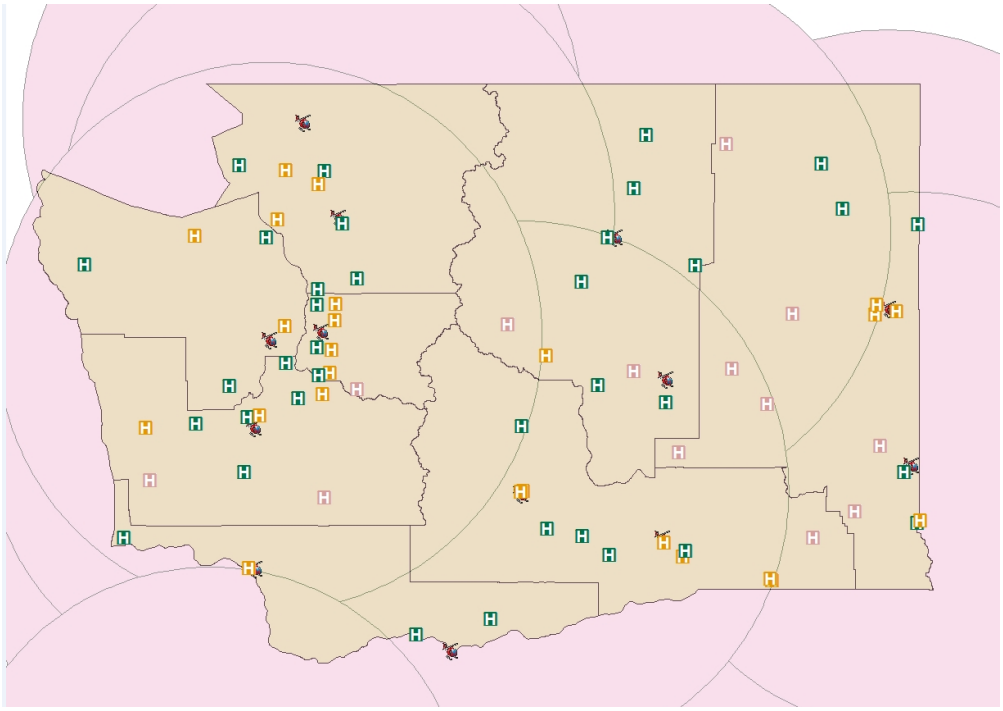
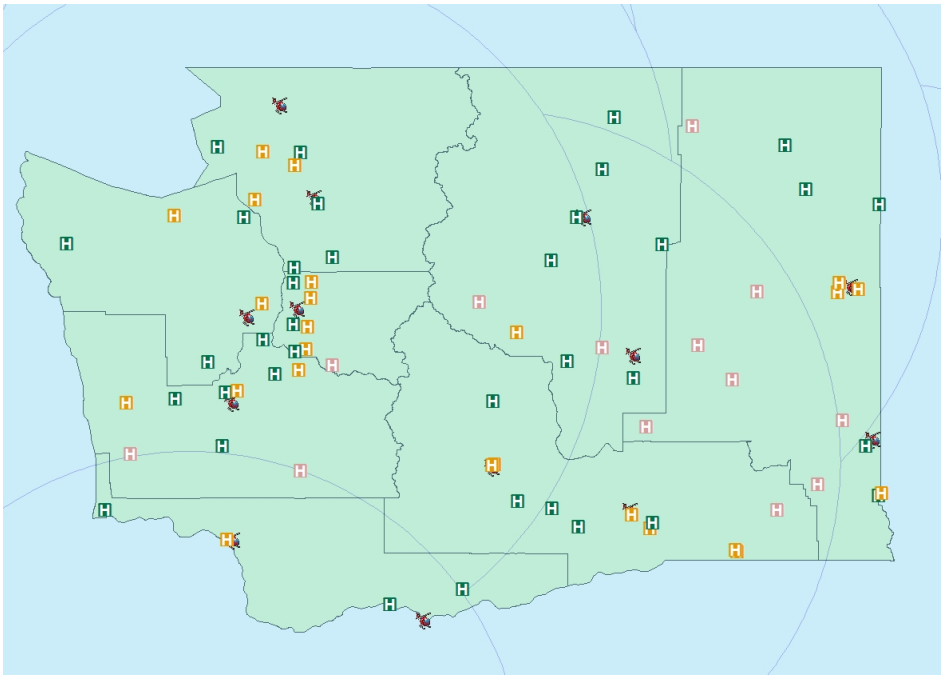


Figure 17. Projected 30-minute response time from air ambulance base to level III, IV, V designed trauma facilities within the buffer zone



Appendix B

Projected response time from air ambulance base to cardiac categorized facilities within buffer zone.

Figure 18. Projected 15-minute response time from air ambulance base to level I and II categorized cardiac facilities within the buffer zone.

