# Ambulance Availability in Story County

## Do We Have Enough?

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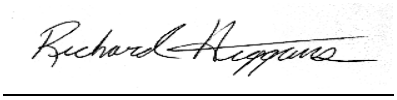
# CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: 

## Abstract

When a medical emergency strikes, patients want to receive the best services as quickly as possible. The problem for the Ames Fire Department (AFD) is that EMS transport unavailability is a rising concern, and without a systematic evaluation, there has been no way to determine if the current capacity meets the needs of emergency medical responders in the county. The purpose of this research was to identify if current availability of emergency medical transport units were meeting the needs of emergency medical service (EMS) responders in the county. Using the evaluative research method, this applied research focused on four research questions to help evaluate the problem. (Q1) What is the current availability of emergency medical transport units in Story County compared to the current needs of the EMS responders? (Q2) How does the current capacity of emergency medical transport units in Story County compare with national, state, and local standards? (Q3) What have other cities and counties of similar size and like resources determined is an appropriate number of emergency medical transport units? (Q4) What alternative service delivery models have other organizations adopted to address emergency medical transport unit availability? Survey results, coupled with a literature review, demonstrated that Story County does not have an ambulance availability problem, but rather a coordination problem. The results confirmed that Story County has adequate EMS resources and providers, but that someone with authority at the county level is needed to bring standardization and coordination to EMS in Story County. Recommendations include the development of an EMS Board to establish minimum standards and protocols, and who would ensure appropriate coordination between all EMS agencies in the county. Recommendations also include increased service levels for first responders, ambulance relocation, and placing advanced life support (ALS) paramedics on fire engines.

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## Introduction

Emergency services are typically viewed as a reactive service. Some type of emergency first has to occur before emergency service providers respond. This should not come as a surprise to anyone in the emergency services field; after all, emergency responses are highly visible and often draw the attention of the public and news outlets. The reactive portion, however, is just the tip of the iceberg when it comes to emergency services. No one sees the massive support structure under the water that keeps the iceberg afloat. Iceberg observers know it is there and they trust that it is there, but they do not dive into the water to look to make sure it is there. The same can be said about the proactive support structure behind every emergency response. The public trusts that it is there, the responders know that it is there, but who is diving into the water to make sure that it is there?

It should come as no surprise to anyone in public safety that EMS incidents are on the rise. One could attribute the rise to a number of different causes, but identifying and understanding the cause does not immediately address the increasing demand on emergency medical responders. To address this current need, this research will focus on a systematic evaluation strategy that will proactively help EMS professionals in Story County evaluate their current capacity in order to better prepare them to meet future needs.

The problem for the AFD is that EMS transport unavailability is a rising concern, and without a systematic evaluation, there has been no way to determine if the current capacity meets the needs of emergency medical responders in the county. The purpose of this research is to identify if the current availability of emergency medical transport units are meeting the needs of EMS responders in the county. Using the evaluative research method, this applied research focused on four research questions: (Q1) What is the current availability of emergency medical transport units in Story County compared to the current needs of the EMS responders? (Q2) How

does the current capacity of emergency medical transport units in Story County compare with national, state, and local standards? (Q3) What have other cities and counties of similar size and like resources determined is an appropriate number of emergency medical transport units? (Q4) What alternative service delivery models have other organizations adopted to address emergency medical transport unit availability?

## Background and Significance

In 1895, the AFD was established in Ames, Iowa. The department started out as an all-volunteer-staffed fire department and now has 57 full-time career firefighters. The 57 members of the AFD are comprised of 40 firefighters, nine lieutenants, three shift commanders, one fire inspector, one training officer, two deputy fire chiefs and one fire chief. AFD members deliver a wide array of services to the community from three different fire stations strategically located throughout the city. The services they provide to the community include fire prevention and suppression, EMS, fire inspections, extrication, water rescue, ice rescue, trench rescue, confined space rescue, and limited rope rescue. Firefighters, lieutenants and shift commanders work a 24-hour on-duty/48-hour off-duty schedule, ensuring that City of Ames' customers have 24-hours seven days a week emergency services.

The AFD covers a 24.7 square mile area and provides services to 65,060 residents (U.S. Census Bureau, 2016). The City of Ames population continues to grow as more land is annexed, increasing the total square miles AFD covers. Since 2000, the City of Ames' population has increased nearly 25% (City-Data.com, 2016). Some of this growth can be attributed to worldwide companies located in Ames, such as 3M, Barilla, Danfoss, and BASF. Ames is also home to two of the largest United States Department of Agriculture facilities in the United States - the Animal and Plant Health Inspection Service and the Agricultural Research Service's National Animal Disease Center. Perhaps one of the largest contributors to the city's growth and

the draw for many, comes from the major university located in Ames - Iowa State University (ISU). ISU has increased enrollment by 37% since 2000 and currently has an enrollment of 36,660, which is the largest in the State of Iowa (ISU, 2016).

The City of Ames is the largest city in Story County. Of the 99 Iowa counties, Story is the eighth largest county in population with 96,021 (Iowa-Demographics.com, 2016). According to USA.com (2017), Story County is the fifth fastest growing county in the state of Iowa. In Story County, 83% of the population lives in the urban areas of the county, which according to the U.S. Census Bureau (2017), would classify Story County as mostly urban, because less than 50% of the county's population lives in rural areas. The county has two hospitals, Mary Greeley Medical Center (MGMC) in Ames, and Story County Medical Center (SCMC) in Nevada. Story County is also home to 18 different assisted living/nursing home facilities, of which nine are located in Ames (State of Iowa, 2016).

Story County is comprised of 14 cities: Ames, Cambridge, Collins, Colo, Gilbert, Huxley, Kelley, Maxwell, McCallsburg, Nevada, Roland, Slater, Story City and Zearing (Story County, 2016). Throughout Story County, there are multiple levels of pre-hospital emergency medical services. There are three dispatch centers in the county. Two of the dispatch centers use Emergency Medical Dispatching (EMD), but they do not use the same EMD program. There are 12-non-transport emergency medical response agencies in Story County, ranging from Emergency Medical Responder (EMR) service level to Emergency Medical Technician (EMT), (Iowa Department of Public Health, 2016). In addition, there are five ambulance transport service providers in the county, of which two are hospital-based. There are two separate medical directors for the county (one for the east side of the county and one for the west side). Both provide oversight and authorization, but this is not done collaboratively and has some agencies in

the county operating under different policies and protocols. The county has an Emergency Management Agency (EMA) with one emergency management coordinator, and one deputy coordinator.

Story County does not have a county-based EMS system. What that means is that there are 12 different non-transport emergency medical response agencies, along with five separate ambulance transport service providers in the county all responding to emergency medical calls in their respective jurisdictions with little to no planning or coordination between them. There are transport service agreements between the non-transport EMS providers and EMS transport service providers in the county, as prescribed by the Iowa Bureau of EMS. A county-wide EMS association, the Story County Emergency Medical Services Association was established in 1998 and meets quarterly. According to their bylaws, the Story County Emergency Medical Services Association's (1998) purpose is to coordinate, evaluate, and improve EMS delivery in Story County.

Currently, when someone calls 911 in Story County, one of the three dispatch centers in the county will take the call. Which dispatch center takes the call depends on the location of the caller. If the caller is located in Ames, then the Ames Dispatch Center will take the call. If the caller is calling from an ISU property on a landline, then the ISU Dispatch Center will take the call. If it is a medical call, however, ISU will transfer the call to Ames because ISU does not do EMD. All other 911 calls outside of Ames and ISU are handled by the Story County Dispatch Center.

Once the 911 call has been processed by the dispatch center, and EMD completed, the dispatch center will then dispatch the appropriate medical first responder agency and ambulance assigned to cover that part of the county, via a radio dispatching system. If either the medical

first responder agency and/or the ambulance for that part of the county are not available to respond, the dispatch center will dispatch the next closest medical first responder agency and ambulance. In Story County, a limited number of agencies use mobile data terminals (MDTs). This means that Story County has a slower response because dispatch centers must wait to see if units go in route before they can dispatch a neighboring agency. If the dispatch center knows ahead of time through the MDT that a unit is not available for that part of the county, they can immediately dispatch the next closest unit versus waiting those few minute to hear if a unit goes in route.

In early 2007, Ames Fire Administration began tracking incidents where the local ambulance provider, MGMC was not available to respond and another ambulance from the county had to be dispatched into Ames. (P. Sandoval, personal communication, December 29, 2016). According to DC Sandoval, Chief Peterson had heard from the crews that they had to wait longer on scene more often because ambulance services were delayed because they were coming from the county versus MGMC (2016). Eight ambulance delay incidents were reported in 2007 (P. Sandoval, personal communication, December 29, 2016).

Four years would pass before anything was done with the ambulance delay data that the AFD was tracking. In June 2011, an ad hoc committee was formed with senior officials from both MGMC and the City of Ames. The personnel from MGMC included the vice president, the director of emergency services and the hospital's medical director. The committee representing the City of Ames were the fire chief, deputy fire chief of support services, and the city's management analyst. The group met multiple times between June and November of 2011 and released a report with three recommendations, all centered around the importance of measuring patient outcomes first before implementing change (Bayouth, 2011). The first recommendation

was to wait until a new computer aided dispatch (CAD) system was installed in 2012 and could better track actual response times before considering a medical response time standard for the City of Ames. The second recommendation was to further evaluate the brainstorming ideas generated by the committee at later meetings. The final recommendation was the continued pursuit of placing automatic external defibrillators (AEDs) throughout the community to increase cardiac arrest survivability. The committee's brainstorming results, which they stated would require further research for financial viability and appropriateness, included: phasing the AFD from a first responder service level into a provisional paramedic level service with the goal of one paramedic per fire crew, staffing stations two and three with paramedics, basing MGMC ambulance services out of the fire stations instead of the hospital, having the AFD take over the paramedic service for the City of Ames, and lastly begin hiring paramedic/firefighters and phasing into a paramedic level service. The committee emphasized the importance of letting patient outcomes drive potential changes and that basic life support (BLS) response with AEDs saves lives (Bayouth, 2011).

Unfortunately, the group's work produced little to no results. The group never met again after the report was released and the brainstorming ideas were never vetted for appropriateness and financial viability. Two events occurred shortly after the report was released that may have caused the committee's progress to stall. First, the Ames City Council met, and following a staff recommendation, did not formally adopt a response time standard for fire or EMS. Instead, they let the fire department adopt a response time standard of 85% of all calls responded to within five minutes as an internal measurement for department effectiveness only. Council directed staff to have further discussion with MGMC representatives to determine an effective response time for medical calls. Council also decided that they would use GIS modeling to predict emergency

response times to help better understand possible impacts on future land use decisions (City of Ames, 2012). The second event that occurred was the retirement of then Fire Chief Peterson, who chaired the ad hoc committee.

In September 2013, the AFD received a request from MGMC Paramedic Supervisor Chris Perrin asking the department to start formally tracking and sharing data with MGMC for incidents when the AFD did not have a MGMC ambulance available to respond to the scene (C. Perrin, personal communication, September 4, 2013). Fortunately, the AFD was already tracking this data but they still made it a point of emphasis with the crews to collect and enter accurate data into the department's records management software. In 2013, the AFD recorded 29 incidents where MGMC did not have an ambulance available to respond. Those 29 incidents represented 1.28% of all medical incidents that the AFD responded to in 2013 (ACS, 2010).

Fast forward to March 2014, when the AFD recorded 50 incidents or 2.12% of all medical incidents where MGMC was not available to respond (ACS, 2010). Story County EMA receives notification from Polk County EMA that MGMC has arranged with neighboring Polk County to bring more ambulances into the county to help with a weeklong ISU student-run college celebration known as VEISHEA, which has a history of taxing local emergency service resources (K. Morgan, personal communication, July 26, 2016). This is concerning for Story County EMA. Questioning if there might be a problem with ambulance availability in the county, they meet with the Story County Emergency Management Commission Chair Rick Sanders to see how they should move forward (K. Morgan, personal communication, July 26, 2016). The information was brought to the entire commission's attention during their July 2014 quarterly meeting. At that meeting, the commission heard from EMA Coordinator Morgan about how the EMA office had noticed during the last six months to one year that ambulances in Story

County were running near maximum capacity (Story County, 2014, July). The commission was reminded by Chair Rick Sanders that they have no authority to correct a potential problem, but they could gather more information to better understand the problem. The commission decided it would be beneficial to invite the ambulance directors in the county to their next quarterly meeting to learn more about medical responses in the county. It was evident, after reviewing all of the minutes from the Emergency Management Commissions meetings related to ambulance availability, that the commission had no authority over the EMS system. What the commission did have, however, was all of the jurisdictional executive stakeholders with the authority to make changes in the EMS system together in one room.

At the following meeting, the commission heard from MGMC Paramedic Supervisor Chris Perrin. Mr. Perrin shared that ambulances are intermittently busier due to increased ambulance transport volume and that no individual ambulance services has the resources to cover all of the calls all of the time (Story County, 2014, October). With little to no direction from the state or federal government on EMS, communities are left in limbo. Mr. Perrin suggested that the whole EMS system, from the initial 911 call to patient delivery at the hospital, needed to be evaluated and that a strategic plan be developed for the county (Story County, 2014, October). The commission agreed with Mr. Perrin's suggestions and directed Emergency Management Coordinator Morgan to bring recommendations back to the commission from an organized work group on the issues facing the whole EMS system in Story County.

It is now 2015; the AFD recorded 91 incidents or 4.04% of all medical incidents where MGMC was not available to respond (ACS, 2010). At the Story County Emergency Management Commission's first meeting of the year, EMA Coordinator Morgan identified the following issues that the work group would evaluate: the current EMS capacity, the use of

mutual aid, the availability of resources, inter-facility transfers, and determine how the county identifies when it is at its capacity. The goal of the group would be to determine what metrics should be used to evaluate the system so gaps in emergency medical response could be identified (Story County, 2015, January). It was also stressed at that meeting that there was no point in doing the study unless all of the stakeholders were willing to participate.

