

EBOLA IN WEST TEXAS:

A survey of West Texas hospital preparedness
and a look into the social implications of Ebola infection

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ABSTRACT

Ebola is a rare yet deadly virus that has recently come to the United States¹ and has ties to West Texas. While it is not highly contagious because of its means of transmission,¹ if an outbreak were to occur it has the potential to run rampant in community health care settings. Society is poorly educated about this disease, causing widespread fear that translates into major social and possible economic implications. While there are biocontainment facilities around the United States, their capacity is limited² and it is predicted smaller towns do not have the equipment to support an Ebola epidemic. The aim of this thesis is to examine the preparedness of West Texas hospitals to handle cases of Ebola, and to explore the social implications that come along with this disease, including the discrimination against people from West Africa and stigmatization of those with or recovering from the disease.

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INTRODUCTION

Since Ebola was first recognized in 1976, more than twenty outbreaks have occurred in Africa.³ The most recent outbreak began in December 2013, but the first cases were not detected until March 2014. This was the largest Ebola outbreak ever recorded and caused extensive health and social issues for those living in the infected areas of West Africa.³ During the outbreak, the mortality rate was about 55% with 1603 confirmed cases and 887 deaths by August 2014.³ There was substantial concern that the disease could spread beyond the epidemic in West Africa due to air travel.³ This concern became a reality when the United States index case occurred in October 2014, causing widespread anxiety. Americans were ignorant of the fact that such a foreign disease could come to our country, and simply were not prepared. Six total American patients were diagnosed with Ebola as of October 6, 2014, and they were all infected in Africa.⁴ The majority of them were transported to the United States for treatment before the index case of Mr. Thomas Eric Duncan. Mr. Duncan was the first patient treated in the United States in which the hospital treating him had no advance notice of his diagnosis.⁵ Three patients including the index case, Mr. Duncan, and nurses who cared for him, Nina Pham and Amber Vinson, were diagnosed in the United States, making the number of American patients diagnosed with Ebola rise to 8 (not including Mr. Duncan since he is not American).⁴ Eight total patients were treated in the United States, with a total of nine patients affecting the United States. One American patient died in Nigeria before he could be transported to the United States for treatment.⁴ The spread of Ebola in the

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United States after Mr. Duncan's case is due in part to inadequate preparedness and lack of awareness of such a rare disease in our industrialized nation.

Two of the Ebola patients had ties to West Texas, Mr. Thomas Eric Duncan (index case) and Dr. Kent Brantley. Mr. Duncan's case sparked the fear of Ebola in the United States due to his misdiagnosis, the fact that he infected healthcare workers, and the fatal outcome of his disease. Mr. Duncan spent five hours in the Emergency Room of a Dallas hospital before he was discharged with a 103° fever.⁶ The nurses did not obtain his travel history even though he complained of abdominal pain, dizziness, nausea, and headaches, all of which are known symptoms of Ebola. The nurse also did not let the physician know about Mr. Duncan's recent visit to Africa once she found out.⁶ These missteps led to Mr. Duncan being diagnosed with sinusitis and abdominal pain, delaying the diagnosis until a few days later when it was too late.⁶ Nina Pham, one of the two health care workers infected while treating Mr. Duncan, stated the hospital's lack of training and proper equipment were a main reason she was infected. She also stated that the hospital failed to develop policies and train its staff for treating Ebola patients.⁷ Overall, this outbreak in the United States occurred as a result of the outbreak over in West Africa. The index case and individuals such as Dr. Kent Brantley were infected in Africa and brought the disease back to the United States. Although these patients coming to the United States was essentially out of anyone's control, the outbreak caused by the index case could have potentially been prevented if proper protocols were in place and were followed.

Ebola is a rare, yet highly infectious and deadly virus that can infect both primates and humans. It is a pathogen of viral hemorrhagic fever that causes high death rates. The high

fatality rate along with the fact that there is no efficient treatment makes Ebola "...an important public health pathogen and biothreat pathogen of category A".⁸ The Ebola virus referred to in this paper is the Ebola virus (EBOV), which is one of the five virus species in the genus *Ebolavirus*.³ Ebola is a part of the family *Filoviridae* in the order of Mononegavirales.⁹ Because of its placement in this family, Ebola is in the group of Filoviruses, which are "...enveloped, non-segmented, negative-stranded RNA viruses of varying morphology. These viruses have characteristic filamentous particles that give the virus family its name. Ebola virus particles have a uniform diameter of 80 nm but can greatly vary in length, with lengths up to 14 000 nm."⁸ The virus' genome consists of a single linear strand of RNA that is about 19,000 bases long and contains only seven genes. A protein on the virus called VP35 helps to shut down the innate immune system by binding to and inactivating proteins in the immune response. It also blocks the branch of the innate immune system that would allow the virus to be recognized.⁹ The only genetic material that can be duplicated by the enzymes carried by cells is DNA, but RNA encodes Ebola's genome. Because of this, the virus encodes a protein that can copy RNA into RNA, rather than DNA. Every copy of the virus has a working polymerase protein packed inside in order to copy the viral genome into messenger RNAs that are then translated into proteins by the infected cells.⁹

Ebola is a virus associated with viral hemorrhagic fever outbreaks, mainly in Africa. Although outbreaks are relatively rare, localized, and small, this disease, along with the other disease that constitutes the family *Filoviridae*, Marburg, creates fear and media attention due to fatality rates that can be as much as 90%.¹⁰ There is also concern over their potential use

as bioweapons.¹⁰ Overall, Ebola's pathogenesis is not well understood;³ however, studies have shown that the Ebola virus replicates in monocytes, macrophages, and dendritic cells and may be found in endothelial cells, fibroblasts, hepatocytes, and adrenal cells.³ The virus can spread to various organs, including the lymph nodes, liver, and spleen. There is little inflammatory response involved with the infection, however lymphopenia seems to be a marker of prognosis.³ In addition, changes to the inflammatory response and coagulation cascade can result in hemorrhage and multi-organ failure.³ While these findings indicate that part of Ebola's pathogenesis is due to its effect on the immune system, other details of its pathogenesis are still not well delineated.

