Trauma Center Development Improved New Mexico Trauma System by Decreasing Inappropriate Air Medical Transport and Increasing System Revenue

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Trauma Center Development Improved New Mexico Trauma System by Decreasing Inappropriate Air Medical Transport and Increasing System Revenue

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Trauma Center Development Improved New Mexico Trauma System by Decreasing Inappropriate Air Medical Transport and Increasing System Revenue

By

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A Scholarly Project Submitted to the College of Nursing in Partial Fulfilment of the Requirement for the Degree of Doctor of Nursing Practice

University of New Mexico

College of Nursing

Albuquerque, NM

Capstone Chair: Dr. Lavin

Capstone Committee Member: Dr. Preda

Date of Submission: March 30, 2022
Abstract

Before 2016 in southern New Mexico, the closest trauma center for patients was El Paso, Texas. Las Cruces, New Mexico, in Doña Ana County began developing its first trauma center in 2016 and became designated in 2017. The development of this trauma center changed trauma triage destination protocols for trauma patients. The improved collaboration and teamwork with prehospital personnel, surrounding hospitals, and existing trauma centers led to the development of trauma triage and transport guidelines. These protocols categorized trauma patients and constituted a guide for emergency personnel. Developing a trauma center in Doña Ana County improved the New Mexico Trauma System by implementing trauma triage and transport guidelines. These guidelines, when implemented, decreased inappropriate air helicopter transport and generated increased revenue for the trauma center and the trauma system.

Keywords: trauma, inappropriate air medical or helicopter transport, trauma system, trauma center, trauma triage guidelines, destination protocols
Dedication

First, I’d like to dedicate this project to my children, Zakary, and Cierra Perez. Although you are both grown now, you put up with all my craziness related to me growing my professional career. The last two years especially, during the pandemic craziness and me obtaining my DNP--you tolerated me. I hope this has taught you that you can always achieve your dreams. I love you to the moon and back!! Second, to my best friend Jacquie Saldana, you have been my rock, my soul sister, and I love you!
Acknowledgment

I would like to give special acknowledgment to Liana Lujan, RN-State Trauma Program Director for her continued dedication and passion for the New Mexico Trauma System.
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Chapter One

Introduction and Background

Trauma claims the lives of over five million people globally per year (Mwandri et al., 2017). In 2016 Las Cruces, New Mexico, decided that one of the two local hospitals would pursue becoming a trauma center. The New Mexico Trauma System includes multiple trauma centers throughout the state. Most of these trauma centers were in the mid-northern and eastern parts of the state, leaving inadequate access in the southwestern portion of New Mexico.

The development of trauma centers creates a culture of collaboration, process improvement, and evidence-based care for injured patients. Effective action requires a systematic approach that includes prehospital care to acute hospital care and considers appropriate resources impacting trauma care and improving patient outcomes (Mwandri et al., 2017).

Before 2016, the closest trauma centers to Las Cruces were in El Paso, Texas. Many patients from southern New Mexico were taken to El Paso either by ground transport or helicopter for trauma care. The development of a trauma center in Las Cruces created healthcare resources that had not been available to the community or region. The collaboration with prehospital providers, coordination of care, and improving specialty services allowed patients in Las Cruces, NM, and southern NM to receive appropriate care in their community finally.

The development of destination protocols created a culture of transporting the patients by ground to the local trauma center for assessment and stabilization, leading to a decrease in the utilization of air helicopter transport to El Paso, TX, particularly from the scene. Previously, helicopter transportation was utilized for trauma patients, even low-level trauma patients, sometimes inappropriately.
Problem Statement

The lack of a trauma center in Doña Ana County led to inappropriate air transport in Dona Ana County. Without a trauma system in place, there is inadequate review of data and resulting opportunities for system improvement.

Study Purpose

The purpose of this implementation study was to evaluate inappropriate helicopter air transports in Doña Ana County that followed destination protocols developed for trauma patients in Region II of the New Mexico Trauma System. Inappropriate air helicopter transport is defined as transport for patients who met a level one or two trauma activation criteria and were within twenty minutes of the Level III trauma center in Las Cruces, New Mexico, but are flown to El Paso. Data is evaluated using the New Mexico Trauma Registry.

