Region 5 Medevac Comprehensive Analysis

2004-2019

This Medevac Comprehensive Analysis was created as a follow up report to the Middle Fire Hoist Rapid Lessons Sharing (RLS) and the Lime Fire Hoist RLS at the request of the Region 5 Risk Management Specialist Mike Noel of the USDA Forest Service. This report builds on the lessons learned from the Dutch Creek incident to incorporate the new lessons captured in the 2019 RLS documents with a history of past medevacs performed in support of wildland fire incidents. This document begins to explore the question, "What should be done next?"

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1. Executive Summary

Following two air medevacs from fires in the Northern Operations Geographic Area Coordination Center (ONCC) within a two-week period in July 2019, a small team was assembled to review these incidents, together with the 2008 Dutch Creek Incident, to provide an overview of the current status and opportunities for developing medevac effectiveness in wildland fire.

Upon reviewing 22 medevacs and 33 injuries over the period 2004-2019, the resultant report identified three basic focus areas:

1. The explicit use of the Risk Management process (in the form of a Risk Assessment or other tool) to weigh the relative risks of management actions on wildland fires related specifically to the difficulty of extracting injured personnel in a timely manner;
2. An evaluation of the current ability of Forest Service Fire and Aviation (FAM) to extract injured personnel, with the potential opportunities for bolstering that ability;
3. The status of Forest Service fire modules' emergency medical capabilities, particularly related to the injuries that appear most often in the sample data, and opportunities to improve immediate response from peers or other assigned resources.

In the sample data, it was discovered that burns and traumatic injuries from falling objects accounted for the vast majority of injuries (82%), and all of the fatalities. This trend is consistent with the NWCG Report on Wildland Firefighter Fatalities in the United States: 2007-2016 in which falling trees or rolling rocks claimed the lives of 12 firefighters during the most recent period. On average, injured personnel arrived at definitive care at a hospital 106 minutes after the injury occurred (62% arriving at hospital at or within 120 minutes, and 90% in 150 minutes). Patient delivery to definitive care within the so-called "golden hour" in this sample occurred 14% of the time (3 injured firefighters). Prompt care at the scene was universal for extended attack fires and in alignment with the Dutch Creek Protocols; however, this only occurred within the first 10 minutes for 50% of those injured in the initial attack phase.

Within the United States, California was the state with the most fatalities (38 fatalities), showing an increase when compared with the period between 1999 and 2006 (35 fatalities) and the period between 1990 and 1998 (29 fatalities). With the inherent difficulty of extracting injured personnel from many fire environments, the use of a Risk Assessment tool adapted specifically for this purpose could increase fire managers' decision-making ability around how, where, and when to deploy fire resources and medevac-capable aircraft. The current gap appears to be greatest during the initial attack phase including preposition of resources to increase surge capacity. Aircraft and other medical services (e.g., ambulance, line EMT's, etc.) are not typically ordered to preposition before fire starts like other resources (e.g., helitack, hotshots, engines, etc.). This leaves vulnerability to the agency's current model associated with medical planning and management.

2. Background

This report is a follow up to the Middle Fire Hoist extraction Rapid Lessons Sharing (RLS) to evaluate what was learned after the Dutch Creek Fatality.

Agency Needs	The USFS recognizes the need to evaluate past accident reports in an attempt to reduce the chances of similar accidents occurring again. This includes reducing extraction times, addressing life-threatening injuries, and reducing line of duty deaths.
Objectives	The overall objective is to reduce line of duty deaths and increases the capability to manage sever injury in the wildland fire field. 1. Identify recommendations across reports that are similar; 2. Identify recommendations across reports that conflict; 3. Where possible, determine implementation status of recommendations; 4. Determine similarities between incidents and highlight problem areas that are not identified in recommendations; 5. Report on any findings that may increase the margin of success during medevac responses.
Parameters	1. Only review reports where any component of medevac was utilized in wildland fire 2. Any mechanism of injury is included 3. Incidents do not include CalFire data 5. Only utilized WLLC data and NWCG data

3. Introduction

The information in this report comes from documented medevac incidents meeting the criteria outlined in the parameters above.

- Incident reports come from USFS incidents within Region 5
- These incidents occurred from 2004 through 2019
- The dataset includes 22 incidents

Research using the incident archives of the Wildland Fire Lessons Learned Center[1] (LLC) revealed 22 medevac reports in Region 5 covering the span 2004 to 2019 that contained enough basic information to compare with one another. The actual numbers of medevacs is much higher, multiple times or even an order of magnitude higher. Medevacs *per se* have not typically triggered the mobilization of an investigate team. Indeed, on a large fire a medevac is very likely to occur, and could possibly be relatively routine in nature.

For these reasons, it is very likely that the sample contained in the data from LLC is not representative of the typical use of medevac on fires. LLC is much more likely to have access to information regarding major injuries or fatalities. The sample, then, may instead be more representative of the *most critical* medevacs that occur on California wildland fires, where death or permanent disability are potential, or even likely outcomes.

[1] Available at the Lessons Learned Center Incident Review Database: https://www.wildfirelessons.net/irdb

4. History of Medevac

Air medical evacuation (medevac) arose as an early use of military aviation at the very beginning of the widespread use of aircraft during the First World War. Severe practical limitations at the time meant that medevac by air was mainly experimental in nature. The average time that elapsed from time of wound to arrival at definitive care (a medical facility that can conclusively manage an injury) averaged 18 hours[2]. While the mortality rate of soldiers Wounded in Action (WIA) remained at the historically consistent rate of about 20%, the percentage of those who Died Of their Wounds in the hospital (DOW) was 8% in one large World War I battle. This DOW figure compares to 4% during the American Italian Campaign of World War II, when time to definitive care had dropped to an average of ten hours.

It was not until the invention and refinement of the helicopters that medevac significantly expanded in practical use in the armed services, as rotor-wing aircraft could land and take off directly adjacent to wounded soldiers without needing additional ground transport to and from an airstrip. The first medevac using rotor-wing aircraft occurred in the Pacific theater of World War II.