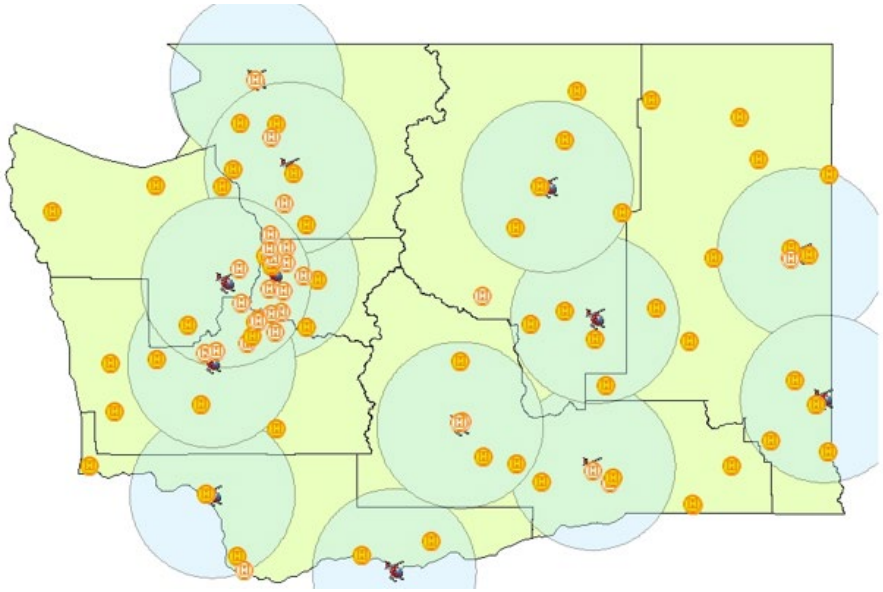


Figure 19. Projected 20-minute response time from air ambulance base to level I and II categorized cardiac facilities within the buffer zone

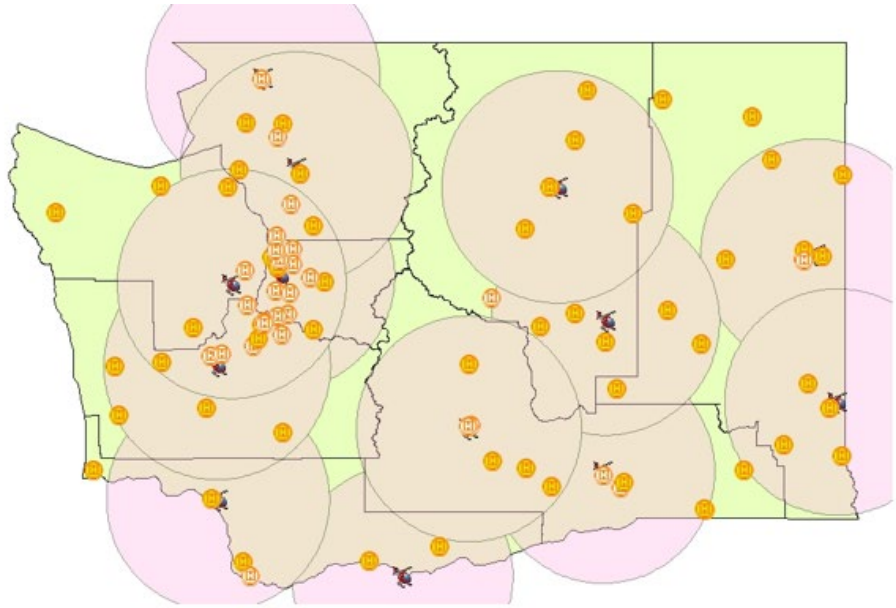


Figure 20. Projected 30-minute response time from air ambulance base to level I and II categorized cardiac facilities within the buffer zone

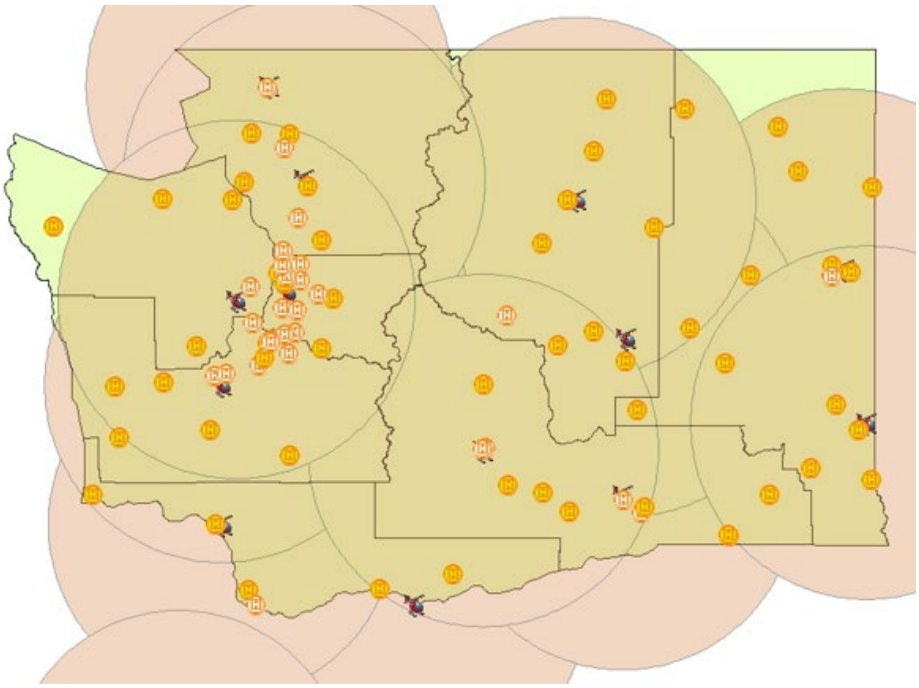


Figure 21. Projected 45- minute response time from air ambulance base to level I and II categorized cardiac facilities within the buffer zone