This disease is most commonly found in Africa, where it was discovered in 1976. It was discovered near the Ebola River, which is in the Democratic Republic of Congo². According to the Centers for Disease Control and Prevention (CDC), symptoms of this rare disease include fever, headache, muscle pain, weakness, fatigue, diarrhea, vomiting, abdominal pain and unexplained bleeding or bruising. According to Vanessa and Matthias, "Hemorrhagic symptoms such as epistaxis, petechiae, bleeding from mucous membranes, and internal bleeding may later develop."¹⁰ If one is thought to have been exposed to Ebola, the person must be monitored for three weeks because it can take anywhere from 2 to 21 days for symptoms to appear.¹¹ It is often difficult to immediately diagnose Ebola, because its symptoms are very similar to those of other, more common diseases. Contrary to popular belief, Ebola is not airborne. It is transmitted through direct contact with bodily fluids of someone who is infected. This includes feces, saliva, sweat, urine, vomit, semen, skin swabs, tears and breast milk.¹² The virus can infect another person if any of the secretions enter

broken skin or mucous membranes or through needle sticks and contact with objects that have been infected by an Ebola patient, making the disease highly infectious. Ebola was actually named first on the Planet Deadly list of top 10 most infectious diseases, beating out cholera, tuberculosis, anthrax, small pox, and MRSA.¹³ It has also been discovered that the virus can stay in both vaginal fluids and semen after the patient has recovered. Therefore, those who have been infected are advised to abstain from sex for at least three months after recovery.¹⁴ In Africa, another source of transmission includes handling infected animals, especially bush meat or infected bats.¹⁴

The treatment for this disease has remained relatively unchanged since the 1950s, although research has been done to make breakthroughs in this area. No vaccine or antiviral drug has been proved to be useful in nonhuman primates after the emergence of symptoms. According to del Rio et al., “Recent studies have shown promise for a combination of monoclonal antibodies and for a small interfering RNA compound (BCX4430) as a post exposure prophylaxis in nonhuman primates. Use of plasma from patients who have recovered from infection and recombinant human protein C have also been tried but have been reported to be unsuccessful.”³ The rarity and infectious nature of Ebola make biocontainment centers necessary for care and proper recovery, and also to ensure the disease does not spread. These units are much more prepared for the challenges of this disease in comparison to a community hospital because of their vast resources, technology and highly trained staff.

The Ebola virus caused quite a scare in the United States in the eighteen months following the diagnosis of the index case, due in part to the inadequate education of the

general public about the virus. It is highly unlikely that Ebola would create an epidemic in the United States because of its means of transmission and the constant advancements in our medical technologies. However, Ebola is such a rare virus that when it did strike the United States, it sparked great concern. While it is unlikely to cause mass problems, the potential is still there. If an outbreak of Ebola were to happen, the disease can spread very quickly in community healthcare settings, especially in rural areas where technology and resources cannot compare to those of urban areas. Therefore, with the 2014 outbreak, West Texas had a reason to feel uncomfortable because this virus struck too close to home. Two of the cases during the most recent outbreak had ties to West Texas. So while it is improbable, if this virus had been able to make its way back to West Texas through these two patients, an epidemic could have run rampant in the rural hospitals of West Texas. The aim of this thesis is to examine the preparedness of West Texas hospitals to handle one or multiple cases of Ebola, and to explore the social implications that come along with this disease, including the discrimination against people from West Africa and stigmatization of those with or recovering from the disease.

What is needed to treat an Ebola patient?

Because of the highly infectious nature of Ebola, protocols to follow with a possible Ebola patient are extensive. There has been a major emphasis on planning and in specifying protocols to help protect the well-being of healthcare workers who potentially could be exposed to a patient with Ebola, while also preventing the spread of the disease in hospitals and other health care settings.¹² The CDC has suggested that any patients with potential Ebola should be isolated immediately, in a single patient room with droplet and contact

precautions. Current recommended personal protective equipment (PPE) includes a full-face shield, a fluid resistant or impermeable gown, double examination gloves, impermeable boot covers, and apron¹⁵, which is more strict than suggested protocols before the October 2014 outbreak.¹⁶ If intubation or a bronchoscopy is to be performed, the CDC recommends wearing an “N95 mask and placing the patient in a negative pressure room.”¹² The CDC recommends that all healthcare personnel from doctors and nurses, to assistants, laboratory personnel, and even people not in patient care (i.e. maintenance, housekeeping, etc.) be aware of the precautions recommended for preventing Ebola transmission in United States hospitals. This includes isolating the patient in a room where there is appropriate and consistent use of PPE and maintaining a log which tracks all people who have entered the room. In addition, disposable medical equipment is advised for treatment of an Ebola patient. If the equipment is non-disposable and non-dedicated to the specific patient, it should be cleaned and disinfected according to hospital policies. In addition, limited use of needles is recommended, but if needed, they should be handled with extreme care and placed in puncture-proof and sealed containers.¹⁷ Other precautions that are stressed include hand hygiene, environmental infection control, safe injection practices, and monitoring/management of potentially exposed personnel.¹⁷ PPE is an essential part of the Ebola prevention protocol. Before anyone can work with an Ebola patient, they must have completed repeated training and demonstrate that they understand proper procedures for putting on (donning) and removing (doffing) PPE.¹⁵ It is important that no skin is exposed and that the donning and doffing procedures are observed by an onsite manager, whose main purpose is to oversee the implementation of precautionary protocols for those in a healthcare

setting. Once put on, the PPE should not be modified or adjusted while in the patient's area.¹⁵ To remove the PPE, it is important that the utmost precautions are taken, since it is possible that the PPE is infected by bodily fluids of the Ebola patient. It must be removed slowly and deliberately with oversight by a trained observer whose responsibility is to read out the step-by-step procedure of donning and doffing of the PPE. This observer also wears recommended PPE during the observation of the donning and doffing. This includes an impermeable gown, a full-face shield, two pairs of examination gloves, and impermeable shoe covers.¹⁵ It is also of the utmost importance that a donning and doffing area is designated in the health care facility, along with appropriate signs indicating the given area along with signs and warning on the patient's room.¹⁵

The CDC has developed a strategy to help hospitals be ready to provide different levels of care to a patient with possible Ebola. There are three "categories" of hospital settings. The first is a frontline healthcare facility. This facility would quickly identify and isolate a patient if they are thought to have Ebola, then notify infection control personnel at that location as well as state and local health officials. This facility only has enough personal protection equipment for up to one day of care, with a limited amount of health care professionals caring for this single patient. Because of this, they usually are going to prepare the patient for transfer to an Ebola assessment hospital.¹⁸ Here, the patient with possible Ebola remains isolated and receives immediate laboratory evaluation and testing for Ebola. This facility has enough Ebola PPE for up to 5 days of care, so after this amount of time, the patient would need to be transported to an Ebola Treatment Center; these facilities amount to a scarce four locations across the United States.¹⁸ At this treatment center, the patient would

be isolated in a biocontainment room. Here the patient will be cared for, for the remainder of their illness. While these locations only have enough PPE for a week of care, there is a staffing plan in place so several weeks of care is manageable. Here, the CDC Ebola Response Teams are ready to provide assistance if it is needed. Although each of the biocontainment locations differ slightly in their readiness and treatment levels for the patient, all facilities are required to have staff that have been trained in the use and safety practices of PPE, systems that allow safe disposal of Ebola wastes and cleaning/disinfection, and strict adherence to infection control protocols.¹⁸ These biocontainment facilities were created to prevent the spread of both highly infectious and highly contagious diseases.