Emergency Management Coordinator Morgan began reaching out to EMS agencies in Story County shortly after the commission's July 2015 meeting and brought a small group of participants together to start the process in late November of 2015. Emergency Management Coordinator Morgan presented a set of metrics to the group but not everyone was in agreement with them. Some seemed somewhat overwhelmed with the amount of data and metrics, especially those metrics dealing with salaries and service costs (K. Morgan, personal communication, July 26, 2016). The meeting was the first and the last for the group. Emergency Management Coordinator Morgan was able to pull together response data from three of the ambulance services in the county and shared with the commission the number of times that an ambulance had to respond to a call outside of its normal response area. He pointed out that one could assume a lack of ambulance capacity, somewhere in the system, when an ambulance has to respond outside of its normal response area, but that more data is needed to really evaluate capacity (Story County, 2016, July). After some discussion, Commission Chair Sanders indicated that the issue did not fall under EMA staff duties and was a jurisdictional matter. At which point, AFD Fire Chief Shawn Bayouth stepped forward and offered to continue the conversations with Story County EMS providers and report back to the commission at a later time (Story County, 2016, July).

This background analysis illustrates that ambulance availability in Story County is being questioned at both a local level and at a county level. However, this concern that there are not enough ambulances in Story County does not indicate a problem, only that more information and research is needed. The problem for the AFD is that EMS transport unavailability is a rising concern, and without a systematic evaluation, there has been no way to determine if the current capacity meets the needs of emergency medical responders in the county. As an EMR service provider, the AFD is limited in the amount of emergency medical services they can provide patients. As an EMR provider, the AFD has limited BLS functions, such as: CPR, AED placement, hemorrhage control, and respiratory assistance. The AFD cannot, however, test blood sugar levels and treat with glucose, splint possible fractures to prevent further injury, or treat a severe allergic reaction through the administration of epinephrine through an auto-injector. With AFD's limited EMS scope of practice, the organization has placed a greater importance on the arrival of Advanced Life Support (ALS) services to help treat common emergencies that a bystander could treat without specialized training or an EMS license. This is a significant problem for the AFD because the only ALS providers in the City of Ames and in Story County are emergency transport service providers, which has the AFD concerned about recent EMS transport unavailability.

Sufficient evidence in the form of data justifies this study. Between 2013, when the AFD officially started tracking the number of times an ambulance was not available in Ames, and mutual aid was requested for an ambulance, and 2015, there has been a more than 300% increase in those calls. The AFD has also seen an increase of 9.8% in the number of medical calls that they respond to since 2013 (ACS, 2010). The population for Ames and Story County continue to rise, and has increased by 3%, since 2013 (Iowa-Demographics.com, 2016). All of this evidence,

in addition to the amount of attention and time devoted at the county level, demonstrate that further research is warranted.

This study will ensure that the City of Ames and Story County EMS providers understand their current EMS system capabilities and how they should plan for the future to be prepared to meet the growing community's needs. This study aligns with the United States Fire Administration strategic goals of enhancing the fire and emergency services' capability for response to and recovery from all hazards, and promoting local planning, preparedness, and response for all hazards (USFA, 2014).

This study is an adaptive challenge requiring multiple agencies (which the author has no authority over) with different perspectives, agendas, and goals to come together. This type of challenge is not quickly resolved and requires extensive study and research to bring all of the stakeholders together and working towards one common goal. The process of working through an adaptive challenge was one of the course goals of the National Fire Academy's (NFA) Executive Fire Officer Program's (EFOP) capstone course Executive Leadership (USFA, 2015).

## Literature Review

The purpose of this research was to identify if current availability of emergency medical transport units were meeting the needs of EMS responders in the county. With this purpose in mind, a literature review was completed focusing on four main research questions: (Q1) What is the current availability of emergency medical transport units in Story County compared to the current needs of the EMS responders. (Q2) How does the current capacity of emergency medical transport units in Story County compare with national, state, and local standards? (Q3) What have other cities and counties of similar size and like resources determined is an appropriate number of emergency medical transport units? (Q4) What alternative service delivery models have other organizations adopted to address emergency medical transport unit availability?

Proactive planning is what a community expects from their EMS service providers. When a customer calls 911 for a medical emergency, they expect that an ambulance will respond, provide them with care, and take them to the hospital, if necessary, as quickly as possible. EMS providers should plan for increasing demands by efficiently balancing ambulance availability instead of reacting to changes (Wu & Hwang, 2009). The reality however, is that there is no guarantee that an ambulance will show up because it is not considered an essential service like police and fire in most states (Van Milligen, 2017). The International Labor Organization (2017) defines an essential service as any service provided to the government and/or its people that if interrupted would endanger life, health, or personal safety. The American College of Emergency Physicians (ACEP, 2017) argues that EMS should be recognized as an essential service because it is an indispensable part of every community's emergency response system and is a critical part of the disaster response infrastructure for the nation. The ACEP (2017) further argues that that EMS should receive the same recognition, support, and funding that police and fire receive from the community. Van Milligen (2017) warns that not recognizing EMS as an essential service is causing the system to be inefficient, ineffective and is harmfully affecting our nation's health care system. In addition to not recognizing EMS as an essential service, many states have not defined a minimum EMS service level of care. According to a 2011 National EMS Assessment, only 13 states had a minimum service level and Iowa was not one of them. Unfortunately, the literature did not extrapolate whether states are not setting a minimum service level because EMS is not recognized as an essential service.

Four states, North Carolina, California, Oregon, and Colorado have made EMS an essential service. According to the report, even though all four states differed in their approach, there were three common similarities. First, basic EMS services and minimum standards were

established and ensured by the counties. Second, counties had the discretion on how they meet the minimum standards. Third, each state dedicated funding to support their respective county EMS programs (Van Milligan et al., 2014). Advantages included a minimum EMS capability in the state, flexibility to design EMS provisions around local circumstances, and funding resources for continuous system improvements. Disadvantages to making EMS an essential service was the reliability of government funding and increased tax burdens (Van Milligan et al., 2014).

A reassessment of Iowa's EMS system report, released by the National Highway Traffic Safety Administration Technical Assistance Team (NHTSATAT, 2015), argues that counties need to develop their own county-wide EMS plan, one that meets the specific needs of their community and utilizes appropriate resources. It should have an ongoing evaluation to make sure the plan is still meeting the needs of patients (NHTSATAT, 2015). Dallas Fire-Rescue did just that when they realized that sending an ambulance out to treat every stubbed toe, was not the best utilization of resources. To meet their patient's needs, the plan needed to change. With swelling EMS calls and limited ambulances, Dallas Fire-Rescue's Mobile Community Healthcare Program was formed, which provides in-home visits and caseworkers for the recurrent 911 users who do not need an ambulance, but do need someone to help teach them how to manage their illness (Hallman, 2016).

The need to have a plan for EMS delivery in the community was a key point made in the literature. The NHTSATAT's (2015) report stated that because the State of Iowa does not have a state EMS transportation plan it is important to gather local data to identify gaps in the system and promote integration between service providers. Just as important as filling current gaps, is the identification of future needs. In Wu and Hwang's (2009) research on balancing ambulance availability with demand, the focus is on building strategies that proactively plan for increasing

demands on the system. Understanding both the current gaps and the future needs of a community could dramatically change what EMS looks like.

More than 16 million medical transports happen each year (Board of Health Care Services, 2007). A large percentage of the population has been transported, has had a family member transported, or knows of someone who has been transported. Looking at how EMS services are delivered nationally, the literature paints a picture of a very fragmented and broken system. According to the Committee on the Future of Emergency Care in the United States Health System, there are six systemic problems causing the fragmentation that need to be addressed: insufficient coordination, disparities in response times, uncertain quality of care, lack of readiness for disaster, divided professional identity and limited evidence base (Board of Health Care Services, 2007). One year later, 2008, The National Association of State EMS Officials (2008) released a report titled, State Emergency Medical Services System: A Model. In this report, The National Association of State EMS Officials accepted the challenge identified by the Committee on the Future of Emergency Care in the United States Health System, and laid out a multi-year plan that states could adopt to assist in EMS system development.

In 2011 the Federal Interagency Committee for Emergency Medical Services (FICEMS, 2012), commissioned the National EMS Assessment, to paint a picture of the current state of the EMS system across the nation as well as at the state level. The assessment showed a big discrepancy in how states define EMS agencies. There are an estimated 19,971 EMS agencies in the U.S., excluding California, (which is an average of 9.2 EMS agencies per county for the 49 states that participated, with an average of 407 agencies per state) (FICEMS, 2012). Of the 19,437 licensed EMS agencies in the U.S., 12,575 are transport agencies, 5,529 are non-transport, 1,074 are EMD dispatch centers, and the remaining 1,699 are miscellaneous non-

emergent transport agencies (FICEMS, 2012). When it comes to the service levels of these EMS agencies, 98% of them are EMT level or higher, with the remaining 2% at the EMD level. First Responder/EMR service level agencies were not included in the calculations because they represent such a small minority of states licenses (FICEMS, 2012). The majority of the EMS agencies in the assessment were fire department-based at 40%, 25% were private non-hospital-based, 21% governmental non-fire-based and 6% were hospital-based agencies (FICEMS, 2012). The assessment also looked at EMS volunteerism. Of the 48 states that participated, 16 of them indicated that a majority of their EMS agencies with transport capabilities are considered volunteer (FICEMS, 2012).

In the State of Iowa, there are 913 EMS agencies: 333 transport, 144 with transport agreements, and 436 non-transport agencies (National Highway Traffic Safety Administration Technical Assistance Team, 2015). If you divide that number out over the 99 counties in the State of Iowa, you average 9.2 EMS agencies per county. There are 11,801 licensed EMS providers in Iowa and 10,551 of them are certified at the EMT level or higher (Iowa Department of Public Health, 2015). In 2015, 67% of EMS dispatches were emergent responses and another 16% were inter-facility transfers. The response outcomes from the EMS emergent dispatches resulted in 83% being transported by ambulance, and 12% were dispatches where no patient was found, the patient refused care, or the ambulance was cancelled before they arrived on scene (Iowa Department of Public Health, 2015).

Even though EMS is not recognized as an essential service, some standards and recommendations have been made. According to Gary G. Ludwig (2004), there are no federal or state laws dictating an EMS response time. The National Fire Protection Association (NFPA), which publishes consensus standards, set a standard response travel time for EMS delivered

through a career fire department. The NFPA (2010) 1710 standard establishes a 4 minutes or less for response travel time for first responders (non-transport and/or BLS) and 8 minutes or less travel time for ALS units, with prior arrival of first responders with BLS and AED, to arrive on the scene for 90% of EMS incidents.

At the state level, the Iowa Department of Public Health (IDPH) Bureau of EMS released their Iowa EMS Systems Standards in 2010. According to the IDPH Bureau of EMS (2010), the Iowa EMS Systems Standards are, "a change initiative that provides a consistent and accountable approach to promoting and protecting the health of Iowans through EMS" (p.2). The standards set forth by the IDPH Bureau of EMS (2010) are the "minimum infrastructure (county) and EMS services that all Iowans can reasonably expect…no matter where they live in the state," (p.2). According to the IDPH Bureau of EMS (2010), the standards were created as a result of the ever-increasing demands placed on EMS providers and agencies, especially the volunteers who are, "being victimized," when it comes to meeting the increasing demands for EMS (p. 23). The IDPH Bureau of EMS standards emphasized a top-down approach, from the county level to establishing policy and providing direction for EMS. The bureau stressed the important role that elected officials play in creating policy and the financial accountability they bring to a system like EMS in the county. One of the first minimum standards is for each county to make requirements for EMS treatment and transport, based off a needs assessment. Include a formal organizational chart identifying who is responsible for implementing the Iowa EMS system standards in the county, including the creation of an EMS representative board. Furthermore, dispatch centers with EMD shall be trained/certified and use an approved program. (IDPH Bureau of EMS, 2010). Non-transporting EMS agencies should have at least one certified EMS provider (IDPH Bureau of EMS, 2010). The IDPH Bureau of EMS also sets a response time

standard similar to the NFPA. The IDPH Bureau of EMS (2010) requires a minimum emergency response time not to exceed five minutes in urban areas and 15 in rural areas for 80% of emergency responses by first responders. When it comes to a minimum not to exceed response time for ambulances in Iowa, the IDPH Bureau of EMS's (2010) minimum standard is eight minutes for urban and 20 minutes for rural areas.

The IDPH Bureau of EMS standards, did not set a minimum for the number of ambulances a county should have, although some states and jurisdictions have requirements for the number of ambulances that agencies should staff daily (Shelley, 2008). Even though the State of Iowa does not set a standard for the daily number of staffed ambulances, there are different models, theories, and even simulation software programs available that can help a community determine how many ambulances their community should have using several different inputs. One such theory is the Queuing Theory, which looks at waiting times and the consequences of waiting, allows EMS managers to determine how many ambulances they need each hour based on current data and trends (Ludwig, 2010). The Maximal Coverage model, according to Jeffrey B. Goldberg (2004), can take multiple objectives and weightings to minimize average travel times. Goldberg (2004) also identified the Hypercube Model for determining the number of ambulances a county should have and where they should be located. According to Goldberg (2004), the Hypercube Model also helps predict the probability of ambulances being idle or busy during certain times of the day to help determine ambulance placement, how many ambulances a service should have, and at what times. The Maximum Availability Model and the Maximum Reliability Model take similar inputs but produce two completely different approaches to ambulance capacity. The Maximum Availability Model looks at when ambulances are available to respond, while the Maximum Reliability Model looks at the dependability of an ambulance

being able to respond (Erkut et al., 2008). While modeling does not take into account every possible scenario, it does provide a starting point in determining ambulance capacity for a county.