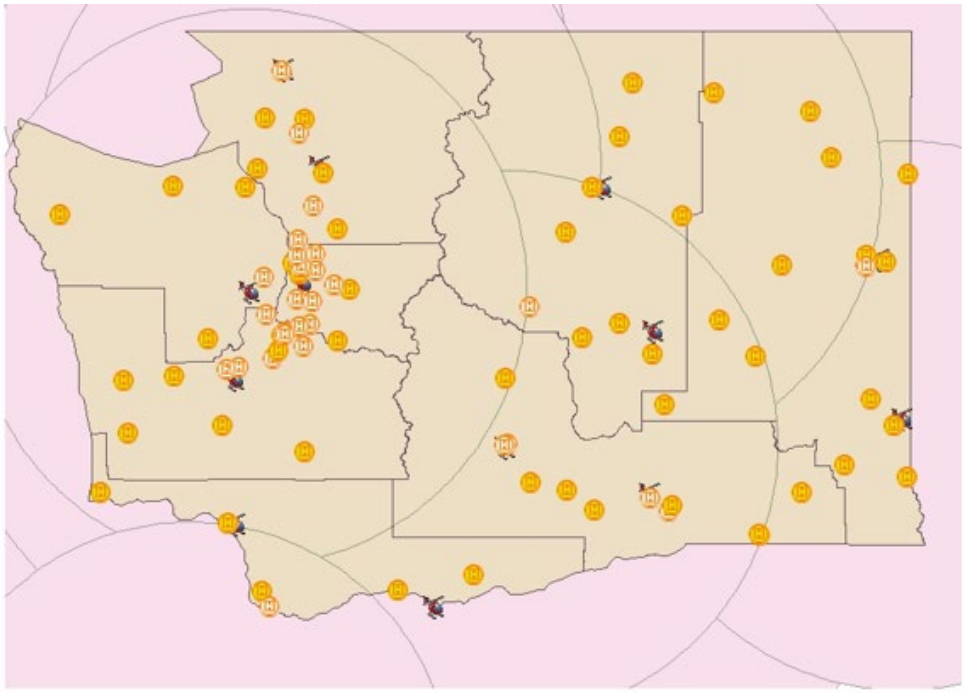
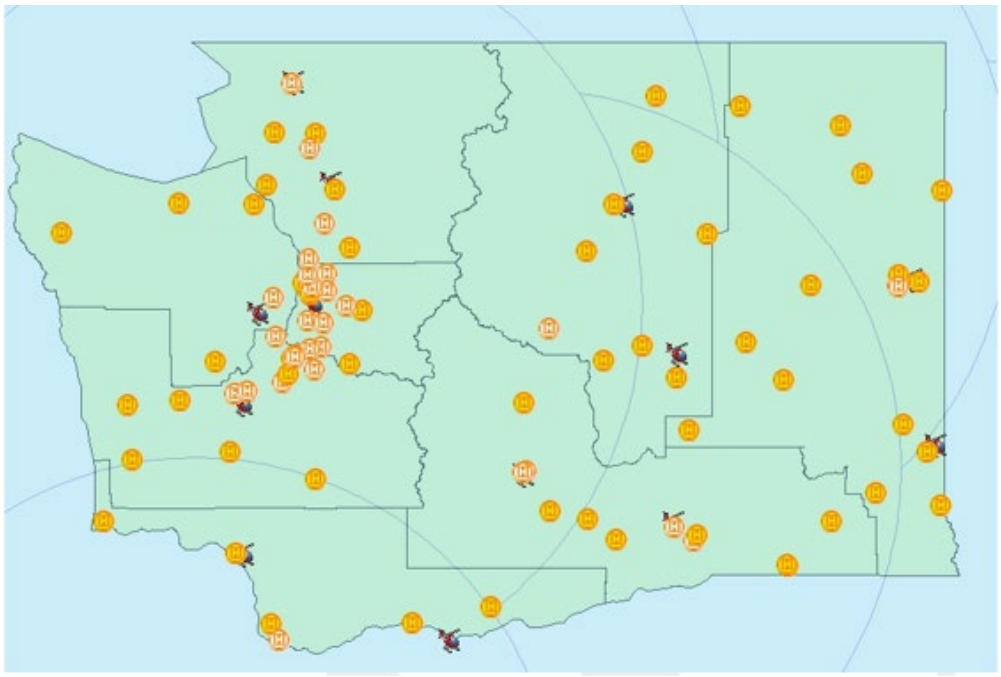


Figure 22. Projected 60-minute response time from air ambulance base to level I and II categorized cardiac facilities within the buffer zone



Appendix C

Projected response time from air ambulance base to stroke categorized facilities within buffer zone.

Figure 23. Projected 15-minute response time from air ambulance base to level I and II categorized stroke facilities within the buffer zone

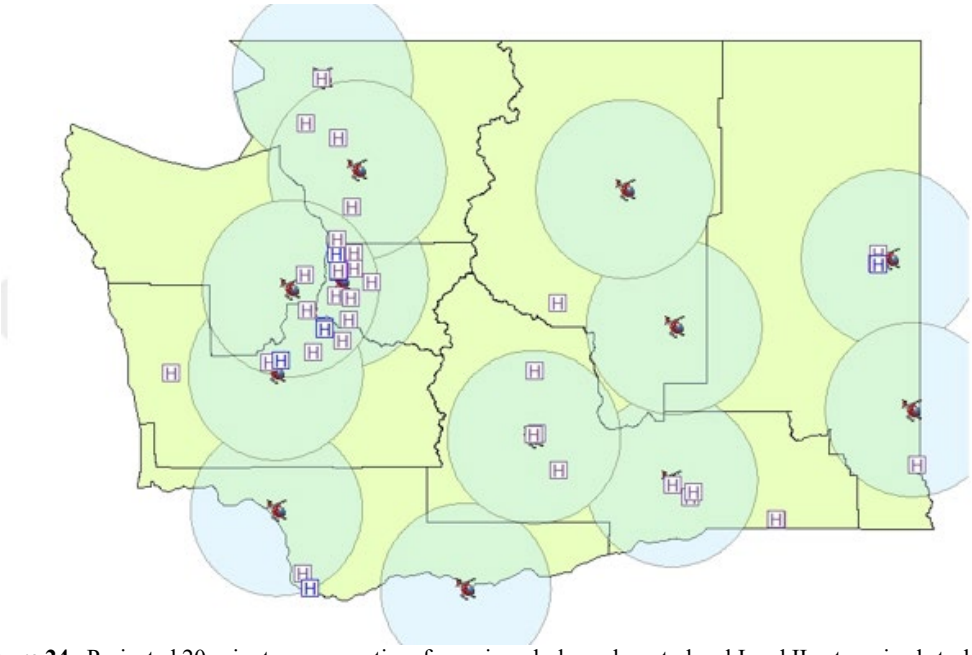


Figure 24. Projected 20-minute response time from air ambulance base to level I and II categorized stroke facilities within the buffer zone