Ebola is classified as a Category A infectious substance which is defined as “An infectious substance which is transported in a form that, when exposure to it occurs, is capable of causing permanent disability, life-threatening or fatal disease in otherwise healthy humans or animals.”¹⁹ Ebola is highly infectious because only a few viral particles (1-10) are needed to infect an individual.²⁰ For example, once a patient has developed symptoms of Ebola only one drop of bodily fluids can have as many as 500,000 viral particles in it.²⁰ To compare the infectious nature of Ebola, 55 particles of Norovirus are needed for infection, 1000 for *Streptococcus*, and for *E.coli* to be infectious billions of particles are needed.²⁰ While Ebola is highly infectious, it is not considered highly contagious due to its means of transmission. A person only becomes contagious once they begin showing symptoms.²¹ Simply being in the presence of a person with Ebola cannot infect you. The disease is not easy to get when compared to an infectious and contagious disease like measles. An individual must come in contact with the virus via bodily fluids, not

just mere contact, which may be why Ebola travels through a population about nine times slower than the measles.²¹ Epidemiologists have calculated a reproduction number to estimate the number of individuals who contract a disease from an infected and contagious individual, denoted R_0 . Ebola has a relatively low R_0 ²¹, falling in the range of 1.5 to 2. In contrast, a disease like measles has an R_0 of 18 and HIV has an R_0 of 4.²¹ This means that if an individual is infectious, they could pass the disease on to 18 and 4 people, respectively. The variable of R_0 is based on many different factors such as how long the individual with the disease is contagious and how many particles of the virus is required to infect someone (this variable determines how infectious a virus is), along with several other factors.²¹ Ebola, although highly infectious, is not highly contagious and is controllable with the appropriate responses from health care professionals.²⁰

The biocontainment facilities have the best equipment, protocols and highly trained personnel to help prevent the spread of disease that normal hospitals would not be prepared for. The four biocontainment hospitals in the United States include the National Institutes of Health in Bethesda, Maryland, Emory University Hospital in Atlanta, Georgia, University of Nebraska Medical Center in Omaha, Nebraska, and the Saint Patrick Hospital in Missoula, Montana.²² Several features make these facilities the best to treat diseases such as Ebola. First, they utilize negative pressure rooms where clean air enters the patient's room, but air with possible infected particles cannot get out to the rest of the hospital. There are also closed-circuit video cameras so the patient can be closely monitored, and glass windows and intercom connections allow healthcare personnel to interact with the patient without PPE.²² Emory Hospital, where some of the 2014 U.S. Ebola patients went, has taken special

precautions to ensure safe disposal of wastes by first sanitizing with pressurized steam then incinerating it. Liquid waste is treated with bleach or detergent. The University of Nebraska Medical Center biocontainment unit has “biopods” or “isopods” that are basically giant bubbles that stay inflated thanks to negative air pressure.²² This allows patients to leave their rooms safely. They also have a sanitation system in which equipment leaving the unit is sanitized and sterilized with high-pressure steam.²² All of the biocontainment facilities are also in close proximity to a Biosafety level 3 or 4 laboratory where specimens from infected patients can be researched.²² While these four hospitals are ready to treat highly infectious and contagious diseases alike, combined these facilities can only handle less than a dozen Ebola patients at a time,²³ which suggests that not only West Texas, but the United States as a whole would not be ready for an Ebola epidemic. Taylor Wilson, who is a spokesperson for the Nebraska Medical Center in Omaha says that “With Ebola, it is pretty labor intensive. A lot of waste is created; a lot of equipment has to be in the patient room so that number [of patients that can be treated at this facility] goes down quite a bit.”²³

Because of the unfavorable outcomes of the case of Mr. Thomas Eric Duncan in Dallas including his death as well as person-to-person transmission, there is a push to rely on the biocontainment facilities.²³ Some experts say that all Ebola patients should be treated only in a biocontainment facility rather than in a community hospital like Mr. Duncan was.²⁴ Dr. Alexander Garza, the Associate Dean and Professor in Epidemiology at Saint Louis University, agrees with this idea, for the following reasons: hospitals are poorly prepared to take care of a patient with a disease such as Ebola; community healthcare resources would be rapidly depleted with the treatment of an Ebola patient; and treatment in a biocontainment

center will lower the risk for community health care workers.²⁴ Although the person-to-person transmission of Ebola in Dallas was due to extensive contact with Mr. Duncan when he had excessive production of bodily fluids such as vomit and diarrhea, the CDC tightened its previous protocols and guidance for infection control following the outbreak, with the main change being training and education. The new guidance is centered on three main ideas: “All healthcare workers undergo rigorous training and are practiced and competent with PPE, including putting it on and taking it off in a systematic manner. No skin exposure when PPE is worn and all workers are supervised by a trained monitor who watches each worker putting PPE on and taking it off.”²⁵

Handling of Ebola specimens

When the diagnosis is suspected, reverse transcriptase polymerase chain reaction and antigen detection by enzyme-linked immunosorbent assay are the most useful tests.³ The Ebola virus can be detected in the blood in as few as 3 days after symptoms. Ideally, a specimen should be taken from a possible Ebola patient as soon as they report to a healthcare setting (staff who collect these specimens should wear PPE discussed earlier). If the result comes up negative and the symptoms have not been apparent for at least 3 days, a later test might need to be performed. The virus can be diagnosed using real time PCR and FDA approved Emergency Use Only assay to detect the virus.²⁶ Ebola specimens to be shipped to the CDC should be shipped at 2-8° Celsius on cold-packs that are not in glass containers. They should be in a durable, leak proof secondary container.²⁶ Presumptive testing for the Ebola virus is available at over 50 laboratories in the United States, but a positive result must

be confirmed through the CDC so further decisions about the treatment and/or transport of the patient can be discussed.²⁶