Reviewing the literature, for what other cities and counties of similar size and like resources have determined is an appropriate capacity of emergency medical transport units, produced more information on how EMS is delivered rather than their capacity. Looking across the U.S., a trend can be seen as the fire service is now the largest EMS pre-hospital provider in all of North America (Moore-Merrell et al., 2010). Over 90% of career and combination fire departments now provide EMS services to their communities, with EMS calls for service accounting for 75% of call volumes (Moore-Merrell et al., 2010). In Iowa, there are 18 full-time career fire departments, and all 18 of them provide EMS. Of those 18 departments, eight provide ALS transport services, 12 provide paramedic level services, and all but one (the AFD) are certified at the EMT level or higher (Iowa Department of Public Health, 2016).

Delivery of EMS by the fire service is just one of six commonly accepted approaches to providing EMS to a community. According to David M. Williams (2006), the other five commonly accepted approaches include private for-profit, third service, not-for-profit, public-utility and hospital-based. Each approach has benefits and drawbacks. For example, Williams (2006) found that hospital-based EMS is a very stable EMS delivery approach and usually provides the best continuum of care for patients. Unfortunately, hospital-based EMS can also operate in complete isolation from other EMS services and is often placed at the bottom of the hierarchy structure of the hospital (Williams, 2006).

Many opportunities for alternative EMS delivery were discovered while exploring the literature. Primarily, not every EMS patient needs to be transported to the hospital and not every

patient that needs to be transported to the hospital needs to go by ambulance. Neely (1997) found that 61% of medical transports were medically unnecessary. Of those 61% of patients who did not need to be transported by ambulance, 71% of them were unwilling to find another way to the hospital (Neely, 1997). The NHTSA (2013) found through unpublished research that if ambulances could either treat approximately 15% of their Medicare patients on scene and/or transport them to a local health care provider instead of to the emergency department, they would save more than 559 million dollars annually.

Perhaps one of the most mentioned alternatives in the literature on EMS delivery models was ambulance staffing models. Alternative ambulance staffing models ranged from staffing an ambulance with physicians to splitting a crew of two between one paramedic and one first responder. For example, in Argentina two ambulance services are running with physician-staffed ambulances (Shrader, 2016). They have found with this model that fewer patients are being transported to the hospital, they have excellent response time reliability, and customer service ratings are excellent (Shrader, 2016). Similarly, the Madison and Green Bay fire departments in Wisconsin have been approved to start a pilot program in community paramedicine (Wahlberg, 2015). This newer approach would allow paramedics to make home visits where wound care, chronic diseases, and medications could be managed prior to patients needing 911 emergency care and/or transportation by ambulance to the hospital (Wahlberg, 2015).

Another alternative approach to delivering EMS comes from the National EMS Advisory Council (2010), which argues that sending both a first responder unit and an ambulance to a medical scene may be an over-utilization of resources. They suggest using an alternative response, (for which evidence-based programs do exist), of sending an EMS professional or two

in a van or SUV to the scene and either providing on-scene patient care, giving a social services referral, and/or giving the patient a ride to the nearest clinic or hospital (National EMS Advisory Council, 2010). The National EMS Advisory Council (2010) also suggested using a consolidated dispatch center, which would provide patients and responders with a more consistent delivery of EMS information and allow for better cost utilization.

Moore-Merrell, et. al. (2010) found an alternate ambulance-staffing model that had a quicker response. Placing one ALS member on an first response engine coupled with an ambulance response having one other ALS member, was two minutes and 15 seconds faster at completing trauma tasks than a BLS first response engine coupled with a two ALS member ambulance (Moore-Merrell, et. al., 2010). They also found that a four-person first response engine company was faster at completing tasks for both trauma and cardiac responses than a crew of three or two. A technical basis has been established that having one ALS member on a first response engine is the most effective staffing option for an EMS response (Moore-Merrell, et al., 2010). Interestingly enough, Michael T. Manahl made the same recommendation in an unpublished paper on increasing emergency medical capabilities in Story County one year earlier. Manahl (2009) recommended staffing ambulances with one paramedic and one EMT, instead of the normal staffing model of two paramedics on an ambulance, to help save money and also increase staffing. Manahl (2009) highlighted that the normal ambulance staffing model in Story County has not increased ambulance capabilities.

## Procedures

The procedures for this applied research started by identifying the purpose, which was to identify if current availability of emergency medical transport units are meeting the needs of EMS responders in the county. Four questions were researched, using the evaluative methodology, to complete the purpose of the applied research: (Q1) What is the current

availability of emergency medical transport units in Story County compared to the current needs of the EMS responders? (Q2) How does the current capacity of emergency medical transport units in Story County compare with national, state, and local standards? (Q3) What have other cities and counties of similar size and like resources determined is an appropriate number of emergency medical transport units? (Q4) What alternative service delivery models have other organizations adopted to address emergency medical transport unit availability?

The process began by meeting with Story County Emergency Management Coordinator Keith Morgan to learn more about what efforts and progress has been made in the past with evaluating ambulance availability in Story County. Coordinator Morgan provided copies of all of his work and correspondences regarding ambulance availability, including detailed information outlining how it came to be that the AFD would take over the study on ambulance availability in Story County from the Story County EMA.

While on campus at the NFA, a literature review was conducted at the Learning Resource Center of available onsite reference literature related to ambulance capacity and availability. Further literature was reviewed and retrieved from the internet, using Google's scholarly research engine. Multiple records management systems were also reviewed and information related to the purpose of this research was retrieved, including meeting minutes, email correspondence, and response data. The literature review provided ample background and knowledge, which was beneficial in learning what other researchers, EMS committees, and other communities have discovered while evaluating ambulance availability. The information discovered from this particular process helped provide background in understanding and evaluating research questions Q2, Q3, and Q4.

With a fundamental understanding established from the literature review, the focus shifted gears to survey design. Eight surveys were designed; four for local county data collection and four for comparable county data collection. All surveys were designed using the website Surveymonkey.com. The survey questions were created after informal discussions with local subject matter experts from the Ames Dispatch Center, MGMC, Story County First Responder Agencies, Story County EMA, and AFD Training Officer Josh Bennett, to determine what type of data survey respondents would have available to share.

All eight of the surveys were first sent to Story County EMA for distribution to the appropriate recipients. After consulting with Story County EMA Deputy Coordinator Melissa Spencer, this approach was chosen for two reasons. First, Story County EMA had all of the email addresses for the Story County EMS agencies and comparable county EMAs. Secondly, it was hoped that more recipients would recognize and open an email coming from the Story County EMA versus a personal email from the author.

On December 5, 2016, six emails were sent to the Story County EMA's office. The first email was a general overview of all of the forthcoming emails with survey links attached for the EMA's office, along with directions on who should be sent each email and corresponding survey. That first email also included what information the survey respondents should be able to answer, so they could look it up ahead of taking the survey. The email also included the survey end date, which was by end of day Friday, December 16, 2016.

The next five emails sent to the Story County EMA's office were for the four stakeholders in Story County: mayors, dispatch centers, first responder agencies, and transport agencies. Each of the four emails, one for each stakeholder, had detailed directions on when the survey had to be completed, who should complete it, and what type of information they should

know in order to complete the survey. The email also included a brief introduction outlining the ambulance availability study, encouragement as to why their input was vital to the study and their specific survey link. The sixth and final email sent to the Story County EMA's office for them to forward, was specifically for distribution to the 13 comparable counties in Iowa of Boone, Cerro Gordo, Clinton, Des Moines, Dubuque, Jasper, Lee, Marion, Marshall, Muscatine, Wapello, Webster, and Woodbury. This email was sent to each county's EMA coordinator, and contained the same directions and information as was sent to Story County stakeholders, just with a different survey link. Each comparable county EMA coordinator was asked to send out agency specific surveys, with corresponding directions, to each EMS agency in their county, one for dispatch, one for first responder agencies, and one for transport agencies. One survey was specifically for the EMA coordinator, to provide a better understanding of their resources and help to define the sample size for their county-specific surveys.

Survey results received after the December 16, 2016 deadline, was much less than the sample size expected for Story County. During a January Story County Emergency Management Commission meeting, attending mayors were notified of the low number of responses from the survey. The Story County mayors asked if the surveys could be re-sent so more could be completed. On January 24, 2017, the surveys for all eight groups were re-sent through email, using the same email process, information, and survey link as previously described, the only exception being a new deadline of Wednesday, January 31, 2017 at midnight.

All eight surveys designed and used specifically for this research included, "yes" or "no" questions, multiple choice questions, data input questions, percentage questions, and an opportunity to evaluate the current emergency medical transport system. Respondents were also asked to describe what type of improvements they would like to see if the current system was not

adequately meeting their needs or the needs of their customers. A look-back-period of 2013 through 2015 was used for all survey questions requesting response data. 2016 was not included in the look-back-period because it was still 2016 during the study.

The first four surveys, designed for Story County, were used to answer research question Q1. The first survey, designed specifically for Story County mayors (see Appendix A), focused on the mayor's perspective of EMS in their community. The purpose of this survey was to collect data about what resources Story County mayors had, how they used those resources, and what they thought were acceptable response times for EMS services in and to their community. The survey was sent to all 14 cities in Story County, and one additional city, Sheldahl, (which is technically not listed as being in Story County because only one third of its city is located in Story County) making the total sample size 15.

The second survey, designed for Story County dispatch centers (see Appendix B), focused on how much involvement those centers had with EMS and what type of data they collected. The survey asked each dispatch center if they provided EMD, how many EMS incidents they dispatch for each city in the county, how many were ALS versus BLS, and how many times the dispatch center had to request mutual aid because the primary transport unit for a specific jurisdiction was not available. The survey was sent to all three dispatch centers in Story County, making the sample size for this survey three.

The third survey, designed for Story County first responders (see Appendix C), asked about call volume, service levels, and use of ambulances in the county. First responders were asked about their response times, ambulance response times, and if there were any negative effects on their patients' outcome from ambulance delays. Respondents were also asked how

many times they assisted the ambulance by either providing an attendant or a driver. The sample size for this survey was all 12 Story County first responder agencies.

The fourth survey, designed for Story County transport agencies (see Appendix D). Transport agencies were asked what parts of Story County they primarily provide service to, at what level they provide their services, and how those services are provided, (i.e., staffing and number of ambulances). They were also asked about their call volume, ALS versus BLS calls, and how many times during the look-back-period they responded to an incident but did not transport because the patient was not there or they refused treatment. Survey questions also asked participants about inter-facility transfers, how many, how much time is spent on them and how many of them are medically necessary. The sample size for this survey was five, which represents all five of the transporting agencies in Story County, including two with transportation agreements that are dependent upon other agencies.

The four surveys designed to answer research questions Q2, Q3 and Q4, were sent to the 13 comparable counties to Story County. They have a population over 25,000 but less than 130,000, they have a hospital in the county, a college in the county and they have a career fire department in the county. Although Pottawattamie County met all of the comparable criteria, it was not included in the survey because the county was without an EMA coordinator at the time of the survey.

Survey number five, designed for comparable county EMA coordinators (see Appendix E), was designed as a survey tool to help estimate sample sizes for potential responses from the comparable counties and their EMS agencies. EMA coordinators were asked how many dispatch centers, non-transport agencies, and emergency medical transport agencies they had in their county. Total sample size for this survey was 13.

Survey number six, designed for comparable county dispatch centers (see Appendix F), survey number seven, designed for comparable county first responder agencies (see Appendix G) and survey number eight, designed specifically for comparable county transport agencies (see Appendix H), each had a minimum sample size of 13. Unfortunately, only a minimum sample size can truly be identified since it is unknown until the results were analyzed, how many dispatch centers, first responders and transport agencies from the comparable counties actually received the survey(s) from their EMA coordinator. Surveys six, seven, and eight were similar to the surveys used for Story County dispatch centers, first responder agencies, and transport agencies. The only difference worth noting between the Story County surveys and the comparable county surveys was the fact that city specific information for the dispatch centers, first responder agencies, and transport agencies was not identified in the comparable surveys since it was unknown.

The procedures for this research did have some limitations. The surveys were only sent to 13 Iowa counties, which limits the perspective of the research. The target audience did not include all of the potential EMS users, such as hospitals, nursing homes, and citizens. One final limitation of the surveys was the inconsistency among agencies to gather and report data from the 2013 to 2015. The different records management systems used by the different agencies throughout the state, county, and even locally, created some discrepancies in what data was thought to be easily accessible and retrievable versus what respondents were able to gather and share.