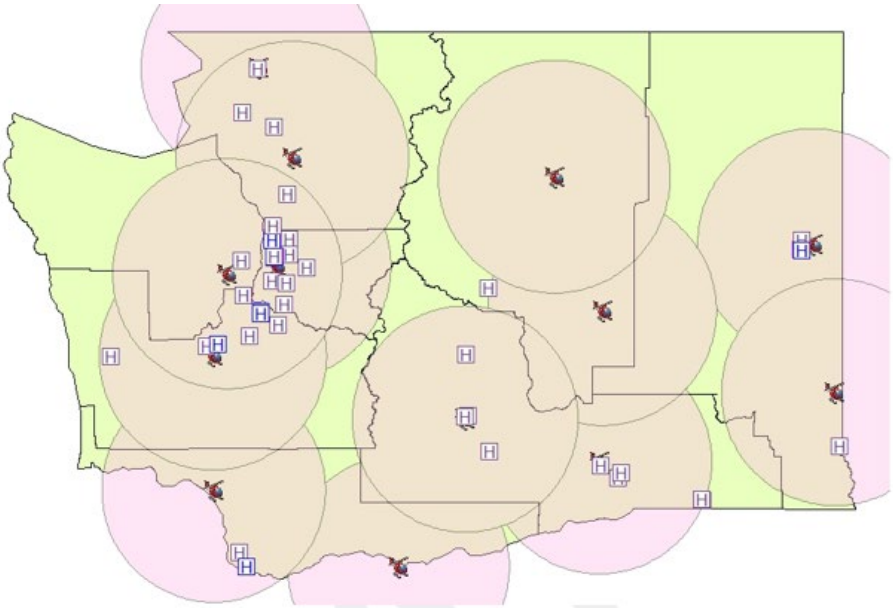


Figure 25. Projected 30 minute response time from air ambulance base to Level I and II categorized stroke facilities within the buffer zone

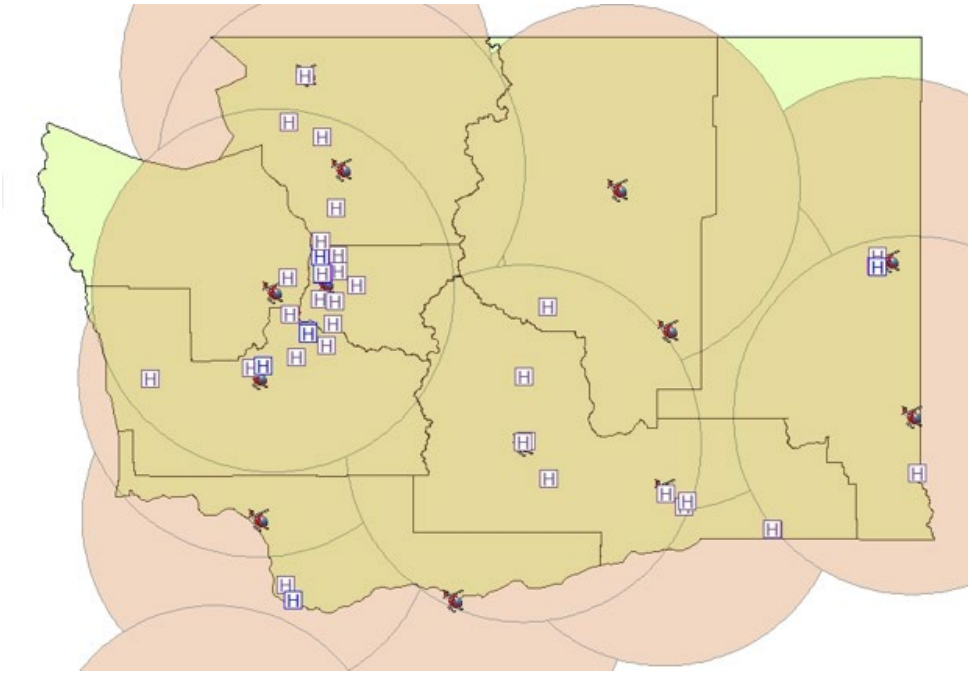


Figure 26. Projected 45-minute response time from air ambulance base to level I and II categorized stroke facilities within the buffer zone