The CDC created a four tier system of classifying laboratories based on levels of containment present when working with certain pathogenic agents, with Biosafety level 4 laboratories being the highest level where work with life threatening infectious diseases, especially those without a vaccine, is done.²⁷ A clinical specimen of Ebola must be handled in a Containment Level 2 laboratory, but no virus culture should be attempted outside of a Biosafety Level 4 (BSL 4) laboratory.²⁸ Biosafety Level 2 (BSL 2) is suitable to perform work that involves agents that have moderate risks and hazards for personnel and the environment, and laboratory personnel must have specific training in handling infectious agents and the procedures to be followed.²⁹ Researchers in BSL-4 laboratories are required to wear protective equipment which entails a full body suit that has air-supplied positive pressure and to undergo extensive training in protocols and handling of these infectious specimens.²⁷ The National Emerging Infectious Diseases Laboratories is a national network that includes secured facilities that do research on infectious diseases. In this network, there are 11 BSL-4 laboratories, with three of them being in Texas. Galveston has two locations while San Antonio has one.²⁷

There are two models of BSL-4 laboratories, a cabinet laboratory and a suit laboratory, with each having a special design to prevent the infectious agents from getting out into the environment. The cabinet laboratory is one in which all interactions with the pathogens must be performed in the Class III biological safety cabinet. Both the BSL-4 suit laboratory and the Class III biological safety cabinet have the highest level of containment

for the given work space where all personnel dealing with the infectious materials wear a positive pressure air protective suit.²⁷ Many rules in these laboratories are standard across laboratories at any level: no eating, drinking, smoking in the lab, or applying makeup. Protocols are in place for what to do if glassware is broken or if there is a spill, and decontamination of work surfaces is stressed. As for the Ebola-associated waste disposal, the exact protocols are not concrete. The CDC recommends that the hospital where the waste accumulated needs to adhere to state and local regulations and is subject to requirements of the Hazardous Materials Regulations until the waste is no longer considered to be hazardous or a threat.³⁰

When dealing with Ebola blood cultures, it is recommended that these be prepared in a closed system, and any handling of Ebola is not done on an open bench.²⁸ When separating samples from Ebola patients, it must be done in a sealed centrifuge in a certified workspace and the laboratory must keep a log including who has handled, decontaminated or transported the Ebola specimens.²⁸ Overall, many precautions must to be taken into consideration when handling an Ebola specimen. Rigorous protocols and training are involved in the disposal, transportation, and handling of possible Ebola specimens.

Why this survey in West Texas?

Knowing of the vast resources, education, and medical personnel needed to treat a patient with Ebola, West Texas residents may be a little skeptical of the preparedness of this rural area to care for a patient with an infectious disease of this caliber. Some may be unaware of the fact that a rare disease like Ebola could make its way to West Texas, but with

the outbreak in October 2014, this disease seemed too close for comfort. Thomas Eric Duncan, the first case diagnosed in Dallas, had a son who plays football at Angelo State University. His son, Karsiah Duncan, went to visit his dad, but Dr. Brian May, the President of Angelo State University asked him to stay in Dallas for two weeks, while people from the CDC also quarantined Karsiah Duncan and his family for 21 days.⁶ What if he had come into contact with his father and come back to school at Angelo State, in close contact with his classmates, roommate, and teammates? Could the Ebola virus have been brought back to rural San Angelo? Another tie to West Texas is patient, Dr. Kent Brantley, who too was infected with the Ebola virus. He is an Abilene Christian University alumnus with family in West Texas. With these ties to the Ebola outbreak, it seemed probable that this disease could come to a rural West Texas hospital with limited resources to care for a disease of this magnitude. Based on the literature review of resources and protocols needed to treat an Ebola patient, I hypothesized that rural West Texas hospitals would be unprepared to treat a disease of this magnitude.

The goals of this study were as follows:

1. To examine the preparedness of West Texas hospitals to diagnose and treat an Ebola patient, based on implementation of recommendations and protocols for the handling of a patient with Ebola and specimens of the virus.
2. To understand the general social implications and reactions to the 2014 Ebola scare.

METHODS

A background literature review was conducted in which the investigator researched information about the Ebola virus along with protocols and precautions that would need to be followed with a suspected Ebola patient. From the information obtained from the literature, pertinent questions were developed to best assess health care facilities preparedness. Once these questions were generated, a survey was designed and created (Fig. 1) based on the literature review. The questionnaire was intended to interview the preparedness of 15 hospitals in prominent towns and cities within a 100-mile radius of San Angelo, Texas by speaking with their chief nursing officers. These hospitals were chosen, as they represent nearly all of the hospitals within the given radius of San Angelo. In addition, these were the 15 most established health care facilities in the area.

The survey assesses changes implemented after the Ebola scare in October 2014, as well as precautions and protocols for an Ebola patient in these rural health care facilities and the overall preparedness of these hospitals to house an Ebola patient. The survey was conducted via phone call with given health care facilities' chief nursing officer. People in this position were chosen to interview because the position is consistent among all hospitals. Not all small rural hospitals have an infection control officer, but they do have chief nursing officers. It was assumed that those in this position underwent the same training and hold comparable positions at their given facilities. In addition, it was expected that those in this position would be easier to get in contact with and would have knowledge of the preparedness in regards to what we were surveying at each facility. Each hospital was contacted a total of five times, if they did not respond initially. Another literature search was

conducted via the Angelo State University online library database, RAMCAT³¹, using the keywords Ebola, preparedness, public health and Texas to assess the social implications and public health aspects that this outbreak placed on our society not only in West Texas, but also throughout the U.S. and other nations. Finally, three separate interviews were conducted to get an inside look at social implications, preparedness and protocols, and what it was like to experience the October 2014 Ebola scare firsthand. Chris Washington, Strategic National Stockpile Coordinator in Dallas, who previously was an Emergency Health Coordinator, was interviewed. He works for the Department of State Health Services. He was interviewed to provide insight about what happened at the state level with the October 2014 scare and to receive more of an unbiased view of how prepared the hospitals of West Texas would be in comparison to the biocontainment facilities. The second interview was with Karsiah Duncan, son of Ebola patient Mr. Thomas Eric Duncan, who experienced the chaos when Ebola came to America and directly affected his family. The third interview was conducted with Dr. Brian May, president of Angelo State University, to get a better idea of the social implications and stigmas a disease like Ebola can place not only on the people, but a community and a university.