Helicopter medevac became standard during the Korean War[3] and developed to a point where continued treatment of a patient was possible during transport. Mortality rates dropped even more during this period. During the Vietnam War, US military personnel suffered a 16% fatality rate from wounds, dropping to 2.5% if they arrived at definitive care alive (i.e. 2.5% DOW rate). Average medevac time was reduced to one to two hours. Many related models of these Vietnam-era Bell helicopters are still in use today as firefighting and multi-use aircraft

[2] Historical statistics regarding US military casualty rates and medevac times in this section are from Joseph Hudak III's "The Origins of the 'Golden Hour' of Medical Care and its Applicability to Combat Medicine" (2015).
[3] The term "medevac" first appears as a portmanteau of "medical evacuation" in literature in 1953 according to Google's Ngram Viewer.

contracted (in our case) or owned by government agencies. In some cases actual Vietnam-era government surplus UH-1H helicopters are still in service with various wildland fire services in the US.

Coincident with the development of medevac techniques from combat zones were the first domestic uses of air medevac. Early examples typically appear in remote parts of the globe, such as interior Africa and the Australian Outback, where travel distances to advanced medical services were very long. Despite this trend, the first organized medevac/air ambulance service was founded in the late 1940s in rapidly urbanizing Southern California.

The success of military medevac during Vietnam (made visible to American TV viewers) served as a catalyst to trauma medical services for the US civilian population in the mid-1960s. One concept of this era was the "Golden Hour," described by Dr. R. Adams Cowley who was concerned with the underdeveloped infrastructure of American civilian emergency medicine in early 1970s[4].

As in the military context, use of assigned firefighting aircraft for medevac missions was a subsequent development and not the primary mission of the aircraft. Unlike the military, firefighting aircraft are often supplemented by nearby private medevac services. Also unlike the military, the vast majority of aircraft used by the federal government for fire management are contract aircraft owned by private entities. As a result, major modifications to aircraft configuration or use are very difficult within the life of the contract, or even between contracts. The federal government has been, therefore, in the position of being an extensive and intensive user of aircraft owned by a third party and has benefitted (in some areas) from the existence of

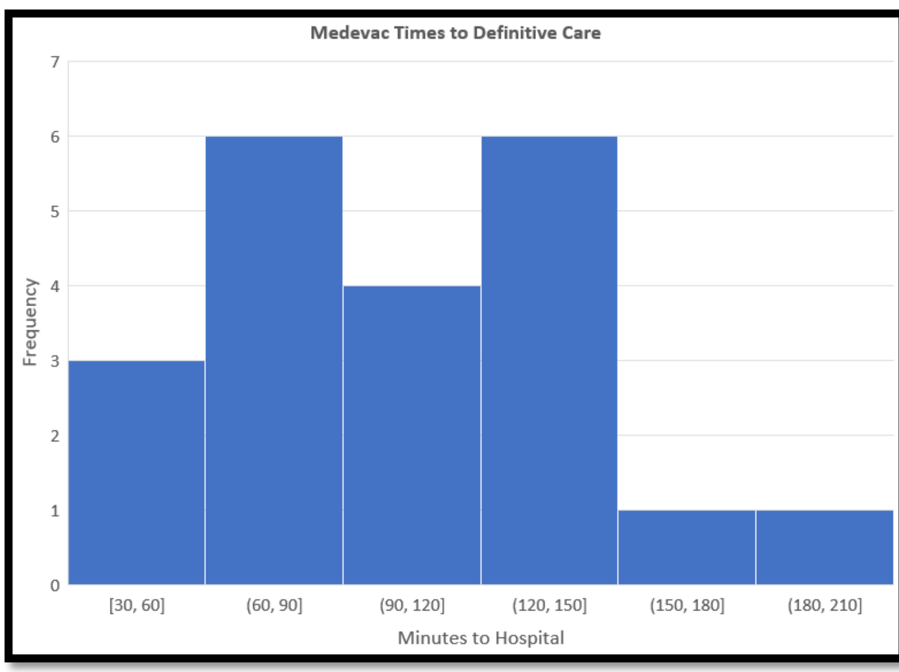
[4] From Hudak III (2015)

private air ambulance services and other government agency aircraft (state and local government fire, law enforcement, military).

Only recently, following the recognition of limited and/or unreliable medevac availability on federally managed wildland fires has the ordering of dedicated medevac helicopters at an incident helibase (or a location central to several fires) become the norm. Further, ordering medevac helicopters *in anticipation* of increased activity (i.e. prepositioning for lightning and wind events) is still <u>*not*</u> the norm. The two key components of emergency medical treatment of injured firefighters – medevac and patient care – are discussed in depth below.

5. Medevac Statistics

At first glance, a striking result of data analysis is the similarity in mean and median extraction time for several owner categories[5]. By 85 minutes post-accident, all the patients rescued by County, Federal Government, Private Company, and CHP helicopters were onboard the helicopter and *en route* to the hospital. By 117 minutes, all patients (save two outliers) were onboard US National Guard helicopters. The odd man out in this dataset is the US Coast Guard (USCG), but only



[5] An evaluation of CALFIRE's medevac program metrics and capability is beyond the scope of this document. Using available data from LLC, however, a cursory analysis indicates that CALFIRE medevac data are consistent with other agencies. CALFIRE aviation has and will continue to play an important role in medevac from wildland fires in California.

two examples of USCG rescues from wildland fires were found (more on USCG use below). With the exception of short-haul rescue (currently in use by the National Park Service), current medevac methods allow for the treatment of injured patients while *en route* with only a brief gap in care during hoisting/loading into the helicopter.

In cases where aircraft are able to extract the patient, the probability of delivering the injured firefighter to a hospital within an hour is very low; a more likely timeframe is 90 minutes *or more* (See Chart 2). In fact, the mean medevac time (injury to definitive care) in this sample was 106 minutes. Just under 43% of injured firefighters arrived at the hospital within 90 minutes of injury (62% arrived at or within the first 2 hours, and 90% at the 2½-hour mark). Patient delivery to definitive care within the so-called "golden hour" in this sample occurred 14% of the time (3 injured firefighters). Times in this sample are roughly equivalent to combat medevac times in the Vietnam War period.