## Results

The purpose of this research was to identify if the current availability of emergency medical transport units are meeting the current needs of EMS responders in the county. The four surveys designed specifically for Story County (see Appendicies A, B, C, & D) were used to

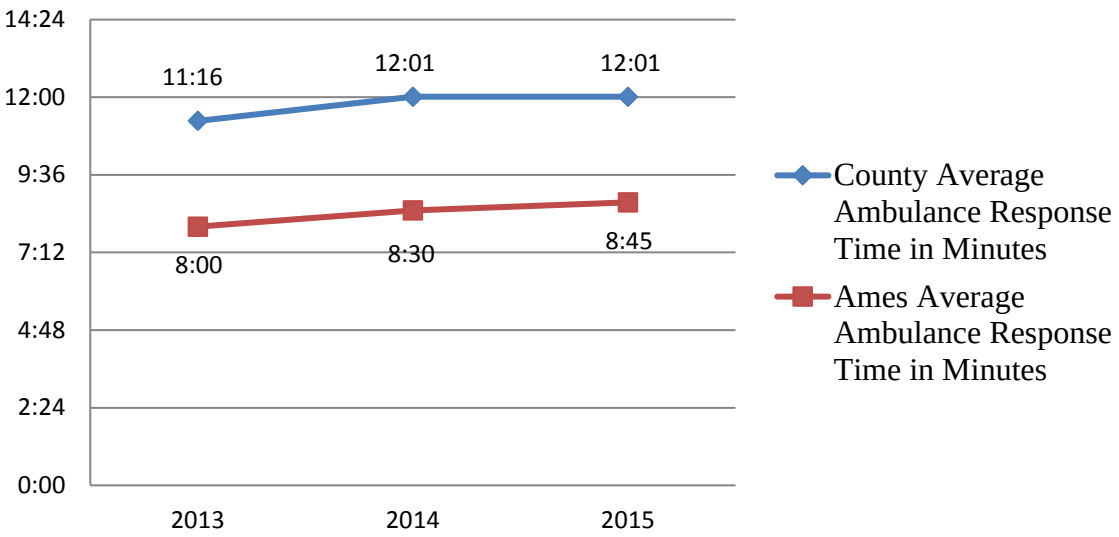
gather data and answer research questions Q1. The four surveys designed specifically for comparable counties (see Appendicies E, F, G, and H), were used to gather data and answer research questions Q2, Q3, and Q4.

**Story County Results**

Research question Q1 - what is the current availability of emergency medical transport units in Story County compared to the current needs of the EMS responders - produced results that established a baseline for answering and addressing the rest of the research questions. According to the survey data from Story County dispatch centers, there were 4,768 medical dispatches in 2013, 4,694 medical dispatches in 2014 and 4,708 medical dispatches in 2015. (Please note that the ISU Dispatch Center was not included in the results because they do not use EMD and all of their calls are also recorded by Ames Dispatch, which would have created duplicate data.) Looking collectively across the three years, from 2013 through 2015, Story County actually had about a 1% decrease in the number of medical dispatches. On average, 56% of the medical dispatches were for Ames, and the remaining 44% were split amongst the rest of the cities in the county. The City of Nevada was the second busiest town on average in the county, representing 13% of the entire county's call volume, followed by Story City at 9%, and Huxley at 5%. The Story County Dispatch Center was not able to differentiate ALS medical dispatches from BLS with their current EMD software (Association of Public-Safety Communications Officials). Ames Dispatch, which uses different EMD software (Priority Dispatch), was able to differentiate ALS medical dispatches from BLS for two of the three years, 2014 and 2015. In 2014, 34% of the medical dispatches in Ames were for ALS services. In 2015, 32% were ALS in Ames.

Looking at ambulance response times from 2013 to 2015, the dispatch center surveys showed a slight increase in response times for both Story County average ambulance response times and City of Ames average ambulance response times. Figure 1 illustrates the average response time for Story County in comparison to the City of Ames. Survey results for individual cities, showed Nevada and Huxley had the shortest ambulance response times into their city, averaging five minute. The longest average ambulance responses times where to the City of Zearing at 18 minutes and 40 seconds.

**Figure 1: Average Primary Ambulance Response Times 2013 - 2015**




When the dispatch centers were asked how well they felt the current emergency medical transport system in Story County was adequately meeting their needs and the needs of their customers, the responses were split. One dispatch center felt that the current system was adequately meeting their needs and the needs of their customers. The other dispatch center disagreed, suggesting improvements needed to be made so ambulances from outside agencies were not needed as much in the City of Ames for day-to-day incident's, larger events, and high traffic times.

The results from the survey sent to all 15 Story County mayors had a return rate of 10. All but one of the 10 stated that they had first responders in their community. Three of the 10 communities stated that they have an ambulance in their community. The most used ambulance provider for these 10 communities was MGMC, followed by SCMC, followed by a tie between Huxley Fire & Rescue and Colo Fire & Rescue, with Story City Ambulance coming in as the least utilized. Two mayors did not know what ambulance service served their community. When the mayors were asked about acceptable response times for first responders in their communities, 70% of them felt that a five to 10 minute response time was acceptable, 20% preferred a zero to five-minute response time, and one mayor felt that a 15 to 20 minute response time was acceptable. When Story County first responders were asked what they thought an acceptable response time was for an ambulance into their community, response ranged from zero to 20 minutes, with a majority in the five to 10 minute category.

When mayors were asked if the current emergency medical transport system in Story County was adequately meeting their needs and the needs of their citizens, the response was split. Half of the mayors felt that the current system was working adequately, while the other half did not. Suggested improvements to the current emergency medical transport system in Story County from the mayors included: more ambulances to meet the growing number of EMS calls, more help from neighboring agencies, more coordination of ambulance services between response areas, better utilization of ALS versus BLS resources, and better ambulance staffing.

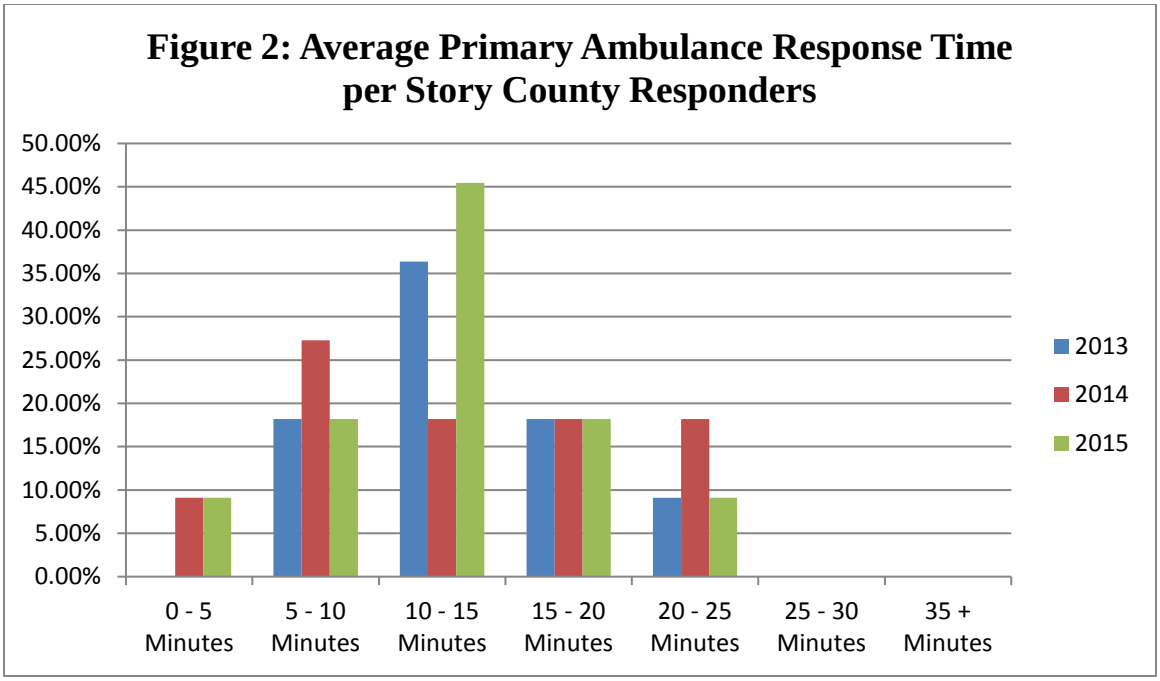
The results from the survey sent to all 12 Story County first responder agencies had a return rate of 92%, with only one agency not completing the survey. Nine of the first responder agencies operate at the EMT service level or higher, including one paramedic provisional service. Two first responder agencies identified at the EMR service level. The number of agency

service members ranged from as little as three members all the way to 57, with the average number of service members being nine, if you exclude the one career department that has 57 members. Ten of the 11 agencies who completed the survey do not have their own ambulance service and rely on another agency to provide them with emergency medical transport services.

When first responders were asked which ambulance service they primarily utilize, SCMC received the most responses with five, followed by MGMC by three agencies, followed by Story City Ambulance with two agencies, and Huxley Fire & Rescue by one agency. MGMC was identified by eight different agencies as their backup ambulance service provider.

When first responders were questioned about their average response times for 2013, four of the agencies had a zero to five-minute response time, three had a five to 10 minute response time, three had a 10 to 15 minute response time, and one agency said they did not know. In 2014, four agencies had a zero to five-minute response time, four had a five to 10 minute response time, two had a 10 to 15 minute response time, and one agency did not know. In 2015, average response times for first responder agencies were zero to five minutes for four agencies, five to 10 minutes for five agencies, and 10 to 15 minutes for the remaining two agencies.

When first responders were questioned about ambulance response times for 2013, a majority of the agencies had an average ambulance response time of 10 to 15 minutes. When first responders were questioned about ambulance response times to their medical incidents for 2014, a majority of the agencies had an average ambulance response time ranging from five to 25 minutes. When first responders were questioned about ambulance response times to their medical incidents for 2015, a majority of the agencies had an average ambulance response time ranging from five to 25 minutes, with most selecting 10 to 15 minutes. Figure 2 illustrates what all three years look like collectively.



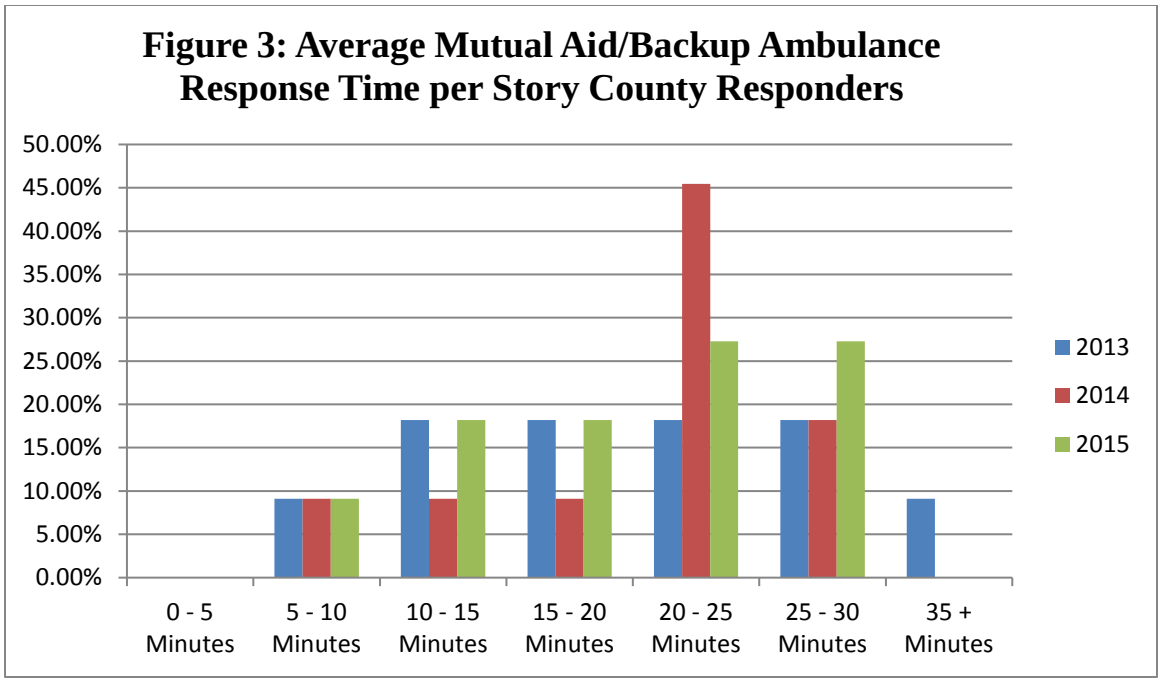

When first responders were questioned about ambulance response times for 2013, when their primary ambulance service provider was not available and a mutual aid/backup ambulance had to respond, a majority of the agencies recorded an increased average ambulance response time ranging from 10 to 30 minutes. The number of times that first responders did not have their primary ambulance available in 2013 and they had to request mutual aid from another ambulance service ranged from as few as only 1% of their medical incidents to as much as 15% of their medical incidents. During 2013, Story County first responders request mutual aid from another ambulance service 7% of the time on average. (Two of the respondents did not know, and one of the responses was thrown out because they reported 400 more mutual aid calls than they had for incidents in 2013.) In addition, Story City First Responder's data was not included in this portion of the results because their primary ambulance provider has a transport agreement with MGMC, is rarely in service, and does not function as a typical ambulance provider.