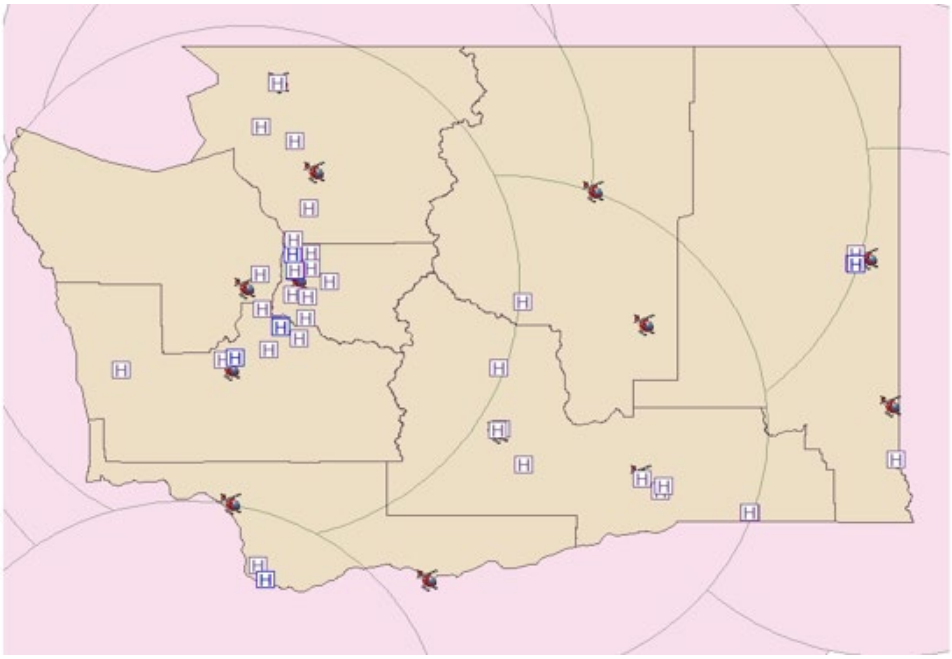


Figure 27. Projected 60-minute response time from air ambulance base to level I and II categorized stroke facilities within the buffer zone

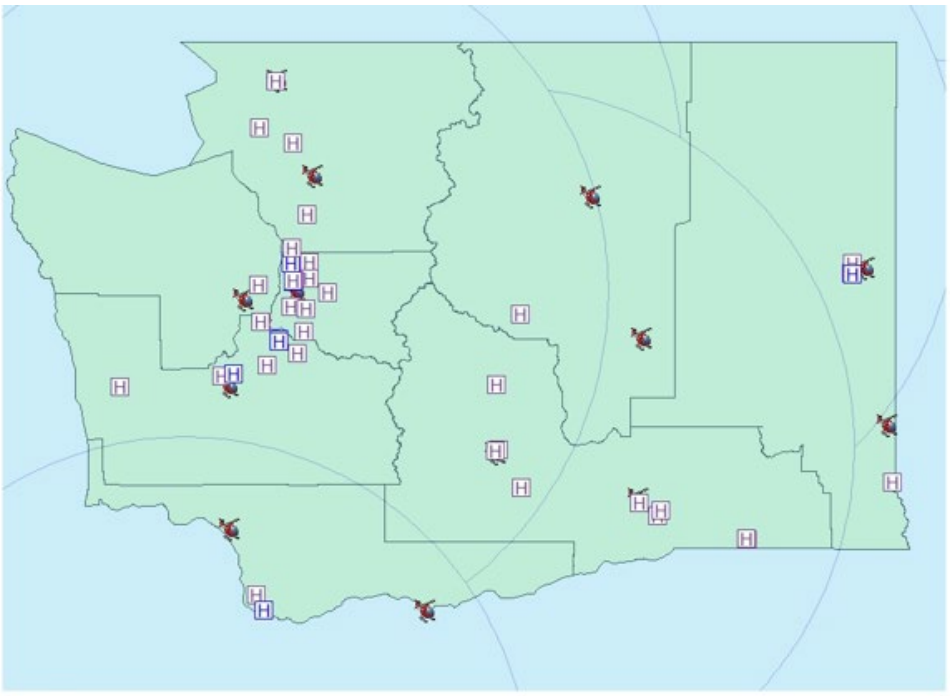


Figure 28. Projected 15-minute response time from air ambulance base to level III categorized stroke facilities within the buffer zone

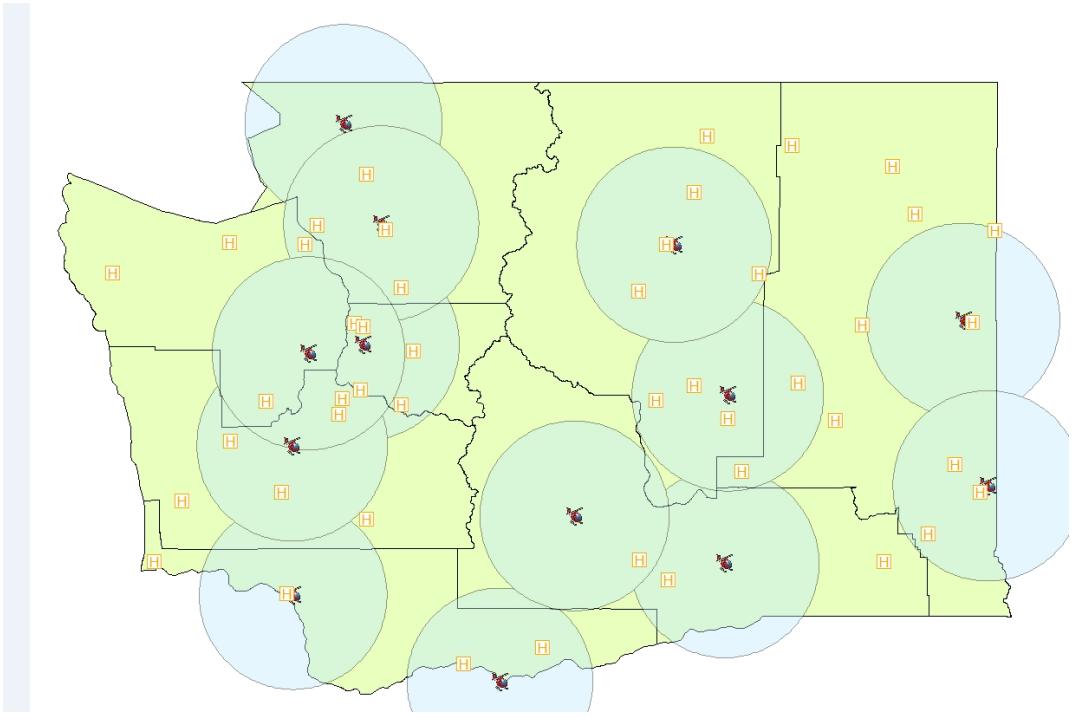


Figure 29. Projected 20-minute response time from air ambulance base to level III categorized stroke facilities within the buffer zone