The US Coast Guard has typically only been used as a resource of absolute necessity (given their distance, substantially different mission, aircraft capabilities, etc.). Both examples of the use of USCG helicopters involve extended response times: 205 minutes for the 2008 Dutch Creek Incident and 420 minutes for the 2019 Middle Fire.

Figure 1 Image from Hirz Fire RLS

6. Factors in Extended Medevac

Extended medevac times were associated the following conditions:

- Night time
- Smoky and/or windy conditions, unfavorable for flying
- Fire behavior makes immediate rescue unsafe or impossible
- Long duration ground evacuations to get the patient to an LZ or hoist spot
- Helicopters coming from very far away (over 50 air miles)
- Helicopters performing missions they are unfamiliar with/working in unfamiliar areas
- Helicopters unsuited to the density altitude or terrain of the medevac location
- Hospital is a long distance from the medevac location

Of these factors, many are entirely out of our control and cannot be mitigated out of the system. A risk management analysis of managing fire in remote areas therefore must include the probability that aircraft will not be able to reach the injured person or will be delayed for extended periods. Alternate methods of extraction such as utilization of a Remote Extraction Module (REM) must be a part of the risk management analysis as these methods would extend medevac timelines and require additional manpower. It was not possible to investigate this probability with the LLC data.

Figure 2 Image from Middle Fire Hoist RLS

7. Injury Statistics

We next looked at our sample data for other information outside of the medevac itself. This dataset was larger, as most incidents included enough data to determine the mechanism of injury, the primary (most serious) injury type, the phase or type of incident (IA, IMT, RX, etc.), the type of responder, and the response time for the initial medical intervention. Only those incidents where multiple of these factors were unknown, or where the CALFIRE personnel were directly involved (as patient or first responder) were excluded. The resultant sample size of incident injuries evaluated was 33.

To keep the sample roughly analogous to the medevac sample, we did not go back into the LLC database to include all reports of injuries in Region 5 during the period from 2004-2019. Like the medevac sample data, these injury reports comprise those of sufficient seriousness to warrant a medevac response and some level of learning review documentation (e.g., RLS and FLA). No doubt, the most common injuries among firefighters are minor in nature and are either not reported or are of minimal consequence to the individual or the agency.

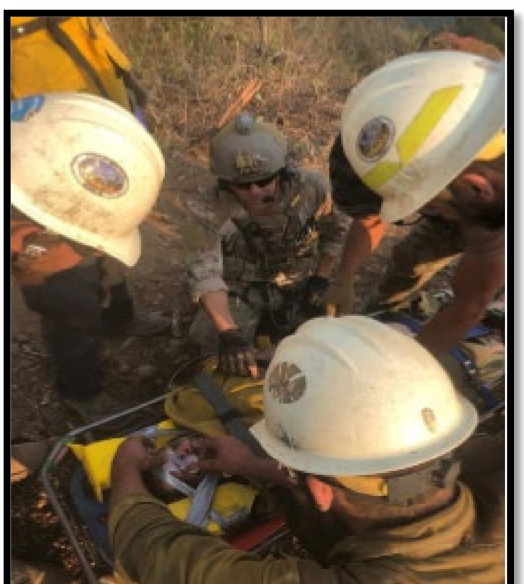
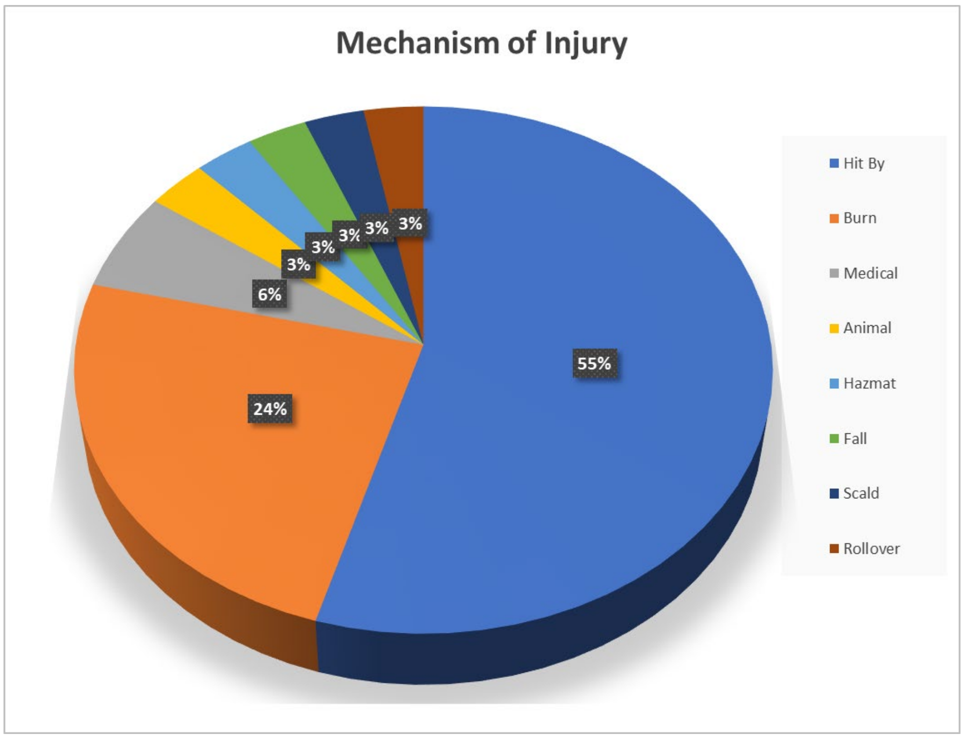


Figure 3 Image from Hirz Fire RLS

Region 5 Medevac Comprehensive Analysis

Anecdotal observation of the prevalence of "hit by" injuries in recent years was strongly backed up by the analysis of this sample. The majority of injuries (55%) in the sample resulted from a firefighter being struck by a tree, tree limb, or rock (Chart 3). This category dwarfs the next two categories: burnover/flame impingement at 24%, and medical events at 6%. Due to this large proportion of injuries caused by external striking force, the majority of injuries resulting in medevacs in this sample can be categorized as "trauma" – 58% (Chart 4). Breaking down this broad category reveals that multiple upper body trauma was most prevalent (42% of trauma injuries), followed by specifically head trauma (32%), followed by individual cases of injured body parts: chest, pelvis, femur, and ribs, each at 6%.