When first responders were questioned about ambulance response times to their medical incidents for 2014, when their primary ambulance service provider was not available and a

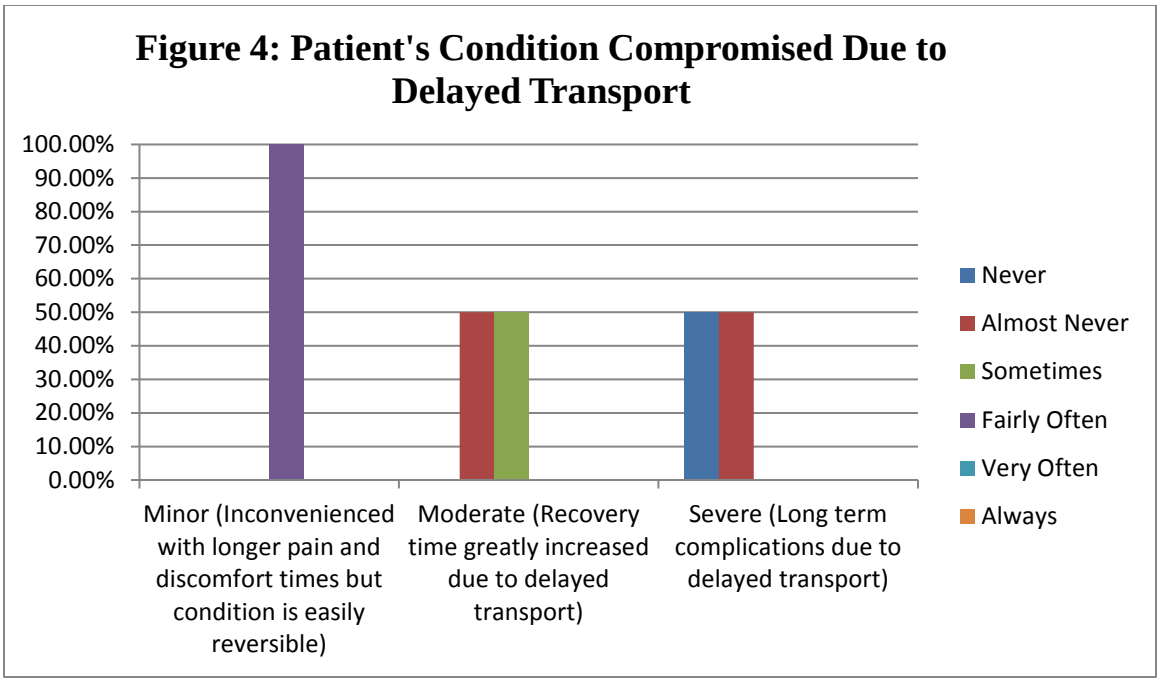
mutual aid/backup ambulance had to respond, a majority of the agencies recorded an increased average ambulance response time ranging from 10 to 30 minutes. The number of times that first responders did not have their primary ambulance available for 2014 and they had to request mutual aid from another ambulance service ranged from as few as 2% of the time to as much as 19% of the time. During 2014, Story County first responders request mutual aid from another ambulance service 9% of the time on average. Two of the respondents did not know, and one of the responses was thrown out because they reported 300 more mutual aid calls than they had for incidents in 2014.

When first responders were questioned about ambulance response times for 2015, when their primary ambulance service provider was not available and a mutual aid/backup ambulance had to respond, a majority of the agencies recorded an increased average ambulance response time ranging from 10 to 30 minutes, with more identifying a 20 to 30 minute response. The number of times that first responders did not have their primary ambulance available in 2015 and they had to request mutual aid from another ambulance service ranged from as few as 4% of the time to as much as 15% of the time. During 2015, Story County first responders request mutual aid from another ambulance service 8% of the time on average. One of the respondents did not know, and one of the responses was thrown out because they reported 450 more mutual aid calls than they had for incidents in 2015.

Figure 3 illustrates the increased response times, according to Story County First Responders, when their primary ambulance was not available to respond and a mutual aid/backup ambulance had to response to the incident. The graph represents all three years, from 2013 through 2015.




In question 21 of the first responder's survey, they were asked if they thought their patients' conditions were ever compromised because they had to wait for a mutual aid ambulance to respond instead of their primary ambulance provider. An overwhelming 82% of them said no. The 18% of respondents who said yes, said that on 32 different occasions, over the last three years, their patients' conditions were compromised. Figure 4 shows their responses when presented with a follow up question as to what degree those 32 patient's conditions were compromised by waiting for a mutual aid ambulance to respond.




The next question Story County First Responders were asked was when an ambulance transports a patient from their incident, what percentage of the time did they have to provide a driver or an attendant for the ambulance service. Responses ranged from as little as 3% of the time all the way up to 100% of the time. Five of the 11 responses said they assist the ambulance service 5% of the time. If you disregard the 100% entry, the second highest percentage was 20% followed by 10% of the time.

When Story County First Responders were asked if the current emergency medical transport system in Story County is adequately meeting their needs as an EMS agency, six responded yes, and five said no. Those who answered no, cited the following possible improvements: more available ambulances from SCMC and MGMC, better 24-hour staffing for ambulances, have SCMC add another ambulance in service all the time, and better utilization of ambulances, especially when working with nursing homes.

Story County has five emergency medical transport service providers. Two ambulance providers have transport agreements with either MGMC or SCMC, which means they only have

an ambulance available when staffing allows. Three of the five emergency medical transport service providers in Story County provided responses to the survey. The transport service providers that completed the survey were all ALS service providers with two staffed by career employees and one staffed by paid on-call volunteers. All three transport service providers provide ALS services to the whole county. In addition, MGMC also provides services to Boone, Hamilton, Hardin, Marshall, and Polk Counties. SCMC also provides ambulance services to parts of Jasper and Polk Counties. MGMC has five ambulances in their fleet and staff two to three Monday through Friday from 07:00 hours to 23:00 hours. Sunday through Saturday, from 23:00 hours to 07:00 hours, MGMC staff one ambulance and has one additional ambulance on-call. SCMC has two ambulances in their fleet and staff one ambulance 24 hours a day, seven days a week. Huxley Fire and Rescue also has two ambulances in their fleet but only staff one. They did not specify during what times and days of the week it is staffed.

According to the survey results, all three transport service providers in Story County provide inter-facility transfers inside the county. Two providers, MGMC and SCMC also provide inter-facility transfers outside of Story County, including outside of the state. Transfers account for 10% of MGMC's call volume and 16% of SCMC. The time spent on transfers, accounts for 10% of MGMC's time and 3% of SCMC's time. Transfers are medically necessary 90% of the time for MGMC and 75% of the time for SCMC, according to their survey results. Huxley Fire and Rescue did not provide inter-facility transfer data in their survey.

Ambulances in Story County, excluding the City of Ames, averaged a response time of 11 minutes and 46 seconds over the three-year lookback period according to survey results from the Story County 911-dispatch centers. Survey results from Story County first responders also identified for at least 61% of the first responders that ambulances had an average

response time of 15 minutes or less over the three-year lookback period. The longest ambulance response time was to the City of Zearing, which averaged 19 minutes over the three-year lookback period. The quickest average ambulance response time was to Huxley at five minutes and 20 seconds, followed by Nevada at five minutes and 40 seconds. When Story County first responders were asked about response times for mutual aid ambulances into their communities, ambulance response times increased from 15 minute or less response time for 61% of Story County first responders to a longer 15 to 30 minutes or more response time for 70% of Story County first responders. The 911-dispatch center survey results for ambulance response times were for all ambulances responses, except Ames, it did not differentiate whether it was the primary ambulance for that community or a mutual aid ambulance. It is apparent from the first responder survey results that the perceptions of ambulance response times for mutual aid ambulance incidents are not as out of proportion as first responders identified, which was as much as double the response time of the primary ambulance response times. There is without a doubt an increased response time for a mutual aid ambulance response but unfortunately, this type of data is currently not being tracked by dispatch. AFD does track this data and has found that on average, over a three-year period, MGMC have an eight minute and 29 second response time. However, when MGMC are not available to respond within Ames and AFD requests another ambulance provider to come into Ames to transport a patient, the average ambulance response time increases to 14 minutes and two seconds, which is a 60% increase in patient wait times.

The survey results from the Story County transport agencies showed that in 2013, SCMC responded to 945 medical incidents. Of those, 66% of them were ALS, 26% were BLS and 8% had no patient transported because the patient signed a medical release or was not there when the

ambulance arrived. In 2013, MGMC responded to 4,357 medical incidents. Of which, 46% were ALS, 30% were BLS and 13% had no patient transported because the patient signed a medical release or was not there when the ambulance arrived. Huxley did not report ALS, BLS or no patient found/released data. In 2014, SCMC responded to 955 medical incidents. They had a slight increase in ALS incidents, at 71%. BLS incidents made up 22% of their incidents and 7% of the incidents resulted in no patients being transported. MGMC's responded to 4,318 incidents in 2014. They saw a small decrease in their ALS incidents at 43%. BLS incidents were at 34% and 18% of the medical incidents MGMC responded to resulted in the patient not being transported. The survey results for 2015 had SCMC responding to 1,015 medical incidents. Of which, 73% were ALS, 15% were BLS and 12% were non-transport incidents. In 2015, MGMC responded to 4,102 incidents. Of those incidents, 44% of them were ALS, 33% were BLS and 14% were no patient transported.

Story County transport agencies were asked if they feel the current pre-hospital emergency medical transport system in Story County is adequately meeting the needs of the communities they serve. Two transport agencies said yes and one said no. The transport agency that said no suggested having a few more ambulances to help cover the county.

**Comparable County Results**

The survey results, from the 13 comparable counties across Iowa, were used to answer research questions: (Q2) How does the current capacity of emergency medical transport units in Story County compare with national, state, and local standards? (Q3) What have other cities and counties of similar size and like resources determined is an appropriate number of emergency medical transport units? (Q4) What alternative service delivery models have other organizations adopted to address emergency medical transport unit availability?

Survey number five (see Appendix E), was sent to 13 county EMA coordinators in Iowa and had a return rate of 77%. The main purpose of the EMA survey was to determine the expected sample sizes for the other three surveys they were asked to distribute within their county. When asked how many 911-dispatch centers they had in their county, eight responded that they had one, and two responded that they had two. Based on survey results, the total sample size for 911-dispatch center from the 10 comparable counties involved in the study was 12. When asked about how many non-transport EMS agencies they had in their county, the total came to 56 agencies all together, which averages 5.6 non-transport EMS agencies per county. Lee County had the most agencies with 12. The smallest counties were Des Moines, Marion and Dubuque with two each.

When comparable county EMA coordinators were asked how many EMS transporting agencies they have in their county, Dubuque County had the most with 12. The least was split between Boone and Marshall with one agency each. The number of EMS transporting agencies was 48, which breaks down to an average of 4.8 agencies per county. When EMAs were asked if they thought the current emergency medical transport system in their county was adequately meeting the needs of their customers, 60% said no. The improvements they suggested were: an increase of volunteer EMT's, reliable staffing, cooperative training, more ALS units, adding an ambulance to the fire department, and system development.

The comparable counties survey for dispatch centers (see Appendix F), had of return rate of 17%. One respondents was a one-dispatch center county and the other a two-dispatch center county. Both dispatch centers use EMD, with one using Association of Public-Safety Communications Officials and the other Priority Dispatch. Only one respondent was able to provide data when asked about ALS versus BLS dispatches. In 2013, 15% of their dispatches

were ALS and the remaining 85% were BLS. In 2014, 16% of their dispatches were ALS and 84 were BLS. In 2015, ALS dispatches increased to 20% and BLS dispatches made up 70% for their county. When dispatch centers were asked about how many times they had to request a mutual aid ambulance into the county for transport, only one agency responded, the other stated that it was something that they did not keep track of. The one agency that provided data, said they had to request mutual aid for an ambulance from a neighboring county 10 times each year in 2013, 2014 and 2015. The final question they were asked was if the current emergency medical transport system in their county was adequately meeting the needs of their customers, to which they both answered yes.

The comparable counties survey for first responders agencies (see Appendix G), had seven responses from four counties but only four respondents completed the whole survey. The sample size for this survey, according to comparable county EMAs, was 56 making the response rate based on the four that completed the entire survey 7%. When asked about what level of service agencies provide, six participants responded. Of those, 67% were EMT and 33% were AEMT. They were served by as many as 15 members on one agency to as few as four on another. The total number of medical incidents that the five respondents who answered the question had were 950 in 2013, 974 in 2014 and 1,037 in 2015. The most EMS incident responses from anyone first responder agency was 862 and the lowest was three.

When the comparable county first responder agencies were asked about their average response times for 2013, three agencies recorded a five to 10 minute response, one agency a 10 to 15 minute response and one agency a 15 to 20 minute response. In 2014 and 2015, one agency reported a response time average of zero to five minutes, three agencies reported a five to 10 minute response time average and one agency reported a 10 to 15 minute response time average.

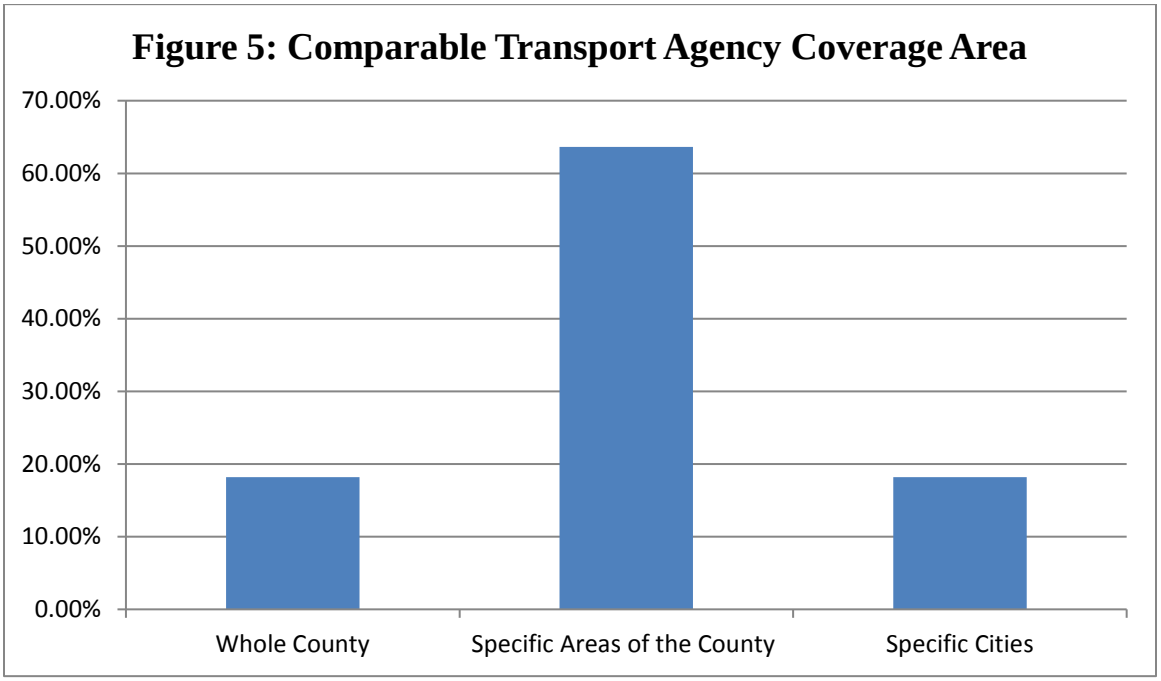
When comparable county first responders were questioned about average ambulance response times for 2013 through 2015, a majority of the agencies had an average ambulance response time of 10 to 15 minutes. Comparable county survey data from first responders on ambulance response times identified an average response time of 15 minutes or less for 80% of the agencies. When comparable county first responders were asked about average ambulance response times for mutual aid/back up ambulance providers for 2013 through 2015, a majority of them just did not know and were unable to provide data.