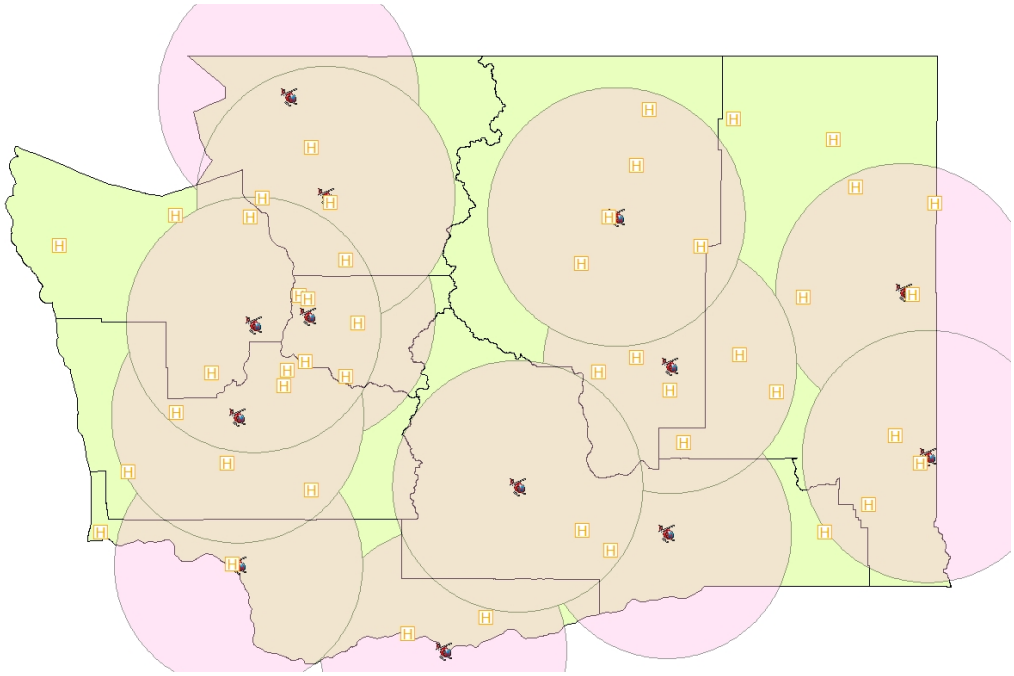


Figure 30. Projected 30-minute response time from air ambulance base to level III categorized stroke facilities within the buffer zone

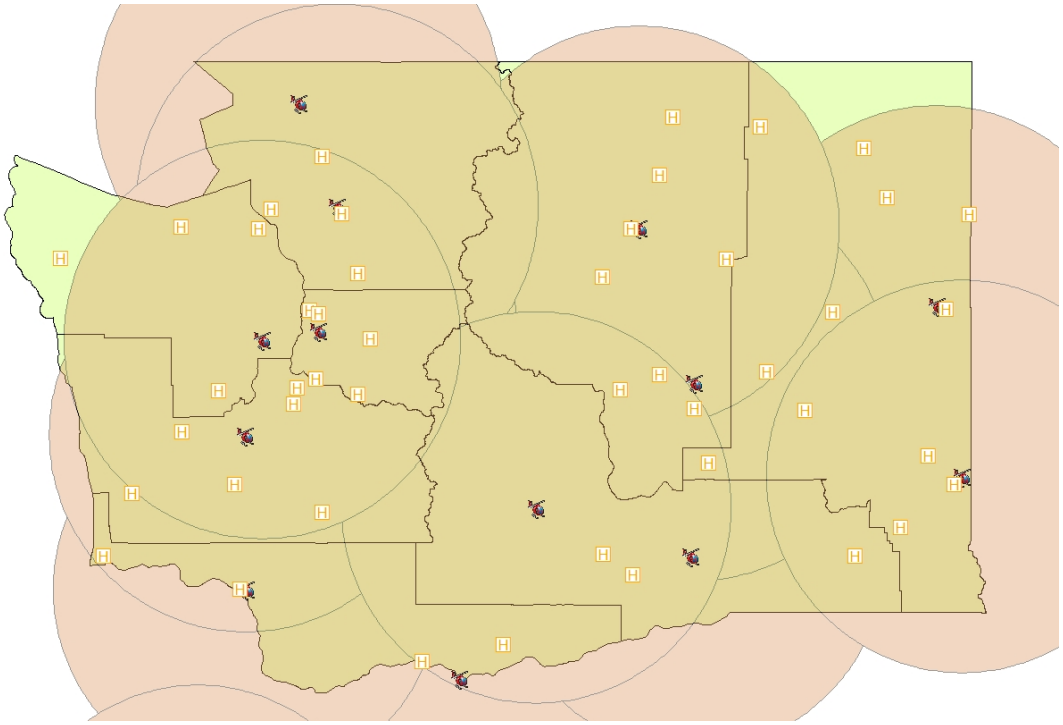


Figure 31. Projected 45-minute response time from air ambulance base to level III categorized stroke facilities within the buffer zone