The trend of "hit by" injuries is consistent with the NWCG Report on Wildland Firefighter Fatalities in the United States: 2007-2016 in which falling trees or rolling rocks claimed the lives of 12 firefighters during the most recent period, compared with seven firefighters during the period between 1999 and 2006. The total number of firefighter fatalities caused by falling trees or rolling rocks between 2007 and 2016 was equal to the combined total between 1990 and 2006. Four of the deaths during the most recent period occurred in California; two in Kentucky; and one each in Colorado, Oregon, Washington, Idaho, Nevada, and Florida[6]. California was the state with the most fatalities (38 fatalities), showing an increase when compared with the period between 1999 and 2006 (35 fatalities) and the period between 1990 and 1998 (29 fatalities).

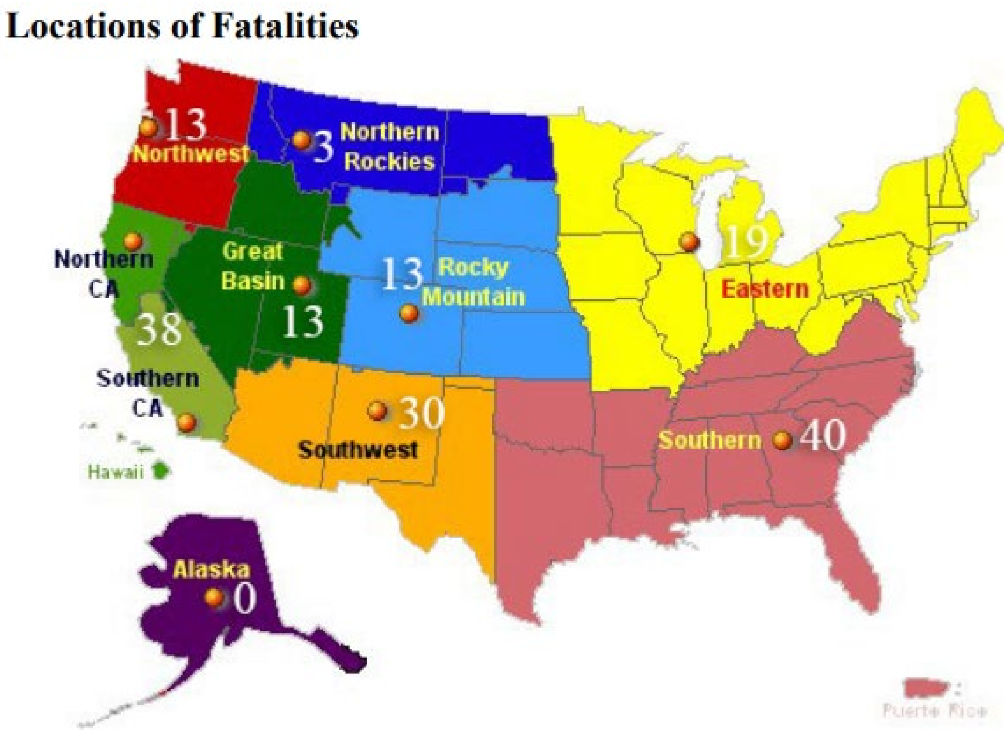
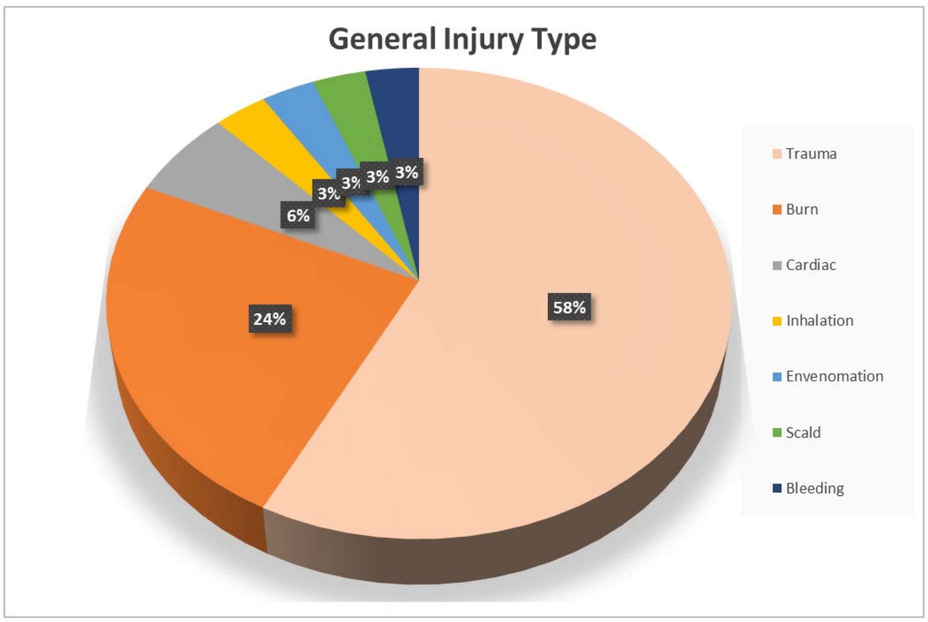


Figure 4 Locations of wildland firefighter fatalities by Geographic Area Coordination Center (GACC).