When first responders from the comparable counties were asked what they considered an acceptable response time for an emergency medical transport ambulance to their city, 100% of the respondents who answered the question, selected 10 to 15 minutes. When those same first responders were asked if they thought their patients' conditions were ever compromised by having to wait for a mutual aid ambulance to respond instead of their primary ambulance provider over the last three years, their responses were split. Three first responder agencies said no and one agency said yes. When the first responder agencies who said yes were questioned further about the extent of their patients' conditions being compromised, they said that fairly often there were minor complications, as in the patient was inconvenienced with longer pain and discomfort time, but conditions were easily reversible. They also said that sometimes, there are moderate complications and almost never any severe complications

Results from the comparable county first responder agency survey showed a mix between the amount of help agencies provide for the ambulances services providing transports in their community. When responders were asked about what percentage of the time they provide a driver or an attendant for the ambulance service, responses ranged from 77% of the time to as few as 10% of the time, with the average from all responses being 37% of the time. When first

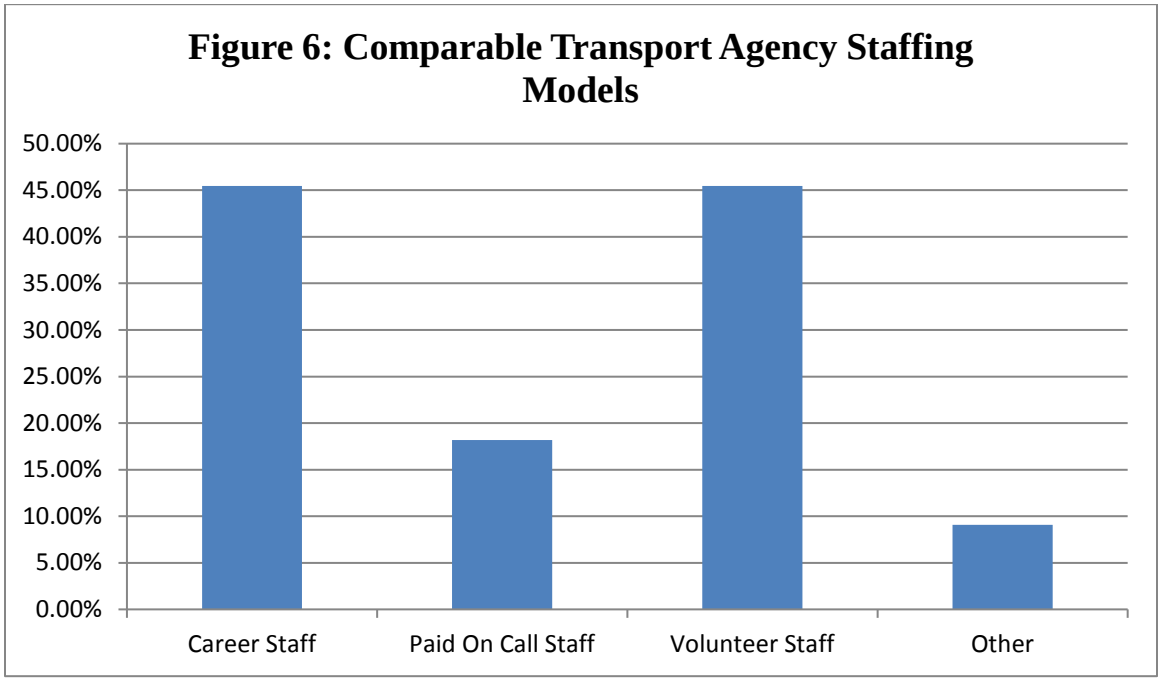
responder agencies were asked if they felt that the current emergency medical transport system in their county was adequately meeting their needs as emergency responders, 100% of the respondents answered yes.

Survey results from the comparable counties transport agencies had 11 surveys returned, which represented data from six different counties and a response rate of 23%. The transport agencies from the comparable counties have a mix of first due coverage models, but a majority of them cover specific areas of their county, as illustrated in Figure 5.




There is also a split down the middle between the number of agencies that provide services, not including inter-facility transports, to other counties outside of their own. A majority of the transport agencies, 64% of them reported that they are an ALS service provider, with 27% providing BLS services and 9% providing ALS services when staffing allowed, otherwise they were a BLS provider. They provide their EMS services through multiple staffing models, as illustrated in Figure 6. The survey demonstrated an equal mix between career and volunteer

staffing models. One agency selected other because they used a blended staffing model that included career, part-time and paid on call members.




Members staff as many as 10 ambulances in one agency, to as few as one ambulance. Three agencies had one ambulance, two agencies had two, three agencies had three, two had four and one agency had 10 ambulances in their fleet. This averages out to three ambulances per agency. The survey results also demonstrated a variety of staffing models when it comes to how many ambulances an agencies has in service, with at least nine of the 10 respondents staffing at least one ambulance 24 hours a day, seven days a week. One agency staffs four ambulances during the day and drops down to three at night. Two agencies staff three ambulances all the time. Another agency staffs three ambulances until 21:00 hours and then drops down to two until 09:00 hours. One volunteer agency staffs two ambulances all the time. Three agencies were staffing one ambulance each all the time. One of the agencies said they were using a model that would have one ambulance available all the time and another one that was on-call all the time.

There was also one agency that staffed one ambulance all the time during the weekend and drops down to just one between 18:00 hours and 06:00 hours Monday through Friday.

Transport agencies from the comparable counties were also asked about their call volume and percentage of ALS versus BLS incidents. In 2013, the seven comparable transport agencies that completed this portion of the survey recorded 15,493 EMS responses. Of those responses, 56% of them were ALS incidents, 38% were BLS incidents and 25% resulted in no patient being transported because the patient was not there when the ambulance arrived or the patient signed a refusal form. In 2014, agencies recorded 16,597 EMS responses. Of those responses, 55% were ALS incidents, 38% were BLS and 16% resulted in no patient being transported because the patient was not there when the ambulance arrived or the patient signed a refusal form. In 2015, agencies recorded 17,445 EMS responses, of which 54% of were ALS incidents, 39% were BLS incidents and 17% resulted in no patient being transported.

When transport agencies from comparable counties were asked about inter-facility transfers, six agencies answered that they only provide transfers within the county. Five agencies said they go outside of the county for inter-facility transfers and three will go out of the state for transfers. Two agencies answered that they do not provide inter-facility transfers at all. Inter-facility transfers made up anywhere from 75% of one agency's call volume to as little as 3% of another agency's call volume. The average percentage of time that these agencies spent on inter-facility transfers was 27% of their time, with the lowest agency reporting only 1% and the most at 65%. When transporting agencies from comparable counties were asked about what percentage of their inter-facilities transfers were medically necessary, three of them said 100% of the time. One agency said 90% of the time and another said 85%, with one agency reporting 0% of the time.

The final question in the survey for transport agencies from comparable counties was if they felt that the current pre-hospital emergency medical transport system in their county is adequately meeting the needs of the communities you serve, to which all but one agency replied yes. The only agency that said no, suggested an improvement in how mutual aid is requested, citing that they have the resources to help out those struggling in the rural areas.

## Discussion

The purpose of this research was to identify if the current availability of emergency medical transport units are meeting the current needs of EMS responders in the county. The four research questions for this applied research project identified that yes, emergency medical transport units in Story County are meeting the current needs of the EMS responders in the county. There are however, several opportunities for improvements within Story County. The information gleaned from this research will have a positive impact on the current system and will be necessary for future planning.

The results from the surveys used to answer research question Q1 and supported by the research of others found during the literature review, showed that Story County does not have a resources problem, but a coordination problem. Survey results from the Story County mayors produced mixed results when they were asked if they felt that the current emergency medical transport system in Story County was adequately meeting the needs of their community. Half of the respondents felt that yes, the current system was adequately meeting the needs of their communities. Over half of the Story County transport agencies, over half of the Story County EMS responder agencies, and half of the 911-dispatch centers also thought that the needs of their communities were being met. Those who felt that the current system was not meeting their community's needs listed the need for more ambulances, better coordination between ambulance

services for nursing home responses, and the appropriate use of BLS and ALS providers as suggested improvements.

The comparable county survey results showed divided responses on whether the current emergency medical transport system in their county was adequately meeting the needs of their customers. Of the 10 county EMAs, 60% of them did not think the current system in their county was adequately meeting their customer's needs. The 911-dispatch centers, first responders, and transport agencies however, completely disagreed with their EMAs, with only one of the 14 responses indicating there was a problem.

From the literature review, the Committee on the Future of Emergency Care in the United States Health System (2007) also identified insufficient coordination as one of the systemic problems fragmenting the nation's EMS systems. The NHTSATAT (2015) argued that counties need to develop county-wide EMS plans to meet their specific needs and utilize their resources appropriately. In Dallas, they learned that sending an ambulance to every stubbed toe call was not the most appropriate utilization of their resources and so they altered their response protocol to instead make in-home visits to those who are heavy 911 users and for those who abuse the EMS system (Hallman, 2016). However, nowhere in the literature was it suggested that more ambulances would solve a perceived ambulance shortage. What the literature did suggest, was making EMS an essential service, (ACEP, 2017; Van Milligen, 2017). Researchers Wu and Hwang (2009) also suggested that planning instead of reacting to changes is how EMS providers efficiently balance ambulance availability.

The analysis of the results from the Story County surveys and the literature review suggests one of three possibilities. First, survey respondents do not think there is a shortage of ambulances in Story County. Second, there could be an ambulance shortage, but EMS service

directors, fire chiefs, and 911-dispatch supervisors are not communicating with each other or with their elected officials to let them know there is a problem. Third, it could be that Story County is just in the beginning stages of experiencing an ambulance shortage and not every city in the county has felt its effects yet.

In each case, the end results are all the same. It does not appear that Story County has an ambulances availability problem, but a coordination problem between ambulances and EMS providers in the county and in how they delivery their services. As pointed out in the background and significance section, Story County does not provide EMS system direction, coordination, or oversight at the county level. Individual agencies work independently from each other because there is no county coordination among them as they all individually try to deliver exceptional EMS services to the county. The Story County Emergency Medical Services Association has been purposed with coordinating EMS services in Story County but does not have the resources, support, or authority. The mayors in Story County are not the correct stakeholders to be asking whether there is an ambulance shortage problem in the county. The level of coordination and oversight that they have within their communities does not afford them opportunities to forecast specific service level deficits. They instead rely on the subject matter experts within their organizations - the EMS service directors, the fire chiefs and dispatch supervisors - to let them know when there could be a problem down the road and how those problems could be avoided or addressed when they occur. What the mayors are however, are the decision makers in the county. They are the ones who will decide, based on the data presented to them from their EMS agencies, how much authority, support, and resources the county EMS system needs. Mayors do not build roads because they think it will be a good idea, they build roads because they have been

shown through data that there is a need. The same holds true for EMS and ambulance availability in Story County - the decision makers need to be shown, through data, that there is a problem.

Further analysis of the survey results showed that collectively, over a three-year average, Story County responder agencies requested a mutual aid ambulance to respond to their medical incident because their primary ambulance was not available 8% of the time. One could also say that ambulances in Story County have an average reliability of 92%. (Specifically in Ames, the three year average was a little over 2% of the time a mutual aid ambulance was needed because the primary ambulance was not available.)

To achieve a better understanding of how often mutual aid is used throughout the county, one must look at what type of impact mutual aid calls have on response times. The literature review revealed that there are no federal or state laws establishing EMS response times (Ludwig, 2004). There are however, recommendations and consensus standards for EMS response times. NFPA (2010) 1710 recommends a standard response travel time of four minutes or less for first responders and eight minutes or less travel time for ALS ambulance to 90% of EMS incident. The IDPH Bureau of EMS (2010), as part of their minimum requirements, requires a response time of five minutes or less for urban areas and 15 or less for rural areas for 80% of medical incidents.. Ambulances are required to have a response time of eight minutes or less for urban areas and 20 minutes or less for rural areas (IDPH, 2010).

In Story County, which was identified by the U.S. Census Bureau (2015) as being mostly urban, only 36% of the first responder agencies identified an average response time of zero to five-minutes over the three-year lookback period. Only 13% of the comparable county first responder agencies were able to meet the zero to five-minute benchmark. The AFD had an average response time of five minutes and 13 seconds during the three-year lookback period for

medical responses. When response times are extended an additional five minutes, to zero to 10 minutes, 72% of the first responder agencies in Story County were able to meet the response time, as were 73% of the comparable county first responder agencies.