RESULTS

Results from West Texas Hospitals regarding preparedness for an Ebola outbreak

The questionnaire sent to the various health care facilities was created by compiling pertinent questions that assess preparedness, based on recommendations found through the initial literature review (Fig 1). After reaching out via phone call to the various hospitals at

least five times if no response was received initially, a response to the questionnaire was obtained from 8 of the 15 hospitals (See appendix A). The questionnaire was standard amongst all of the hospitals, while also allowing for separate and additional commentary from some of the sources (Table 1). The average preparedness the hospitals reported for their ability to receive a patient with the Ebola virus was 3.8 on a scale of 0 to 5 and the adequacy of PPE at their health care facility was 4.375. The overall global preparedness of the eight hospitals was reported as a 4. The extent to which protocols changed after the outbreak in October 2014 was 4.375. The standard deviation for the values obtained was relatively similar with the exception of the response about having an adequate amount of PPE on hand and persons on staff as an infection preventionist (Table 1).

<p>1. Please answer the following questions on a scale of 0 to 5, with 0 being not prepared at all, to 5 being extremely prepared.</p> <ul style="list-style-type: none">○ How prepared is your facility to receive a patient with the Ebola virus?○ Do you have an adequate amount of PPE on hand?○ What PPE do you have and how many sets of each?○ Amount of infection tracking/monitoring technology○ Persons on staff as an infection preventionist○ Global assessment of preparedness <p>2. Please answer the following questions on a scale of 0 to 5, with 0 being no change, to 5 being massive changes.</p> <ul style="list-style-type: none">○ Extent to which protocols changed with the outbreak in the October 2014?○ What training related to Ebola PPE have physicians, nurses, and other staff received and has this training changed following the events in October 2014? <p>3. Please answer the following questions on a scale of 0 to 5, with 0 being not strict, to 5 being extremely strict.</p> <ul style="list-style-type: none">○ Would you consider the protocol to dispose of materials that the Ebola patient contaminated or the decontamination of the area they were in to be intensive and strict?○ Who decontaminates the area and what PPE do they wear? <p>4. What course of action would be taken if you did in fact have a patient come in with Ebola? How/ where would you transport them?</p>

Figure 1. Questionnaire used to interview the hospitals.

Table 1. Data from the questionnaire from the 8 hospitals who responded.

Question	Average Response	Highest Response	Lowest Response	Standard Deviation
How prepared is your facility to receive a patient with the Ebola virus?	3.8	5.0	3.0	0.65
Do you have an adequate amount of PPE on hand?	4.375	5.0	1.0	1.41
Amount of infection tracking/monitoring technology (7)*	3.625	5.0	3.0	0.95
Persons on staff as an infection preventionist (7)*	4.375	5.0	0.0	1.89
Global assessment of preparedness (7)*	4	5.0	3.0	0.58
Extent to which protocols changed with the outbreak in the October 2014 (7)*	4.375	5.0	3.0	0.90
Would you consider the protocol to dispose of materials that the Ebola patient contaminated or the decontamination of the area they were in to be intensive and strict?	4.75	5.0	4.0	0.49

**Indicates fewer than 8 hospitals answered this question. The number in parenthesis indicates how many hospitals answered the given question.*

Answers from the questionnaire and additional commentary

Changes implemented after the October 2014 outbreak were common among the eight hospitals contacted. All eight hospitals instituted an Ebola protocol that included coordination with local EMS. All of the health care facilities also implemented other training for staff that included, but was not limited to, drills and education about the disease. Seventy-five percent of the hospitals included training in donning and doffing of PPE, and 88% now have a questionnaire about travel history for incoming patients. Regarding the disposal and clean up of Ebola materials, 50% of the hospitals had a contract with a company who would come in to de-contaminate and sanitize the area where the Ebola patient was treated. Twelve and a half percent of the hospitals used housekeeping to clean up and the remaining 37.5% utilized the fire department for clean up. Regardless of the people who came in to decontaminate the area, 100% of the hospitals required whoever was cleaning up after the Ebola patient to wear full PPE as described in the introduction to this study. Additionally, 100% of the hospitals would have to transfer their patient to a larger hospital for treatment.

Common course of action proposed by West Texas health care facilities

The course of action that would be taken by the rural health care facilities in West Texas is essentially the same, based on the follow-up discussion when performing the interview. They would house the patient in the Emergency Room in a separate room that is isolated to the best of the hospital's ability. The hospital personnel would then determine how they would safely transfer the patient based on protocols in place, which includes the donning and doffing of the appropriate PPE. For most of the hospitals, the patient would be

transported by ambulance or by helicopter to a larger, more equipped hospital within 24 hours. The rural health care facilities would either transport the patient to a larger hospital in West Texas that is in close proximity or to a hospital that is designated to treat infectious agents of this caliber (the four biocontainment facilities discussed earlier). The CDC would also be contacted as soon as the diagnosis is made to get their input on proper course of action. Once the patient has been transported, clean up would be essential to decontaminate the area infected by the Ebola patient. As seen in the results, the local fire department, a contracted company or the housekeeping department at the hospital would be responsible for cleanup.

Commentary from Chris Washington- A look into the outbreak from the state level

An interview was conducted with Mr. Chris Washington from the Department of State Health Services to provide an unbiased, state level perspective on West Texas Ebola preparedness.³² His office is in direct contact with all of the local hospitals, and these hospitals have a list of diseases that they must report to the region or state. If one of these diseases were reported, his office is responsible to immediately make sure proper procedures are in place and that unnecessary people are not exposed. The biggest responsibility his office has when faced with a reportable disease is to make sure the patient gets onto a plane to be shipped to a facility that can provide better care, while also working hand in hand with the CDC.

With the outbreak in October 2014, he noted the scare associated with the outbreak and that society was undoubtedly affected by the worry and panic of the situation. People

began to think that if someone were infected with the Ebola virus, others around them would inevitably be infected. Mr. Washington stated that Ebola really should not be feared in the United States unless it mutates to a form that is highly contagious and that could be passed through a cough, for example. False information and lack of education ran rampant through the general public with the October 2014 outbreak, contributing largely to the widespread fear. Mr. Washington and his colleagues attempted to correctly inform patients and the general public. Changes implemented after the outbreak included an Ebola grant for health care facilities that provided money to plan specifically for Ebola. It was a governmental grant used to plan and educate about high consequence diseases, which are those that can cause a high amount of deaths in a short period of time. State health officials also went out to each of the eleven regions where they held a conference to educate about these diseases. Experts came to talk and there were tabletop exercises simulating what a patient would go through and what would happen in the event these diseases came to local healthcare facilities.