Because loss of life among federal firefighters on wildland fire incidents is thankfully an uncommon event, individual large-scale tragedies significantly alter statistical analysis. These events, such as the tragic loss of Engine 57 on the Esperanza Fire in this sample, cannot be excluded as an outlier event as these "outliers" account for an outsize portion of loss of life in

[6] NWCG Report on Wildland Firefighter Fatalities in the United States: 2007-2016 p.6

any given year, and across multiple years of analysis. In this analysis, nine firefighter fatalities are included in the sample data, five of whom were members of Engine 57. This being the case, over 60% of burn injuries accounted for in this data resulted in loss of life, while fatal burn injuries made up 56% of all fatalities. The next most lethal injuries were from catastrophic multiple system trauma. In these three cases, an entire tree or a large portion of a tree falling from a great height caused catastrophic multi-system trauma. The final cause of death was categorized in this analysis as blood loss, though the mechanism of injury was the same as the others, and the coincident injury was a femur break.



When analyzing the medical response to injuries in this sample, we investigated the type of responder and the approximate response time. The vast majority of responses could be described as either immediate or at least prompt, with a responder providing initial care within 10 minutes of injury in 73% of injuries in this sample. Often these response times were surely much less than 10 minutes, sometimes occurring within a minute or two of injury. Longer response times were almost always associated with the injury being either unreported for a period of time or an external barrier (such as extreme fire behavior) inhibiting a quicker response. Twelve percent of injured firefighters received initial care within 45 minutes of injury, while the five firefighters on the Esperanza Fire (15% of sample) were not found for over an hour.

Finally, we looked at incident type and type of medical responder. In this data, a firefighter was just as likely to receive EMT-or-better care whether they were assigned to an initial attack fire or a fire with an IMT. In both circumstances, 100% of firefighter patients were treated by someone with at least EMT qualification and training (excluding (3) “unknown” responder types). Response times, however, were dramatically different. Only 50% of firefighters on initial attack fires received initial treatment within the first ten minutes of injury. This compares to 91% of injured firefighters on IMT fires, with the remaining 9% receiving treatment about 15 minutes after injury.

Figure 5 Image from Dutch Creek Investigation Report

8. Factors in Patient Care

A key factor missing in any analysis of medevac success looking strictly at evacuation time is treatment of the patient in the minutes immediately following the injury up until medevac. Substantial data indicates that adequate and complete treatment of the primary injury (blunt force trauma, bleeding, etc.) in the first 15 minutes substantially reduces mortality of the injured person[7]. Several sources cited by Hudak indicate two mortality spikes among injured people: one between 5-15 minutes following injury, and another between 60-180 minutes. This seems to point to the need for rapid care to stabilize a patient, followed by evacuation to a medical facility with adequate care while *en route*. Some percentage of injured people will succumb to their wounds regardless of treatment and/or before treatment can begin, of course.

In Hudak's research, the analysis of the 75th Ranger Regiment is instructive. In 1998, the 75th Rangers initiated medical training for all soldiers at a level above the previous standard. In a review of combat medicine through early 2010, the 75th Rangers saw a 3% mortality rate from wounds rated as "potentially survivable." As 32 Rangers of the 75th Regiment were killed in this period, 3% amounts to one Ranger killed in action. Significantly, of the other Rangers killed in action, none died of the wounds specifically targeted for additional training by the regiment. Their 3% rate compares to a 24% mortality rate in other US military units operating in the same theater of operations at the same time.

This leads to the next question…does First Aid/CPR increase firefighter survivability for trauma? It was noted that a number of successes were a direct result of "best practices" such as employing crew EMT's, the availability of BLS equipment, supplementing inventory with additional extraction gear (e.g. vehicle roll over kits consisting of ropes, pulleys, etc.), and

[7] Documented in the extensive literature review in Hudak III (2015)

participating in additional rescue training (e.g. Low Angel Rope Rescue Operations (LARRO)). It appears that Wildland firefighting units have locally implemented these mitigations, above agency policy, to attend to the risk observed in the field. Firefighters are recognizing the risks inherent in their environment, which includes operating outside the "Golden Hour" radius. Is the "Golden Hour" the correct model for the wildland firefighting environment?

9. Dutch Creek Incident Lessons Learned Review

The Dutch Creek incident prompted great concern regarding medical response, medical management, and firefighter extraction within the wildland community. As a result, the Dutch Creek Serious Accident Task Team (Task Team), assembled by the NWCG Executive Board in February 2010, was tasked to provide recommendations to resolve the findings from the Dutch Creek Serious Accident Investigation Report and Accident Review Board. Based on the work and recommendations of the Task Team, NWCG provided direction in three main areas:

1. Standardized Medical Emergency Procedures for Incident Management Teams (IMT) to include in their Incident Emergency Plans
2. Standardized Communication Center Protocols
3. An expanded ICS 206 Medical Plan to include emergency medical procedures that will be reviewed each Operational Period at the Planning Meeting.

The theory behind incorporating these procedures and protocols into daily operations and practicing the critical elements *should* result in faster and more effective medical emergency medical response. Furthermore, a "Dutch Creek Protocol" supplement to the 2010 Incident Response Pocket Guide (IRPG) was made available to wildland firefighters, and subsequent IRPG versions were reorganized with a fully developed "Dutch Creek Protocol" – the Medical Incident Report (MIR) – incorporated into the medical section.

Many incident reports mention the implementation of these recommendations; however, implementation is limited in audience. Incident Management Teams (IMT) with delegated authority, increased capacity, and authorized funding meet less resistance in prepositioning a complement of medical resources (i.e. medevac helicopter, REM, line medics) with appropriate oversight (i.e. medical unit leader). For the Geographic Area Communication Centers (GACCs), there are notable challenges to preposition medical resources in preparation for increased or elevated fire activity, in support of prepositioned fire resources, or for initial attack phases with limited ICS structure (e.g., lightning). These challenges include funding, agreements, and limited resources within the geographic area that can accommodate the mission set. This leaves vulnerabilities within the system and a reliance on USCG aircraft, California Highway Patrol (CHP), and other local resources.