In analyzing the survey results, and taking into consideration the standards and recommendations from the literature review, it would appear that only a few first responder agencies in Story County, four to be exact, and two ambulance providers for specific responses to the cities of Nevada and Huxley, are actually meeting the non-punitive response recommendations established in the literature review. Other agencies within Story County may also be meeting the response recommendations but only if you disregard the U.S. Census Bureau's (2015) determination that Story County is a mostly urban county. Response times recommendations for urban versus rural settings are 60% more restrictive, with five minutes or less for first responders instead of 15 minutes, and eight minutes or less for ambulances instead of 20 minutes (IDPH, 2010). It is unreasonable to paint an entire county with one stroke of the brush, as the U.S. Census Bureau has done. To say that Story County is mostly urban and expect small towns like Kelley, McCallsburg, and Collins, whose combined population is less than 1,200 to meet the same recommendation as a town like Ames with over 65,000 people and a career fire department is not realistic, or even practical. Most of the other first responders and ambulances in Story County, including MGMC, were also unable to meet the recommended urban first responder response times and/or ambulance urban response times. MGMC had an eight minutes and 29 seconds response time within Ames over a three-year average. Cities like Huxley, who have their own ambulance and Nevada, where the SCMC ambulance is based, were the only two ambulance service providers within the recommended urban response time of eight minutes or less set by the IDPH Bureau of EMS (2010). What is impressive is that Huxley Fire

& Rescue ambulance accomplished this goal with paid on-call staff and volunteers. In fact, all of Story County's first responders are volunteer, which is common amongst at least 16 other states (Federal Interagency Committee on Emergency Medical Services, 2012). Huxley Fire & Rescue ambulance service does not provide services to other counties and they only provide inter-facility transfers within Story County. Whereas MGMC and SCMC provide transport services to other counties and provide inter-facility transfers to other counties, including out-of-state. Regardless, SCMC was still under the recommended response time, and only staff one ambulance, whereas MGMC staff two to three ambulances. MGMC is a much larger hospital than SCMC, and sometimes paramedics assist with patient care within the hospital and other duties as assigned. So the fact that MGMC is not meeting the recommended IDPH Bureau of EMS (2010) response times could be caused by delayed turnout times, which is the time between a unit being notified of a call to the time they are in the apparatus and ready to respond, due to the other functions their paramedics are being asked to do. It could also be simply that the City of Ames is a much larger city than Nevada and it takes longer to navigate from point A to point B.

The AFD is also struggling to meet the response time recommendation from the IDPH (2010) Bureau of EMS. Ames has three fire stations spread out across the city, and Ames has multiple units in service, which should provide a quicker response time. Perhaps the city is growing at a faster rate than emergency services can keep up with, or turnout times need to be evaluated. Regardless of the cause, there is an opportunity to improve response times for MGMC and the AFD, even if the response time standards set by the IDPH (2010) Bureau of EMS are just a recommendation.

Survey results from ambulance transport providers also looked at inter-facility transports and the impact they have on ambulance availability. In Story County, on average, inter-facility

transfers account for 13% of the ambulance transport provider's calls volume, for those agencies whom provide them. That 13% however, only accounts for 7% of the ambulance provider's time that it takes to complete inter-facility transfers, and inter-facility transfers were medically necessary 83% of the time. Survey results from the comparable county transport agencies showed inter-facility transfers account for 24% of their call volume on average, accounting for 27% of their time to complete. The amount of time Story County transport agencies spend completing inter-facility transfers is negligible. When an ambulance takes an inter-facility transfer, they are decreasing their availability for other emergency calls. However, if 83% of those inter-facility transfers are medically necessary, should they be given a similar priority as 911-emergency calls? This is why EMS responders were also asked what percentage of their 911 emergent responses were ALS versus BLS.

Evaluating ALS versus BLS incidents for ambulance transport agencies does not necessarily provide insight into who should be transported or not. What it does provide, however, is a priority level for ambulance calls and helps to evaluate appropriate resource allocation. For example, Story County ambulance incidents were an average of 57% ALS, 27% BLS incidents, and 12% of the incidents had no patient on arrival or the patient refused transport. Comparable county ambulances logged similar results in their surveys, averaging 55% of their incidents ALS, 38% BLS incidents, and 19% of their incidents had no patient on arrival or the patient refused transport. Ambulances from the comparable counties are spread out among service levels with 72% ALS providers and 28% BLS providers, almost a 3:1 ratio. In Story County, all ambulance providers are ALS, even though only 57% of the incidents required ALS services.

To answer research question Q3, Story County's available resources were compared with other comparable counties in Iowa. Story County has 17 EMS agencies in the county, which is almost double the U.S. and the State of Iowa averages of 9.2 EMS agencies per county (National EMS Assessment, 2011; State of Iowa Reassessment of Emergency Medical Services, 2015). The 10 comparable Iowa counties that completed the survey averaged 5.6 EMS agencies per county. Lee County had the most with 12 agencies, while Des Moines, Dubuque, and Marion had the least with only two agencies each. Story County was well above the average for EMS agencies compared to other Iowa counties, but they did not have the most. Story County's total of five emergency medical transport agencies was right on with the average for comparable counties of 4.8 emergency medical transport agencies per county. There were six other counties, 60% of those completing the survey, which either had the same number of ambulances as Story County or more. Dubuque County recorded the most, with 12 ambulances, while counties like Boone and Marshall only have one.

A minimum service level for first responders was not recommended in the literature review, but 98% of U.S. EMS agencies are EMT service level or higher (Federal Interagency Committee on Emergency Medical Services, 2012). In fact, the National EMS Assessment did not even include a service level lower than EMT in its study because they represent such a small percentage of EMS agencies in the U.S. (Federal Interagency Committee on Emergency Medical Services, 2012). Results from the comparable county first responder surveys demonstrated the same findings with 100% of them at the EMT or higher service level. Story County, however, still had 18% of their EMS agencies operating below the EMT service level.

Reviewing alternative service delivery models for EMS, (Q4), provided three distinct models with applicability for Story County. The most predominant model identified through the

literature was alternative ambulance staffing. There are two different approaches to ambulance staffing. The first approach involves staffing ambulances with a split crew - one ALS provider and one BLS provider. The literature review showed that staffing an ambulance with two ALS providers does not increase ambulance capabilities (Manahl, 2009). According to Manahl (2009), staffing ambulances with one ALS provider and one EMT will save money and increase staffing levels. The second approach involves the opposite strategy - placing physicians on ambulances and allowing paramedics to make home visits. This approach focuses on providing patient care while minimizing patient transports. Ambulances are able to make home visits, provide wound care, help manage chronic diseases and help manage medications, which results in fewer ambulance transports to the ER (Shrader, 2016; Wahlberg, 2015).

The second alternative service delivery model is similar but instead of sending an ambulance to the incident, a van or an SUV responds with two EMS professionals. According to the National EMS Advisory Council (2010), this alternative response model provides the same patient care, but patients can be taken to the nearest clinic or hospital if needed, or be provided with a social services referral. This approach reduces the number of calls requiring an ambulance while still providing excellent patient care. According to the National EMS Advisory Council (2010), this approach would require excellent coordination between service provider and 911-dispatch centers. The IDPH Bureau of EMS (2010) recommends that at a minimum all 911-dispatch centers should use and be trained in EMD. The survey results from the Story County dispatch centers identified that two of the three dispatch centers in the county were in compliance with using EMD. Surveys from comparable Iowa counties showed similar results, with 50% reporting that they use EMD. The National EMS Advisory Council (2010) also

recommended using a consolidated dispatch center, which 80% of comparable counties have done, however Story County is not one of them.

The third alternative service delivery model is staffing one ALS provider on a first response engine coupled with an ambulance response with one ALS provider. This approach, shaved off two minutes and 15 seconds from the time it takes to complete trauma tasks compared to that of a BLS first response engine coupled with a two ALS-provider ambulance (Moore-Merrell, et al., 2010). A four person first response engine company was faster at completing tasks for both a trauma and a cardiac response than a crew of three or two. A technical basis has been established that having one ALS provider on a first response engine is the most effective staffing option for an EMS response (Moore-Merrell, et al., 2010).

## Recommendations

The purpose of this research was to identify if the current availability of emergency medical transport units are meeting the needs of EMS responders in the county. The results identified that Story County does not necessarily have an ambulance availability problem, but rather a coordination problem. The number of EMS resources throughout Story County are better than national averages and the averages from comparable counties in Iowa. The results also identified some opportunities in Story County, specifically within the AFD, that can improve EMS delivery within Story County and potentially improve patient care and ambulance availability.

### Recommendation #1

As pointed out in the background and signification section, supported by the literature review, and evaluated in the discussion section, Story County needs a countywide EMS system. Story County should reorganize and provide authority to the Story County Emergency Medical Services Association to establish a countywide EMS system. The association should be

transformed into a board with representation from the decision makers at the 20 EMS agencies in Story County. Oversight of the board would come from the Story County Emergency Management Commission. The Story County Emergency Medical Services Board would be tasked with establishing minimum countywide standards, similar to those provided by the IPDH Bureau of EMS. They would also ensure the appropriate coordination among all EMS agencies within the county, including establishing countywide protocols. Finally, the board would be responsible for the ongoing evaluation of the county's EMS system and would have recommendation authority to the Story County Emergency Management Commission, where elected officials would have the final say. Moving forward with this recommendation would allow for the creation of a county-wide EMS system, which would provide the coordination between the different EMS agencies, improve response times, and ensure the appropriate allocation of resources.

**Recommendation #2**

The AFD should become an EMT service level provider. It has been pointed out throughout this research that the AFD's limited EMS scope of practice has placed too much of a reliance on ALS providers. Given the extended ambulance response times recognized through survey results, the AFD has an opportunity to improve patient outcomes by adding a few more skills and lifesaving treatments at an EMT service level versus their current EMR service level.

**Recommendation #3**

As highlighted throughout this research, alternative service delivery models provide excellent opportunities to improve patient care times, ambulance availability, and the appropriate allocation of resource. The AFD and MGMC officials should meet to discuss a trial run of exchanging one MGMC paramedic for one AFD EMT during prearranged periods, to evaluate

the feasibility, cost-sharing opportunity, and increased patient care potential. Patient care and outcomes would need to be closely monitored during this trial period to ensure the exchange process is working well. During this trial period, it is recommended that exchanges last no longer than 12 hours at first in order to gauge effectiveness. It is also recommended that MGMC ambulances involved in an exchange are used for in-town use only and not for inter-facility transfers out of the city. MGMC would also not be asked to perform any other fire department operation function other than EMS. As learned from the research, placing one ALS paramedic on a first response engine can have a dramatic impact on patient care times.

Additional research is needed to establish a baseline for patient care and outcomes using the current EMS delivery process in Story County. As recommendations become reality, it is important to have a baseline to measure the future success of different implementations. At the end of the day, the most important part of EMS is patient care and making sure patients have a positive outcome. Additional research on ambulance placement within Story County would also be beneficial. By working with county and city GIS representatives, and by incorporating some of the different ambulance coverage and queuing software available on the market, Story County could strategically locate EMS resources in the county so they would have the greatest impact on response times and patient care outcomes. Further research is needed to evaluate the prospect of bringing in a private ambulance provider to serve Story County. This competitive analysis approach would provide information for stakeholders on what a private system in Story County would look like, the cost, and the potential impact on patient care and outcomes. It could also potentially encourage current EMS transport providers in Story County to be more competitive as they evaluate how to be more efficient and effective in how they deliver EMS services in Story County.

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# Appendix A

## Story County Mayor Survey

1. What is the name of your city?

2. Does your city have emergency medical responders (First Responders, EMTs. etc.) specifically for your community?

Yes

No

3. In your city, do you have an emergency medical transport ambulance service?

Yes

No

Other (please specify)

4. Who provides ambulance services for your city? (Please select all that apply)

Mary Greeley Medical Center (Mobile Intensive Care Service)

Story City Ambulance Service

Huxley Fire & Rescue Ambulance

Colo Fire & Rescue Ambulance

Story County Medical Center

Don't Know

5. What do you consider an acceptable response time (time from dispatched to on scene) for the emergency medical responders in your community?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

6. What do you consider an acceptable response time (time from dispatched to on scene) for an emergency medical transport ambulance to your community?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

7. Do you feel that the current emergency medical transport system in Story County is adequately meeting the needs of your community?

Yes

No

8. What improvements to Story County's current emergency medical transport system would you like to see in order to better meet the needs of your community? Please be specific.

# Appendix B

## Story County Dispatch Center Survey

1. Do you use Emergency Medical Dispatching (EMD)?

Yes

No

2. If Yes, what program do you use?

3. What percentage of medical incidents that you dispatched in 2013 were ALS?

4. What percentage of medical incidents that you dispatched in 2013 were BLS?

Ames

Cambridge

Collins

Colo

Gilbert

Huxley

Kelley

Maxwell

McCallsburg

Nevada

Roland

Slater

Story City

Zearing

5. How many medical dispatches were initiated in 2013 for each city?

Ames

Cambridge

Collins

Colo

Gilbert

Huxley

Kelley

Maxwell

McCallsburg

Nevada

Roland

Slater

Story City

Zearing

6. What was the average ambulance response time (dispatched to on-scene) in 2013 for each city?

7. What percentage of medical incidents that you dispatched in 2014 were ALS?

8. What percentage of medical incidents that you dispatched in 2014 were BLS?

Ames

Cambridge

Collins

Colo

Gilbert

Huxley

Kelley

Maxwell

McCallsburg

Nevada

Roland

Slater

Story City

Zearing

9. How many medical dispatches were initiated in 2014 for each city?

Ames

Cambridge

Collins

Colo

Gilbert

Huxley

Kelley

Maxwell

McCallsburg

Nevada

Roland

Slater

Story City

Zearing

10. What was the average ambulance response time (dispatched to on-scene) in 2014 for each city?

11. What percentage of medical incidents that you dispatched in 2015 were ALS?

12. What percentage of medical incidents that you dispatched in 2015 were BLS?

Ames

Cambridge

Collins

Colo

Gilbert

Huxley

Kelley

Maxwell

McCallsburg

Nevada

Roland

Slater

Story City

Zearing

13. How many medical dispatches were initiated in 2015 for each city?

Ames

Cambridge

Collins

Colo

Gilbert

Huxley

Kelley

Maxwell

McCallsburg

Nevada

Roland

Slater

Story City

Zearing

14. What was the average ambulance response time (dispatched to on-scene) in 2015 for each city?

15. In 2013, how many times were no ambulances available in Story County and you had to dispatch an ambulance from a neighboring county?