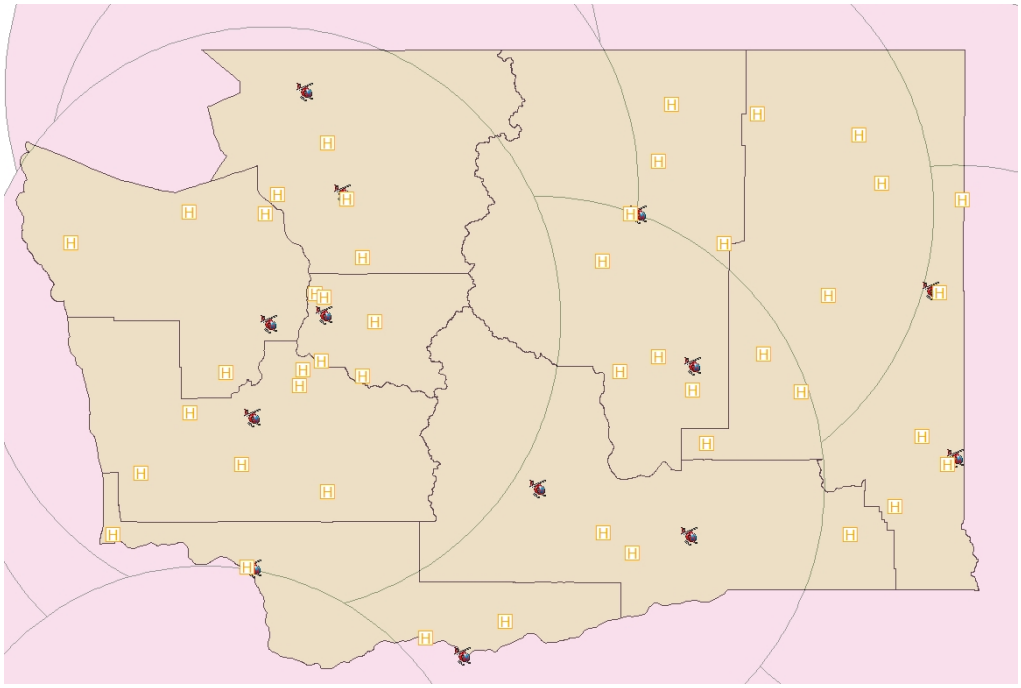
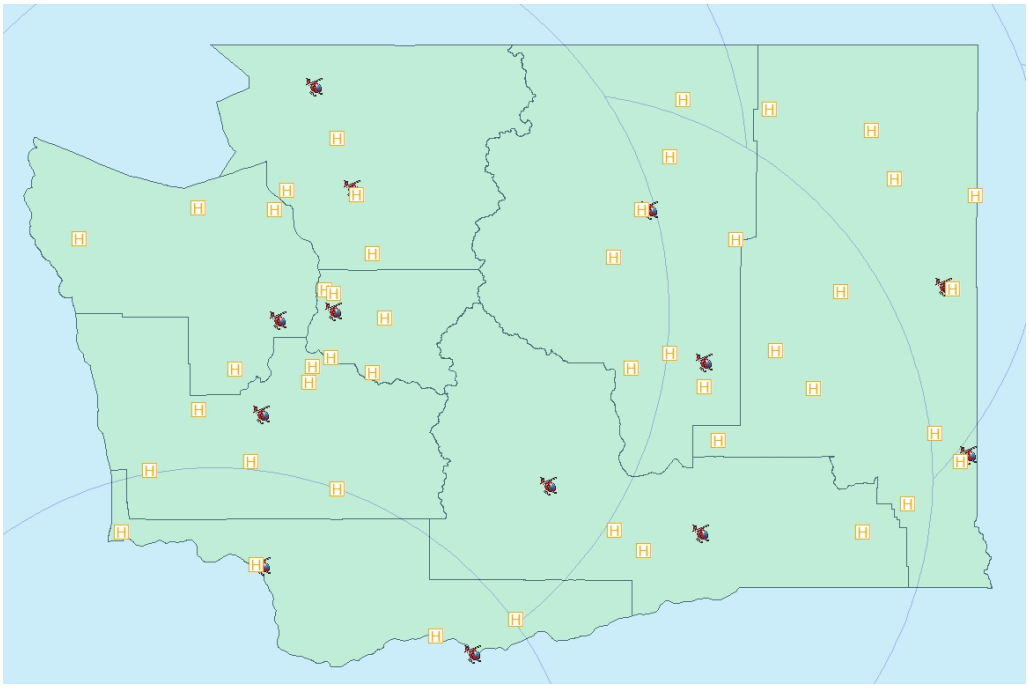


Figure 32. Projected 60-minute response time from air ambulance base to level III categorized stroke facilities within the buffer zone



Appendix D

Definition of Terms Used

Term	Definition(s)
Activation	A request for service.
Ambulance	Means a ground or air vehicle designed and used to transport the ill and injured, and to provide personnel, facilities, and equipment to treat patients before and during transportation. (RCW 18.73.030)
Ambulance service	Means an organization that operates one or more ambulances. (RCW 18.73.030)
Aircraft	Means a vehicle designed for flight that is powered by liquid petroleum fuel. (NAAMTA Standards Manual Glossary)
Aircraft type	The FAA lists three main aircraft types: fixed-wing (airplane), rotorcraft (helicopter), and experimental aircraft. Within these categories are specific designations for aircraft based on a number of variables. When referencing the aircraft you may be asked for a specific make and model. (NAAMTA Standards Manual Glossary)
Arrival at Destination	The date and time the vehicle arrived at the destination landing area. (NEMSIS)
Arrived at Patient	The date and time the responding unit arrived at the patient's side.
Arrived on Scene	(1) Means the date and time the vehicle arrived at the destination landing area. (NEMSIS) (2) The point at which a vehicle is stopped on the scene of a response destination or address. (NAAMTA Standards Manual Glossary)
Auto Launch	Based on pre-determined criteria an algorithm is built into a computer-aided dispatch (CAD) system that automatically activates an air ambulance as a primary response unit to a call in addition to other primary responders.
Cancellation	Air ambulance services are no longer needed and the request for service is canceled.