Many LLC Incident reviews mention the existence of a district or forest ICS-206 to incorporate better medical planning to cover initial attack fire and projects. These plans typically include local resources and remain unchanged without the activation of an IMT. This creates a gap in what is needed and what is available during increased activity periods. Furthermore, medical response and management capabilities become even more restricted when working night shift. So what more can we learn by comparing Dutch Creek to the Middle Fire?

10. Dutch Creek and Middle Fire Incident Comparison

These incidents offer commonalities regarding medical planning and response. For example, both incidents were located merely a drainage apart, included similar injuries (femur), and emphasized the use of local EMS. In both circumstances, the extraction of the injured firefighters was performed by the USCG. However, as we take a deeper look at each incident, there are some distinct differences in the decision-making process post injury. These factors display the idea of immediate and complete care once the injury is sustained (post injury) through the period until the firefighter arrives at definitive care.

During the Dutch Creek incident, the severity of the injury was not immediately apparent to first responders. The ALS paramedics responding to the incident were advised that the injury was a broken leg. This information played a role into the type of response equipment chosen by responding paramedics. It was not until the wound was revealed fully that the severity of the injury was recognized. Furthermore, both paramedics determined that a tourniquet would not have worked to stabilize the bleeding due to the severity. This was confirmed by the Shasta County Corner[8]. This is a motivating factor in why extraction was a focal point of the lessons learned for Dutch Creek.

In contrast, factors during the Middle Fire offer a different perspective. The Middle Fire incident did not have ALS care available, so patient care responsibilities were absorbed by a module crewmember with the highest level of training (EMT). The crew EMT made the decision not to move the patient or provide extraction by ground for fear of clipping the intact artery and declining the patient's condition. This decision was later deemed the best course of action for patient care[9].

Fire	Ops	Status	Level	Mechanism	# of Patients	Injury	Care	Method	Extraction Time
Middle Fire	Night	Initial Attack (IA)	ICT4	Hit by Rock	2	Femur, no bleeding and head	Crew EMT	USCG Hoist	7 hours
Dutch Creek	Day	Extended Attack (EA)	IMT	Tree Felling	1	Femur, arterial bleed	ALS	USCG Hoist	4 hours

[8] The Accident Investigation: Factual Report on Dutch Creek p.6
[9] Rapid Lessons Sharing Middle Fire Night Hoist p.4

This contrast can challenge the mental models created from the lessons learned in the Dutch Creek Incident. In the Middle Fire, the patient had a closed femur fracture resulting in different care priorities (e.g. stabilization when medevac helicopter was unavailable). In Dutch Creek, the open femur fracture with arterial bleeding could not be stabilized, resulting in an extraction priority. Both incidents display the importance of contingency planning for extraction methods extending beyond the golden hour and/or beyond helicopter utilization. Overall, it is important to validate our mental models created by experience. It is equally important to calibrate our situational awareness surrounding patient care and extraction priorities through the risk management process in dynamic situations.

It should be noted that in the event an aircraft is unavailable, additional resources and equipment are required to extract an injured firefighter. Should the anticipated extraction method decline patient condition, it may be in the best interest of patient care to have a longer extraction time exceeding the golden hour (> 1 hour). This is more readily available for IMTs supervising extended attack as opposed to fire modules in an initial attack environment.

Lastly, both incidents offered an opportunity to explore the idea to supplement medical resources pre-incident through prepositioning options. In Dutch Creek, prepositioning medical resources would have been through the IMT which was a lessons learned for the event. For the Middle Fire, it would have been commensurate with the prepositioning of surplus fire personnel in preparation for predicted activity level within the GACC. This is not current practice within the agency. In highlighting these differences, it brings to question, does the "Golden Hour" increase firefighter survivability?"

11. Middle Fire and Lime Fire Incident Comparison

The Middle Fire is a particularly instructive case, as the day following the incident a dedicated night-hoist-capable medevac helicopter arrived in the area to cover local fires. This helicopter rescued an injured firefighter (tree strike) from the Lime Fire less than two weeks following the Middle Fire and delivered him to definitive care only 71 minutes after his injury. While not a perfect comparison, night vs. day, open ridgeline vs. mid-slope in trees – it seems reasonable to conclude the dedicated night-hoist helicopter could have significantly reduced the time-to-care on the Middle Fire incident.

The Middle Fire also highlights the deficiencies in the current practice of relying on a kaleidoscope of different resources with differing primary missions, capabilities, constraints. While in many areas there may be considerable redundancy in medevac resources on a particular day, in more remote places this is far from the case (Such as in the 2013 Saddleback Fire in the Warner Mountains). Even in heavily urbanized areas, duty day limitations, scheduled maintenance, and limitations on night flying or unimproved landings all mean that coverage is unpredictable from day to day.

On the other end of the spectrum, outliers where transport to care was almost immediate shed light on factors that lead to successful rapid medevac. When a helicopter is dedicated to incident support, the proximity of staged area to the accident site, time of day, and the patient's surrounding terrain and vegetation are critically important. These factors must be included into the decision-making process as they affect mission acceptance, mission timeline, and resource commitment.

It needs to be stressed that only under rare circumstances have there been medevacs of seriously injured patients to definitive care within the "golden hour" (See Chart 2). The mean medevac time using the sample data from LLC was 106 minutes, excluding the Middle Fire's 420-minute outlier. Many factors need to align for fast medevac to be achieved, given the LLC data used here. The helicopter in these very fast medevac examples was either assigned to the fire as a firefighting resource or staged for medevac; the patient did not require transport by ground to a helispot; it was daytime with clear air and good flying conditions. Moreover, the medical facility receiving the patient was nearby.