16. In 2014, how many times were no ambulances available in Story County and you had to dispatch an ambulance from a neighboring county?

17. In 2015, how many times were no ambulances available in Story County and you had to dispatch an ambulance from a neighboring county?

18. Do you feel that the current emergency medical transport system in Story County is adequately

meeting the needs of the customers you serve?

Yes

No

19. What improvements to Story County's current emergency medical transport system would you like to see to better meet the needs of the customers you serve? Please be specific.

# Appendix C

## Story County First Responder Survey

1. Does your city have emergency medical service/responders (First Responders, EMTs, etc.) specifically for your community?

Yes

No

2. What is the name of your emergency medical service?

3. What is your current service level?

Emergency Medical Responder (EMR)

Emergency Medical Technician (EMT)

Advanced Emergency Medical Technician (AEMT)

Paramedic

Other (please specify)

4. How many emergency medical responders does your agency have?

5. Who is the primary ambulance transport service for your response area? If more than one, please prioritize from the most often utilized/primary (1) to the least (6).

Story County Medical Center

Mary Greeley Medical Center (MICS)

Story City Ambulance Service

Huxley Fire & Rescue Ambulance

Colo Fire & Rescue Ambulance

Other

6. How many emergency medical incidents did your agency respond to in 2013?

7. What was your average response time (time from dispatched to on scene) for those incidents in 2013?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

8. What was the average response time for an emergency medical transport ambulance to those incidents in 2013?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

9. In 2013, how many times was the primary ambulance transport service for your response area not available during an incident and you had to have a different ambulance service respond?

10. What was the average response time for the other ambulance service to respond (time from original dispatch of incident to on-scene) when your primary ambulance transport service was not available in 2013?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

11. How many emergency medical incidents did your agency respond to in 2014?

12. What was your average response time (time from dispatched to on scene) for those incidents in 2014?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

13. What was the average response time for an emergency medical transport ambulance to those incidents in 2014?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

14. In 2014, how many times was the primary ambulance transport service for your response area not available during an incident and you had to have a different ambulance service respond?

15. What was the average response time for the other ambulance service to respond (time from original dispatch of incident to on-scene) when your primary ambulance transport service was not available in 2014?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

16. How many emergency medical incidents did your agency respond to in 2015?

17. What was your average response time (time from dispatched to on scene) for those incidents in 2015?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

18. What was the average response time for an emergency medical transport ambulance to those incidents in 2015?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

19. In 2015, how many times was the primary ambulance transport service for your response area not available during an incident and you had to have a different ambulance service respond?

20. What was the average response time for the other ambulance service to respond (time from original dispatch of incident to on-scene) when your primary ambulance transport service was not available in 2015?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

21. Thinking back over the last 3 years, in your professional opinion were any of your patient's conditions compromised in any way by extended wait times for a transporting ambulance?

Yes

No

22. How many times over the last 3 years (2013 - 2015) were a patient's conditions compromised in any way by extended wait times for a transporting ambulance?

Never - Almost Never - Sometimes - Fairly Often - Very Often - Always

Minor (inconvenienced with longer pain and discomfort times but condition is easily reversible)

Moderate (recovery time greatly increased due to delayed transport)

Severe (long term complications due to delayed transport)

23. Of those times, to what degree were patient's conditions compromised?

24. When an ambulance transports a patient from your incident, what percentage of the time do you provide a driver or an attendant for the ambulance service?

25. What do you consider an acceptable response time (time from dispatched to on scene) for an emergency medical transport ambulance to your city?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

26. Does your organization have its own emergency medical transport ambulance?

Yes

No

27. Do you feel that the current emergency medical transport system in Story County is adequately meeting your needs as an emergency medical service?

Yes

No

28. What improvements to Story County's current emergency medical transport system would you like to see to better meet your service's needs? Please be specific.

# Appendix D

## Story County Transport Agency Survey

1. What is the name of your agency?

2. Does your agency provide emergency medical transport services in Story County?

Yes

No

3. What part of Story County do you consider your primary response or first due coverage area?

Whole County

Specific areas of the County

Specific Cities

4. Would you please describe the specific areas of Story County that you provide transport services for?

5. Would you please select all of the cities in Story County that you provide transport services for?

Ames

Cambridge

Collins

Colo

Gilbert

Huxley

Kelley

Maxwell

McCallsburg

Nevada

Roland

Slater

Story City

Zearing

6. What level of service do you provide?

ALS

BLS

ALS when staffing allows, otherwise BLS

7. How many total ambulances do you have in your fleet?

8. How do you staff your ambulance(s)?

Career Staff

Paid On Call Staff

Volunteer Staff

Other (please specify)

9. On average, how many ambulances do you have staffed during the week and during what times? Staffed would include career, paid on call and volunteer. (Example: 1 Sunday-Thursday 0700 to 1700 and 2 Friday-Saturday 0700 to 0700.)

10. How many total incidents did your service respond to in 2013?

11. Of those incident, what percentage were ALS incidents?

12. What percentage were BLS incidents?

13. What percentage resulted in no patient(s) being transported due to either a patient refusal, or no patient on scene?

14. How many total incidents did your service respond to in 2014?

15. Of those incident, what percentage were ALS incidents?

16. What percentage were BLS incidents?

17. What percentage resulted in no patient(s) being transported due to either a patient refusal, or no patient on scene?

18. How many total incidents did your service respond to in 2015?

19. Of those incident, what percentage were ALS incidents?

20. What percentage were BLS incidents?

21. What percentage resulted in no patient(s) being transported due to either a patient refusal, or no patient on scene?

22. Do you provide ambulance services, not including inter-facility transports, to other communities outside of Story County?

Yes

No

23. What county or counties outside of Story, do you provide ambulance services to?

24. Do you provide inter-facility transfers to the following locations? Please select all that apply.

Inside Story County

Outside Story County

Outside the State of Iowa

We do not provide inter-facility transfers

25. On average, what percentage of your service's total call volume is made up by inter-facility transfers?

26. On average, what percentage of your service's time is spent doing inter-facility transfers?

27. What percentage of your inter-facility transfers are medically necessary?

28. Do you feel that the current pre-hospital emergency medical transport system in Story County is adequately meeting the needs of the communities you serve?

Yes

No

29. What improvements to Story County's current pre-hospital emergency medical transport system would you like to see in order to better serve the communities you respond to? Please be specific.

# Appendix E

## Comparable County EMA Coordinator Survey

1. Please select your County?

2. How many 911 Dispatch Centers do you have in your County?

3. How many non-transport Emergency Medical Service agencies do you have in your County?

4. How many Emergency Medical Service Transport agencies do you have in your County?

5. Do you feel that the current emergency medical transport system in your County is adequately meeting the needs of the customers you serve?

Yes

No

6. What improvements to your County's current emergency medical transport system would you like to see to better meet the needs of the customers you serve? Please be specific.

# Appendix F

## Comparable County Dispatch Center Survey

1. Please select your organizations County?

2. Do all of the dispatches for Fire & EMS incidents in your County come from one 911 Dispatch Center within your County?

Yes

No

3. Do you use Emergency Medical Dispatching (EMD)?

Yes

No

4. What EMD * program do you use?

5. What percentage of medical incidents that you dispatched in 2013 were ALS?

6. What percentage of medical incidents that you dispatched in 2013 were BLS?

7. What percentage of medical incidents that you dispatched in 2014 were ALS?

8. What percentage of medical incidents that you dispatched in 2014 were BLS?

9. What percentage of medical incidents that you dispatched in 2015 were ALS?

10. What percentage of medical incidents that you dispatched in 2015 were BLS?

11. In 2013, how many times were no ambulances available in your County and you had to dispatch an ambulance from a neighboring County?

12. In 2014, how many times were no ambulances available in your County and you had to dispatch an ambulance from a neighboring County?

13. In 2015, how many times were no ambulances available in your County and you had to dispatch an ambulance from a neighboring County?

14. Do you feel that the current emergency medical transport system in your County is adequately meeting the needs of the customers you serve?

Yes

No

15. What improvements to your County's current emergency medical transport system would you like to see to better meet the needs of the customers you serve? Please be specific.

# Appendix G

## Comparable County First Responder Survey

1. Please select your organization's County?

2. Does your city have emergency medical service/responders (First Responders, EMTs, etc.) specifically for your community?

Yes

No

3. How many non-transport emergency medical service agencies do you have in your County?

4. How many emergency medical transport (ambulance) service providers do you have in your County?

5. What is the name of your emergency medical service?

6. What is your agency's current service level?

Emergency Medical Responder (EMR)

Emergency Medical Technician (EMT)

Advanced Emergency Medical Technician (AEMT)

Paramedic

Other (please specify)

7. How many emergency medical responders does your agency have?

8. How many emergency medical incidents did your agency respond to in 2013?

9. What was your average response time (time from dispatched to on scene) for those incidents in 2013?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't know

10. What was the average response time for an emergency medical transport ambulance to those incidents in 2013?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

11. In 2013, how many times was the primary ambulance transport service for your response area not available during an incident and you had to have a different ambulance service respond?

12. What was the average response time for the other ambulance service to respond (time from original dispatch of incident to on-scene) when your primary ambulance transport service was not available in 2013?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

13. How many emergency medical incidents did your agency respond to in 2014?

14. What was your average response time (time from dispatched to on scene) for those incidents in 2014?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

15. What was the average response time for an emergency medical transport ambulance to those incidents in 2014?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

16. In 2014, how many times was the primary ambulance transport service for your response area not available during an incident and you had to have a different ambulance service respond?

17. What was the average response time for the other ambulance service to respond (time from original dispatch of incident to on-scene) when your primary ambulance transport service was not available in 2014?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

18. How many emergency medical incidents did your agency respond to in 2015?

19. What was your average response time (time from dispatched to on scene) for those incidents in 2015?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

20. What was the average response time for an emergency medical transport ambulance to those incidents in 2015?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

21. In 2015, how many times was the primary ambulance transport service for your response area not available during an incident and you had to have a different ambulance service respond?

22. What was the average response time for the other ambulance service to respond (time from original dispatch of incident to on-scene) when your primary ambulance transport service was not available in 2015?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

Don't Know

23. Thinking back over the last 3 years, in your professional opinion were any of your patient's condition compromised in any way by extended wait times for a transporting ambulance?

Yes

No

24. How many times over the last 3 years (2013 - 2015) were a patient's conditions compromised in any way by extended wait times for a transporting ambulance?

Never - Almost Never - Sometimes - Fairly Often - Very Often - Always

Minor (inconvenienced with longer pain and discomfort times but condition is easily reversible)

Moderate (recovery time greatly increased due to delayed transport)

Severe (long term complications due to delayed transport)

25. Of those times, to what degree were patient's conditions compromised?

26. When an ambulance transports a patient from your incident, what percentage of the time do you provide a driver or an attendant for the ambulance service?

27. What do you consider an acceptable response time (time from dispatched to on scene) for an emergency medical transport ambulance to your city?

0 – 5 Minutes

5 – 10 Minutes

10 – 15 Minutes

15 – 20 Minutes

20 – 25 Minutes

25 – 30 Minutes

30 + Minutes

28. Does your organization have its own emergency medical transport ambulance?

Yes

No

29. Do you feel that the current emergency medical transport system in your County is adequately meeting your needs as an emergency medical service?

Yes

No

30. What improvements to your County's current emergency medical transport system would you like to see to better meet your service's needs? Please be specific.

# Appendix H

## Comparable County Transport Agency Survey

1. Please select your organization's County?

2. What is the name of your organization?

3. What part of your County do you consider your primary response or first due coverage area?

Whole County

Specific areas of the County

Specific Cities

4. What level of service do you provide?

ALS

BLS

ALS when staffing allows, otherwise BLS

5. How many total ambulances do you have in your fleet?

6. How do you staff your ambulance(s)? Please select all that apply.

Career Staff

Paid On Call Staff

Volunteer Staff

Other (please specify)

7. On average, how many ambulances do you have staffed during the week and during what times? Staffed would include career, paid on call and volunteer. (Example: 1 Sunday-Thursday 0700 to 1700 and 2 Friday-Saturday 0700 to 0700.)

8. How many total incidents did your service respond to in 2013?

9. Of those incident, what percentage were ALS incidents?

10. What percentage were BLS incidents?

11. What percentage resulted in no patient(s) being transported due to either a patient refusal, or no patient on scene?

12. How many total incidents did your service respond to in 2014?

13. Of those incident, what percentage were ALS incidents?

14. What percentage were BLS incidents?

15. What percentage resulted in no patient(s) being transported due to either a patient refusal, or no patient on scene?

16. How many total incidents did your service respond to in 2015?

17. Of those incident, what percentage were ALS incidents?

18. What percentage were BLS incidents?

19. What percentage resulted in no patient(s) being transported due to either a patient refusal, or no patient on scene?

20. Do you provide ambulance services, not including inter-facility transports, to other communities outside of your County?

Yes

No

21. Do you provide inter-facility transfers to the following locations? Please select all that apply.

Inside Your County

Outside Your County

Outside the State of Iowa

We do not provide inter-facility transfers

22. On average, what percentage of your service's total call volume is made up by inter-facility transfers?

23. On average, what percentage of your service's time is spent doing inter-facility transfers?

24. What percentage of your inter-facility transfers are medically necessary?

25. Do you feel that the current pre-hospital emergency medical transport system in your County is adequately meeting the needs of the communities you serve?

Yes

No

26. What improvements to your County's current pre-hospital emergency medical transport system would you like to see in order to better serve the communities you respond to? Please be specific.