If the events of 2014 were to happen today, Texas hospitals would definitely be more prepared, according to Mr. Washington. If at all possible, the patient would be immediately shipped to areas that are better equipped and have undergone specific training to treat diseases of this magnitude. Due to a lack of effective communication at the health care facility that was treating Mr. Thomas Eric Duncan, health care workers were infected. Health care facilities already knew prior to the October 2014 outbreak that a patient could have Ebola if they had recently been to West Africa and presented the proper symptoms. Donning and doffing was already a common practice. While health officials already had protocols in place to treat a disease like Ebola, Mr. Washington stated that the biggest change was

awareness and that communication is key when faced with a disease of the magnitude of Ebola. The country is now more aware because it is known that this disease can happen in America. However, when asked about his thoughts about the preparedness of rural West Texas to receive a patient with Ebola, he did not seem impressed with the results generated from the survey. He stated that none of them are actually prepared when compared on a global scale and to the specialized centers ready to receive patients with high consequence diseases. While Washington does believe that the mass training implemented helped with awareness and that individual hospitals may have done more on their own to be prepared, the hospitals are not equipped to treat an Ebola patient. He stated that there are only 4 to 5 locations in the United States that can adequately handle an Ebola patient.

Receiving a patient with Ebola affects a community health care facility greatly. It is a huge drain economically; it exposes the facilities to the virus and the stigma, and requires a great deal of manpower. It is also a significant social drain due to the negative stigmas and social media and media outlets that alter the stories and the realities of the disease. Overall, Ebola is a serious disease, but with proper health care, it should be restricted to the hospital setting and not spread to the general public. If it were to infect the general public, yes, it would be of great concern. But in October 2014, in Texas, the disease infected one person who came from West Africa (Mr. Thomas Eric Duncan) and only infected two others in the United States. This deadly disease only spread to Nina Pham and one other health care worker, Amber Vinson, through the index case in Texas. No matter what, in Mr. Washington's opinion, Ebola would not create an epidemic of the caliber evident in West Africa.³²

DISCUSSION

What are the social implications of Ebola?

The Ebola virus does not only affect those in the medical profession. The implications extend beyond the scope of a community health care setting or a biocontainment center. A virus of this caliber is categorized as a “viral hemorrhagic fever,” which is a category of diseases that have historically caught health care facilities off guard.³³ These outbreaks are usually fraught with misdiagnosis, patient morbidity, and the secondary infection of health care workers wearing various levels of PPE.³³ The outbreak of Ebola in the United States in October 2014 was accompanied by a series of errors in the diagnosis. Mr. Duncan, the index case in the United States, progressed from initial symptoms to explosive diarrhea and projectile vomiting in three days, prior to diagnosis. In his case, there was initial misdiagnosis, miscommunication, and a treatment delay.³³ If exposure to infected bodily fluids occurs, this could be problematic and infection could occur. However, the means of transmission of diseases of this category are often misunderstood. For Ebola, as discussed earlier, its means of transmission is via direct contact with bodily fluids of an infected person (i.e. someone who is actively showing the symptoms of this virus). Because of the lack of education about the disease, many Americans believe this is a highly contagious disease and that merely being in the presence of someone with Ebola guarantees you will contract the disease. This inadequate information and awareness about this disease can largely be attributed to social media, media outlets, and public figures, rather than receiving pertinent information from highly respected sources such as the World Health Organization or the Centers for Disease Control and Prevention. According to Carney and Weber, “The

consequence of poorly managed or inadequate public health intelligence can result in under-reliance on reputable sources of intelligence and over-reliance on less vetted sources of information like the internet, social media, talk radio, and cable news outlets. When CNN becomes a more trusted news source on a public health crisis than the Centers for Disease Control and Prevention, we have a major problem.”³⁴ This miseducation leads to major social implications that also have political and economic effects on society.

Major social implications of the disease surround the stigmatization of the Ebola virus. “The word [Ebola] is enough to cause worldwide fear and ignite heated political debate in the U.S.”³⁵ The stigma began in West Africa where the worst and largest Ebola outbreak to date began in December 2013 and was first detected in March 2014 when cases were recognized in southern Guinea. According to del Rio et al., “The challenge is unprecedented because these countries have some of the worst physician–patient ratios in West Africa (more than 86,000 patients per physician in Liberia and 45,000 patients per physician in Sierra Leone).”³ While the initial stigma of the disease was localized in West Africa, the airlifting of two patients to Emory University Hospital in Atlanta, Georgia, in October 2014 brought an unprecedented level of media attention to Ebola as well as concern for its potential spread in the U.S. population. This widespread fear was similar to the reaction to recent reports of Chikungunya diagnoses in U.S. citizens.⁷ In a poll in November 2014, “the U.S. public ranked Ebola as the third most urgent health problem facing the country--just below cost and access and higher than any other disease, including cancer or heart disease, which together account for nearly half of all U.S. deaths each year.”³⁶ A reason for this incredibly high concern and priority placed on the Ebola virus most likely stems from lack of understanding

or education about the disease, including its means of transmission, since 85% of those polled said they were likely to get Ebola if an infected person sneezed or coughed on them.³⁶ These thoughts are not entirely correct as Ebola has not been proven to be airborne. However, if someone projectile vomits, coughs, or sneezes directly onto another individual and these particles reach a person's mucous membranes or through an open cut or wound, the person is at risk. It is thought that the media played a crucial role in instilling fear and public concern during the 2014 outbreak by running many stories about Ebola.³⁶

This fear has created great concern in American society that has led to people from West Africa in the United States facing discrimination, even though only one of the thousands of Ebola casualties occurred in the United States. With Ebola coming to the United States, "African immigrants experienced stigma similar to communities stigmatized by the AIDS epidemic in the '80s... in the early stages of the Ebola virus outbreak in West Africa and amid sensationalized reports, we found a fear linked with African immigrants around spreading the disease in the U.S. Some of these populations felt like they had to hide their ethnicity in an effort to avoid the stigma."³⁷ Not only did those from West Africa and other Ebola affected regions of Africa feel like they had to hide their ethnicity here in the United States, but children were teased at school, and adults were the butt of jokes at work, resulting in stress and hardships for these populations.³⁶ The United States Justice Department had to go as far as to issue guidelines in December 2014 that were designed to help government workers avoid illegally discriminating against people because of the Ebola virus by advising against Ebola-related bullying or harassment of people who are from West Africa.³⁸ Some examples of Ebola discrimination include schools requiring children to stay home if they are

from Africa or African descent, even though public health officials had not issued a quarantine; schools putting teachers on leave after traveling to African countries that weren't even affected by the virus;³⁸ slurs against West Africans in neighborhoods and communities;³⁹ people avoiding people of West African descent; yelling discriminatory comments like "African, go back to Africa with your Ebola;"³⁹ or even college admissions offices, such as in Navarro, Texas, stopping accepting applications from any African students.⁴⁰ Those suffering from the disease in Africa have noted that people are afraid to come near them, or have anything to do with them for fear of catching the disease. They further claim that the "...stigma is worse than the fever."⁴⁰ Similar stigmas like those in Africa have surfaced in the United States, although on a lesser scale due to the smaller magnitude of the outbreak.