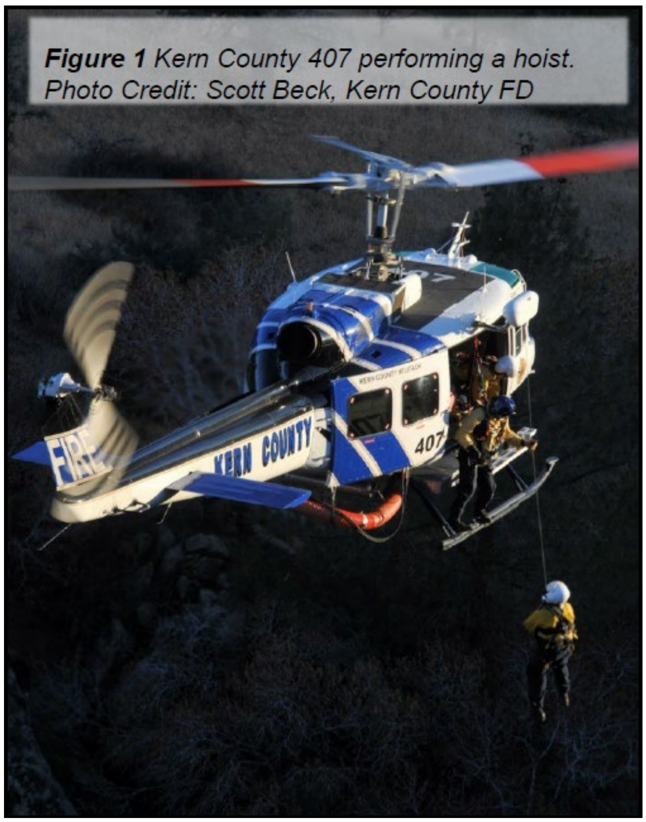


Figure 6 Image from Lime Fire RLS

12. Additional Considerations

- Consider the use of the Risk Management process (in the form of a Risk Assessment or other tool) to weigh the relative risks of management actions on wildland fires related specifically to the difficulty of extracting injured personnel in a timely manner.
- Consider incorporating scenario-based training into Risk 101 for agency administrators to include incident medical response and planning.
- Consider identifying criteria for staged medical response during preposition and/or increase activity within the GACC.
- Consider exploring the feasibility of a contract medevac helicopter during fire season.
- Consider allotting funding/training for areas with limited resources to participate in Remote Urban Backcountry Training (RUBE) also known as Remote Extraction Module (REM).
- Consider increasing EMT/BLS capability based on module size and/or discipline type (e.g., IHC, Helitack, Smokejumper, WFM, etc.).
- Consider developing a tracking protocol for all medevacs within the Region.
- Consider including injury to validate policy, procedures, and medical training to increase firefighter survivability.
- Consider developing an annual review or refresher for agency personnel that touches on the previous year's trends associated with medevac, injury, and illnesses. This could be incorporated in the Annual Fireline Refresher Training (RT-130) or be a stand-alone course similar to the Interagency Aviation Training (IAT) A-200 Mishap Review course for aviation.

12. Data Summary

Name (Click to view report)	Year	Mechanism	Extract Type*	Assigned	Time† to Onboard helo	Time† to Hospital	Conditions	Helo Station Distance from Incident
Powerhouse	**2004**	**Tree Limb**	**L**	**N**	**0:41**	**1:25**	**Day**	**45 mi**
Tuolumne	2004	Burnover	L	Y	0:20	0:20	Day	At Incident
Grant West§	**2004**	**Tree**	**L**	**U**	**N/A**	**N/A**	**Day**	**Unk**
Esperanza	**2006**	**Burnover**	**L**	**Y**	**0:25/ 0:38**	**1:12**	**Day**	**<10 mi**
Pine	**2007**	**Dozer Burnover**	**L**	**N**	**0:45**	**1:05**	**Day**	**20-40 mi**
Colorado	2007	Dozer Roll	S	Y	1:30 - 2:00 approx	2:36	Day	At Incident
Dutch Creek	**2008**	**Tree**	**H**	**N**	**2:35**	**3:25**	**Day**	**60 mi**
Panther	2008	Unk	H	U	Unk	Unk	Day	Unk
Little Grass Valley	**2009**	**Tree**	**L**	**N**	**1:46**	**2:10 approx**	**Day**	**55 mi**
Feather River RX	**2010**	**Burn**	**L**	**N**	**Unk**	**1:22**	**Day**	**40 mi**
Patrol Motorcycle	2010	Vehicle	L	N	0:48	1:09	Day	4 mi
McDonald	**2010**	**Snake**	**L**	**N**	**0:59**	**2:00 – 2:30**	**Night**	**30 mi**
Bear	**2010**	**Hazmat**	**L**	**N**		**1:54**	**Day**	**Unk**
Bagley	**2012**	**Tree**	**H**	**N**	**1:26**	**Unk**	**Day**	**30 mi**
Border #14	2012	Medical Heat	L	Y	0:31	Unk	Day	At Incident
Chips	**2012**	**Tree Limb**	**H**	**Y**	**0:39**	**1:14**	**Day**	**10 mi**
Chips	**2012**	**Fall**	**H**	**Y**	**Unk**	**0:55**	**Day**	**10 mi**
Saddleback	**2013**	**Tree**	**L**	**N**	**1:25**	**2:00 (est)**	**Day**	**120 mi**