Departure	(1) The date and time the responding unit left the scene with a patient (started moving). (2) An aircraft taking off from an airport. (NAAMTA Standards Manual Glossary)
Destination Patient Transferred	The date and time that patient care was transferred to the destination healthcare facilities staff.
Dispatch Acknowledged Date/Time	The date and time the dispatch was acknowledged by the EMS unit. (NEMSIS)
Dispatch Notified Date/Time	The date and time dispatch was notified by the 911 call taker (if a separate entity).
Early Activation	An air ambulance service provider is requested to respond and is launched to a scene before arrival of first responders, based on the high index of suspicion that specialty services or rapid transport will be necessary. (Discussed 10.24.2017, discussed differentiation between auto launch, early activation, simultaneous activation, etc.)
En Route Date / Time	The date and time the unit responded; that is, the time the vehicle started moving.
En Route Interval	A measurement that begins at the time a response unit starts to move toward an incident, and the time the unit comes to a complete stop at the location of the incident. (NAAMTA Standards Manual Glossary)
Fixed-wing aircraft	Means airplane
Flight time	The estimated time from launch to the aircraft landing at the scene.
Landing zone	The physical landing location for the aircraft. . A landing zone should be a flat area, free from obstructions, a minimum of 100 by 100 feet.
Landing zone hazard assessment	The assessment of the landing zone. A landing zone should be a flat area, free from obstructions, a minimum of 100 by 100. Landing zone assessment should include evaluation of overhead wires, rocks, uneven

	surfaces, loose debris, trees, vehicles, foot traffic, and high winds. Such hazards should be reported to the pilot.
Launch	An air ambulance service provider is requested to respond to the scene After the arrival and patient assessment by first responders, based on the ground medic's determination that specialty services are necessary.
Launch time	The time at which the helicopter lifts from the launch location and is en route to the scene.
Patient Arrived at Destination	The date and time the responding unit arrived with the patient at the destination or transfer point.
PSAP Call Date/Time	The date and time the phone rings (911 call to public safety answering point or other designated entity) requesting EMS services. (NEMSIS)
Rendezvous	To meet up with. An alternate site for patient transfer from ground ambulance to air ambulance.
Rotor-wing aircraft	Means helicopter (Merriam-Webster)
Trauma response area	Means a service coverage zone identified in an approved regional plan. (WAC 246-976-010)
Unit Notified Dispatch	(1) The date and time the responding unit was notified by dispatch. (NEMSIS) (2) To send out emergency resources promptly to an address or incident location for a specific purpose. (NAAMTA Standards Manual Glossary).
Standby	A state of heightened alertness and preparation for an air ambulance service provider about a possible mission. While on standby status, the aircraft will remain available to respond to another request for service. The next course of action would be for EMS to request launch or to cancel the standby.

Resources

Below are some resources air ambulance workgroup members presented and reviewed during the development of this plan.

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2. Wish, John R, and Daniel P Davis. *Auto Launch/early Activation: A Survey of AAMS Members and Literature Review.* Air Medical Journal 24.2 (2005): 83-8. Web.

3. McQueen, Carl, Mike Smyth, Gavin Perkins, and Joanne Fisher. *Does the Use of Dedicated Dispatch Criteria by Emergency Medical Services Optimise Appropriate Allocation of Advanced Care Resources in Cases of High Severity Trauma? A Systematic Review.* Injury 46.7 (2015): 1197-206. Web.

4. Kehoe, Sheehan, Davies, and David. *13: Reliability of Dispatch Criteria for Activation of a Helicopter-Based Out-of-Hospital EMS System.* Annals of Emergency Medicine 51.4 (2008): 474-75. Web.

5. Hirshon, Galvagno, Comer, Millin, Floccare, Alcorta, Lawner, Margolis, Nable, and Bass. *Maryland's Helicopter Emergency Medical Services Experience From 2001 to 2011: System Improvements and Patients' Outcomes.* Annals of Emergency Medicine 67.3 (2016): 332-40.e3. Web.

6. L'Heureux Randy, Bell Nathaniel J, Schuurman Nadine, and Hameed Syed M. *Modelling Optimal Location for Pre-hospital Helicopter Emergency Medical Services.* BMC Emergency Medicine 9.1 (2009): 6. Web.

7. *Early Activation of an Air Medical Helicopter and Auto Launch Recommendations.* AAMS,aams.org/publications/early-activation-air-medical-helicopter-auto-launch-recommendations/.

8. Goldstein, Doig, Bates, Rink, and Kortbeek. *Adopting the Pre-hospital Index for Interfacility Helicopter Transport: A Proposal.* Injury 34.1 (2003): 3-11. Web.

9. Brändström, Helge, Ola Winsö, Lars Lindholm, and Michael Haney. *Regional Intensive Care Transports: A Prospective Analysis of Distance, Time and Cost for Road, Helicopter and Fixed-wing Ambulances.* Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine 22.1 (2014): 36. Web.

10. Milligan, Jones, Helm, and Munford. *The Principles of Aeromedical Retrieval of the Critically Ill.* Current Anaesthesia & Critical Care *1.1* (2010): 22-26. Web.