An interview with Karsiah Duncan, son of the index case Mr. Thomas Eric Duncan, exposed the immense social implications of the disease and is of particular relevance to West Texas as he is a student at Angelo State University. Karsiah stated that several newspapers were in contact with his family and the CDC was in heavy contact with the family after the diagnosis was reported. Karsiah said the publicity was out of control and they could not even get out of their house because of the chaos this diagnosis brought to America.⁴¹ Similarly, Dr. Brian May, President of Angelo State University, also dealt with the negative social stigmas of Ebola. Dr. May said that because Angelo State had a connection to Mr. Thomas Eric Duncan through his son, fear was generated through the media and he had to fight that. He perceived a temporary negative stigma towards the university because of the publicity of the scenario. Overall, Dr. May said the same challenges that he was faced with, the publicity,

media, and negative stigma, were the same challenges that faced the San Angelo community at that time. The fact that Mr. Duncan had a son at Angelo State was headline news all over the state and even the country. Dr. May also stated that the fear had people wanting to stop all airlines from leaving and entering the Dallas area. Although this was an unfortunate scenario, Dr. May stated that our country learned a lot from the outbreak. He believes that we are now more prepared for this disease because we learned how it is transmitted thanks to science, rather than just believing everything the media puts out, which was a contributor to the widespread fear and negative stigma. We also learned how to specifically treat the disease and proved that we can treat it. He believes the negative stigma that still lingers around the disease is because of the death of Mr. Duncan. The American people forget that infected persons survived this outbreak in October 2014. He believes we are now more adequately prepared and aware in West Texas and that the only thing we have to fear is fear itself.⁴²

However, this stigma extends beyond social implications. Ebola poses economic implications as well. Because of the social stigma, members of society oftentimes will alter their normal, everyday behaviors, such as staying home from work or school or canceling a trip, which has economic effects.⁴³ The fear of Ebola has the potential to hinder productivity because some children are being kept home from school because of the fear of contagion. Therefore, parents must then stay home from work, which could affect the level of workplace productivity.⁴³ The fear in October 2014 was also thought to have affected Wall Street as airline stocks dropped most likely due to fears of catching this disease. When people choose to not travel, the airline and tourism industries are affected. The World Bank estimated that

“the economic effect of Ebola in the hardest hit countries of Liberia, Guinea, and Sierra Leone, would be ‘catastrophic’ in a global economy that could impact American companies.”⁴³ While there are broad economic impacts, there are also direct costs that are associated with the disease, such as the cost of quarantine. With Mr. Thomas Eric Duncan’s case, as many as 177 people had to be quarantined and go through the 21-day watch period to make sure no one was infected with the virus. In all, it is estimated that this Ebola flare up cost Dallas County more than \$1 million.⁴⁴ This makes one wonder how hard hit the United States economy would be if an Ebola outbreak did in fact come to our soil.

When addressing Filovirus outbreaks, such as Ebola, the public must be aware that such outbreaks produce an enormous amount of fear, in part due to the fact that many communities are unfamiliar with the techniques used to manage them. According to Vanessa and Matthias, “Efforts to sensitize the community to control efforts and establish a trusting, respectful relationship between the community and outbreak control team are of paramount importance.”¹⁰ There is often misunderstanding, stigma, and distrust during outbreaks of this magnitude. It takes a community effort to confront a disease that comes with heavy implications such as Ebola. As Vanessa and Matthias show:

“To establish a trusting relationship with the community and facilitate the acceptance of control efforts, measures must be transparent and culturally sensitive... There is significant benefit to providing psychosocial support to patients, family members, and health workers... Involvement of community leaders can help mobilize persons to adopt measures to protect themselves, including acceptance of the isolation ward. Regular reports through media outlets are another possible route of social mobilization; however this reporting needs to be conducted in an organized, ethical manner, so that the media may aid rather than hinder outbreak management. It is always important to convey a message of hope rather than fear; filoviral disease is survivable and treatment likely improves the chance of survival.”¹⁰

So, is West Texas prepared?

Before this study, it was suspected that if Ebola were to come to West Texas through connections of Dr. Kent Brantley and Mr. Duncan, regional hospitals and clinics would be completely unprepared and this disease would have the potential to cause a serious outbreak. While the results were more promising than suspected, it would be erroneous to say that rural West Texas is completely prepared and equipped. The Thomas Eric Duncan case indicates that even urban hospitals were unprepared to treat Ebola before the October 2014 outbreak, seeing that a man died and other health care personnel on the case were also infected. However, Chris Washington's discussions of the reform of health care facilities after the outbreak offers hope for many health care settings in the United States. That raises the question, is West Texas now prepared? Evidence suggests that rural West Texas would not be adequately prepared to treat an Ebola patient, but would have enough resources to potentially house an Ebola patient until transfer to a better prepared facility equipped with isolated, negative flow rooms, Biosafety level 2 labs, and related equipment required to adequately treat an Ebola patient. Vast changes were implemented for the treatment of an Ebola patient after the outbreak in 2014, which included education, training, and overall awareness of the infectious disease. The overall, global assessment of preparedness that looks at the readiness of the West Texas hospitals compared to those in more developed areas was a 3.5 on a 5.0 scale, showing that rural West Texas is not up to par with those hospitals designated to treat and quarantine the infectious agents. West Texas' preparedness to receive a patient after the outbreak rated 3.8, which is better than anticipated. However, officials at three sites assessed their hospitals as a 3 and two of the eight officials reported that before the

outbreak of 2014 their hospital would rate 0 out of 5 in terms of preparedness to treat a patient with Ebola (this question was a late addition to the survey, asked to hospitals contacted later in the research). Obviously, the outbreak in 2014 resulted in the implementation of changes that were essential to the preparedness of West Texas, although the hospitals certainly do not measure up to hospitals such as Emory, who are ready and equipped to take on a patient with the Ebola virus.