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Streeter	**2013**	**Medical**	**L**	**N**	**0:37**	**Unk**	**Day**	**20 mi**
Monticello	2014	Dozer Roll	H	U	Unk	Unk	Day	Unk
French	**2014**	**Tree**	**H**	**Y**	**1:13**	**1:33 (est)**	**NVG/ Smoke**	**10 mi**
Upper Lyons	**2014**	**Burnover**	**L**	**N**	**0:57**	**2:15 – 2:30**	**Day**	**Unk**
Sierra§	**2015**	**Tree**	**L**	**N**	**1:00**	**N/A**	**Day**	**55 mi**
E-346 Roll‡	2015	Vehicle	L	N	0:26	0:30 – 0:45	Day	8 mi
Rough	**2015**	**Log**	**L**	**Y**	**2:20**	**2:40**	**Day/ Smoke**	**<20 mi**
Valley (CDF)	2015	Burnover	L	Y	1:00 approx	2:00 approx	Day/ Smoke	At Incident
Mountain Rest	**2015**	**Log**	**L**	**N**	**0:45**	**1:15 (est)**	**Day**	**<30 mi**
Mulholland	2016	Rock	H	Y	Unk	Unk	Day	At Incident
PT Hike	**2016**	**Medical Heat**	**L**	**N**	**0:20**	**0:30 – 0:40**	**Day**	**At Adj. Incident**
Black Springs	**2016**	**Tree Limb**	**L**	**N**	**1:10**	**2:05**	**Day**	**12 mi**
SRF PT	**2017**	**Medical**	**H**	**N**	**1:57**	**Unk**	**Day**	**90 mi**
Minerva 5	**2017**	**Tree**	**L**	**Y**	**1:03**	**2:03 (Est)**	**Day**	**<10 mi**
Sandy	2017	Medical	H	N	Unk	Unk	Day/ Hot	Unk
Crescent	**2017**	**Scald**	**L**	**N**	**0:50**	**2:02**	**Day**	**25 mi**
Carr	**2018**	**Dozer Roll**	**G**	**Y**	**Cancel**	**4:00**	**NVG/ Smoke**	**30 mi (est)**
Ferguson§	**2018**	**Tree**	**L**	**N**	**1:09**	**1:09**	**Day**	**10 mi**
Hirz	**2018**	**Rock**	**H**	**Y**	**1:42**	**Unk**	**Day**	**30 mi (est)**
ANF IWI	**2019**	**Ankle/ Tree**	**L**	**N**	**0:30**	**0:50 (est)**	**Day**	**<25 mi**
De Luz (CDF)	**2019**	**Medical**	**H**	**N**	**0:55**	**1:00**	**Day**	**Unk**
Middle	**2019**	**Rock**	**H**	**N**	**6:00**	**7:00**	**NVG**	**65 mi**
Lime	**2019**	**Tree**	**H**	**Y**	**0:45**	**1:11**	**Day**	**35 mi**
Out of Region								

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Peter's Ridge	2011	SMKJ landing	S	N	4:00	4:12	Day	Unk
Las Conchas	2011	Rock	S	Y	1:10	2:07	Day	Unk
Green Ridge	2013	Medical	S	Y	0:40	1:00 (est)	Day	6 mi
Kelley	2013	Tree	S	Y	1:32	1:50	Day	<5 mi
Freezeout	2014	Tree	E	Y	0:56	1:43	Dusk/ Smoke	Unk

Incidents in blue cells were included in medevac data analysis

Incident in bold type were included in medical response/injury analysis

*Extract Type: G:Ground Ambulance; H:Hoist/L:Landed; S:Shorthaul; E:Emergency Longline Extraction

† Time Elapsed, not Clock Time

§ Patient declared deceased before reaching definitive care facility

⸸ Conditions too unlike wildland fire to reasonably compare

13. Risk Assessment Tool Example (RAT)

		1	2	3	4	5	Rating
Operational Factors	Type of Fire Suppression Operation	Preposition	RX or Project	Lightning Plan	Day WX	Night WX	
	Primary Extraction Method Available for patient deemed Yellow/Red Priority *Consider "Golden Hour" Rule	NVG/ Helicopter/ Hoist	NVG/ Helicopter/ No Hoist	Helicopter Short Haul	REM	Ground	
	Availability of Secondary Air Extraction *Consider limitations to handle multiple patients	Hoist/ Short Haul <2 hours	Hoist/ Short Haul >2 hours	Helicopter/ <2 hours	Helicopter >2 hours	>3 hours or none	
	Estimated Extraction Time of Current Resources	< 1 hour	<2 hours	2-4 hours	4-6 hours	>6	
	Primary ALS Access Route	Paved Road	Dirt Road	Trail	Line	Air	
	ALS Esimated Time Enroute (mins)	<30	<45	<60	<120	>121	
	Hike Time to Vehicle Access	<30 mins	<45 mins	<60 mins	<2 hours	>2 hours	
Personnel Factors	# of Prepositioned Fire Supression Personnel	0	<10	<25	<30	>31	
	Estimated Shift Duration	< 8 hours	<12 hours	<14 hours	<15.5 hours	Extended	
	Estimated Extended Staffing (days)	0	1	2	3	>4	
	Medical Qualifications	ALS	Wilderness EMT	EMT	1st Aide CPR	N/A	
	On Scene Medical Equipment	ALS	BLS w/ Oxygen	BLS Trauma Bag Only	>(2) 10 Man	(1) 10 Man	
Environmental Factors	Weather Forecast for Operation	Clear	Reducing Visibility	Precip	Wind Event	T-Storm or Heavy Inversion	
	Forecast Wind (mph)	Calm	10-15	15-25	25-35	>35	
	Lightning Activity Level	1-2	3	4	5	6	
	Slope %	0-10	10-20	20-30	30-40	>40	
	Surrounding Area/Terrain	Urban	Flat	Mountain	Wilderness	Pinnacle	
	Surface/Vegetation Type	Grass	Brush	Timber	Snag Patch Heavy Down	Rocky Boulder	
						Total Risk Score→	
Acceptable with current resources & continuous situational awareness. Use normal medical planning and operating procedures (i.e. ICS 206). Requires Module Leader approval. ______________________							18-39
Acceptable after review of the operation. Requires continued tracking & recorded action plans. Consider alternatives to reduce risk. Requires Battalion, Division Chief or designee's approval. ______________________							40-54
Manageable under risk control & mitigation. Requires authorized decision. Conduct risk mitigation to review all elements to identify those that could be modified to reduce risk. Consider alternate suppression strategies (i.e. patrol, monititor, confine/contain) until conditions improve and risk is reduced. Requires District Ranger or designee's approval. ______________________							55-74 Total
Unacceptable under existing circumstances, requires immediate action. Conduct risk mitigation to review all elements to identify those that could be modified to reduce risk. Consider delaying suppression activities until conditions improve and risk is reduced. Requires Forest Supervisor or designee's approval. ______________________							>75 Total

To create a customized Risk Assessment Tool, consult the ORM webpage

https://sites.google.com/firenet.gov/operational-risk-management/resources