Although this survey provides insight into the preparedness of rural West Texas health care facilities, the validity of this information is not entirely reliable. This was a small sample size, with only a little over half of the contacted hospitals actually completing the survey. Also, it was assumed that the chief nursing officers who did answer the survey knew what was needed for their respective hospitals to be classified as “prepared.” With any survey, there is always the possibility of bias, especially when discussing an infectious disease that has social implications and stigmas. There is no way to eliminate this from the survey, but one must be aware that this bias could skew results, most likely in the direction that portrays their hospitals as “more prepared”. While these results are from a small sample size and could include bias, the hospitals surveyed suggest that rural West Texas may in fact be prepared to handle an Ebola patient for a short amount of time before transfer. With the implementation of mass training following the October 2014 outbreak and the addition of necessary infection control officers along with maintaining adequate PPE on hand, the survey results seem promising for an area that was hypothesized to be ill prepared. The fact that the hospitals reported their preparedness to receive an Ebola patient as a 3.8 is more promising than was expected. However, one must note that this value is how they assess their health

care facility today, after the implementation of vast changes (4.375 reported as the extent of their changes after the Ebola October 2014 outbreak on the scale of 0 to 5). With these promising improvements in equipment and recognition, there is hope that missteps will no longer allow a patient to succumb to the fatal effects of Ebola, as Mr. Thomas Eric Duncan did, or allow for Ebola to spread from patient to health care facility workers.

Limitations of the study

While the survey results proved more promising than expected, treating an Ebola patient would likely be too overwhelming for a rural health care setting in West Texas to adequately care for an Ebola patient for an extended period. Manpower and other resources needed are just too vast to treat even a single case of Ebola. While health care facilities in West Texas may be able to adequately receive a patient, it is in the patient's and hospital's best interest to transport the patient to a biocontainment facility elsewhere in the United States that is better equipped to treat a disease of this caliber. Although West Texas is not ready to successfully treat an Ebola outbreak, hospitals and clinics have implemented significant changes in regards to training that would better equip and prepare these facilities for short term management of a patient. Nonetheless, the occurrence of an outbreak in West Texas would pose significant problems.

Future studies could be conducted in which additional questions would be asked to better understand the preparedness of West Texas to treat an Ebola patient and to assess the degree of change after the October 2014 outbreak. While widespread training was implemented, we did not obtain data to perform statistical analysis to see the difference in

preparedness before and after the October 2014 outbreak. For example, rating overall preparedness before and after the outbreak would be beneficial to this study, along with details about what materials and resources needed to treat an Ebola patient were at their healthcare facilities before and after the outbreak. Also more details about PPE available would be useful to better assess how well the facility could house a single Ebola patient versus multiple patients in an outbreak at their facility. This should include questions such as how much PPE is needed per health care professional to treat a patient, and how many health care professionals are needed to treat the patient. Some of the hospitals could not answer what specific PPE they had and how many sets of PPE they had at hand, yet stated that they felt they had an adequate amount of PPE on hand. Additionally, questions should be asked addressing the preparedness of the hospital in regards to their ability to obtain Ebola specimens, testing the specimen, and the overall process of handling the specimen. To decrease bias, a larger number of hospitals could be surveyed by a single evaluator with known infectious disease skills. This person could physically go to each hospital to assess the criteria found to determine if a facility is prepared to receive and treat a patient with Ebola.

Relevance and Conclusions

According to Carney and Weber, “Today’s public health crises, as exemplified by the Ebola outbreak, lead to dramatic calls to action that typically include improved electronic monitoring systems to better prepare for, and respond to, similar occurrences in the future. Even a preliminary public health informatics evaluation of the current Ebola crisis exposes the need for enhanced coordination and sharing of trustworthy public health intelligence.”³⁴

The need for enhanced coordination, improved electronic monitoring systems, and overall preparedness is essential for West Texas. Research exploring the preparedness of West Texas is essential because many diseases uncommon to most of the United States are first encountered in Texas, largely due to its border with Mexico and the influx of people from Central and South America as well as the changing boundaries for vectors that transmit disease. This may have implications for several other diseases, such as the latest emerging disease, Zika.

While West Texas initially seemed to be unprepared for a disease of the magnitude of Ebola, the results are promising. After the outbreak in October 2014, West Texas underwent massive training and education in order to be better prepared for a hypothetical Ebola outbreak. While the social stigma associated with the disease was evident during the outbreak, education about the transmission and the training of health care professionals can help alleviate these fears. Regardless, while West Texas is better prepared for an Ebola outbreak, a disease of this magnitude is best treated at a fully equipped biocontainment center with trained professionals and the necessary diagnostic tools and equipment.

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APPENDIX A

The survey was sent to the following 15 hospitals:

Abilene Regional Medical Center

Ballinger Memorial Hospital

Brownwood Regional Medical Center

Coleman County Medical Center

Community Medical Center (San Angelo)

Heart of Texas Memorial Hospital (Brady)

Iraan General Hospital

Lillian M. Hudspeth Memorial Hospital (Sonora)

Medical Arts Hospital (Lamesa)

Midland Memorial Hospital

Reagan Memorial Hospital (Big Lake)

Rolling Plains Memorial Hospital (Sweetwater)

Scenic Mountain Medical Center (Big Spring)

Schleicher County Medical Center (Eldorado)

Shannon Medical Center (San Angelo)

VITA

Katelyn (Katie) Jo MacLeay was raised in San Antonio, Texas, by her two loving parents John and Anita Comander, along with her younger brother, Mercer Comander. Katie graduated from Angelo State University in May 2016 with a Bachelor of Science in biology with a chemistry minor and Highest University Honors. She was the recipient of the 2016 Presidential Award, which is awarded to the top graduating senior. Katie was a four-year letter winner for Angelo State's NCAA Division II nationally ranked volleyball team. She was a two-year team captain and was the first in program history to win dual All-American honors, being named to the AVCA All-American team and the Co-SIDA Academic All-American team. She left Angelo State second in all-time digs history and first in total digs in a single season. In addition to being an active member on Angelo State's volleyball team, Katie was involved with Tri-Beta Biological Honor Society, Phi Kappa Phi, the Honors Program, and the Honors Student Association. She also was president of the Student Athlete Advisory Committee, a Huddle Leader for Fellowship of Christian Athletes, and an Executive Founder of the Angelo Culture Exchange. She was a nominee for NCAA Woman of the Year, and winner of Angelo State's Homecoming Queen in 2015. She was also a recipient of the NCAA Post Graduate Scholarship and was named a Distinguished Freemont Scholar, receiving an additional scholarship for postgraduate studies. Katie will attend medical school at Texas Tech University Health Sciences Center starting July of 2016 where she gained admission through the Honors Early Acceptance Program.

Katie can be contacted at kmacleay@angelo.edu.