PICOT Question

Does the development of a trauma center in Doña Ana County improve the New Mexico trauma system by implementing trauma triage destination protocols and decreasing inappropriate helicopter emergency transports from the scene for Level One and Level Two traumas, and increasing ground transport to the local trauma center, and increasing revenue for New Mexico?

Objectives and Goals

This project aims to demonstrate that the development of a trauma center in Las Cruces, NM improved the trauma system development by decreasing inappropriate air medical transport and increasing ground transport to the local trauma center, and increasing profit captured in the NM Trauma System. The goal is to demonstrate that the development of trauma centers in the area created a systemic collaboration that improved system outcomes and increased revenue.
Therefore, trauma center development should be supported and have continued funding at the legislative level.

These data points from 2016-2019 will include:

- 30 Zip Codes (Doña Ana County)
- Trauma Level I
- Trauma Level II
- Transport-EMS Ground
- Transport-EMS-Air helicopter
- Charges related to revenue

The increased billing for the trauma system will be defined as increased profit captured in the New Mexico Trauma System by patients staying in the New Mexico Trauma System for trauma care. Using helicopter transport is costly and was overutilized before implementing collaboration and prehospital destination protocols in the region. The integration of care at a systemic level allowed for improved systems outcomes and increased revenue to the New Mexico trauma system.

The development of the trauma center in Las Cruces improved access to trauma care to the local community and the whole southern region. Using activation criteria categorized by trauma severity expedites care to trauma patients at the facility while ensuring more appropriate use of resources. The destination protocols for Region II were developed by the local Doña Ana Prehospital Committee and approved by the Regional Trauma Advisory Council (ReTrAC). These protocols are divided into three levels, level one, level two, and level three. (New Mexico Southwest ReTrAC Trauma Triage and Transport Guidelines, 2018).
Each level defines specific criteria that the trauma patient would meet to activate as a level one, two, or three. The guidance derives from a national expert panel from 2011 and created criteria. The criteria are based on physiologic criteria, anatomic criteria, mechanism of injury, and other special considerations (CDC, 2012).

**Table 1**

NM Southwest ReTrAC Triage Transport Guidelines (2018) Strive for 10-minute scene time

<table>
<thead>
<tr>
<th>Level I: VS, LOC, anatomy of injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow Coma Scale ≤13</td>
</tr>
<tr>
<td>Systolic BP/Respiratory Rate</td>
</tr>
<tr>
<td>Pediatric =&lt;70mmHg+2x age/&lt;20 in infant &gt;1 year, need for ventilator</td>
</tr>
<tr>
<td>Adult =&lt;90mmHg/&lt;10 or &gt;29 breaths/min, need for ventilator</td>
</tr>
<tr>
<td>Geriatric =&lt;110mmHg/&lt;10, or &gt;29, need for ventilator</td>
</tr>
<tr>
<td>All penetrating injuries:</td>
</tr>
<tr>
<td>Head, neck, torso</td>
</tr>
<tr>
<td>Extremities proximal to elbow or knee</td>
</tr>
</tbody>
</table>

Chest wall instability

Two or more proximal long bone fracture

Burns 2nd degree involving face, hands, feet, genitalia, perineum or major joints, >10% to Body Surface Area, 3rd degree burns

Amputation proximal to wrist or ankle

Pelvic Fractures

Open or depressed skull fractures

Paralysis

**Level II: Mechanism of injury, high-energy impact**

Falls

Pediatric=>10ft. or 2x height of a child

Adult=>20 ft. (one story equals 10ft.)

Geriatric=ground level fall (+) intake of anticoagulant, antiplatelet, anti-thrombin medication

Intrusion into interior compartment, including roof>12in. Occupant site, >18 in any site

Ejection (partial/complete) from automobile, motorcycle, all-terrain vehicle
Death in same passenger compartment

Vehicle data telemetry consistent with high risk for injury

Auto vs. Pedestrian/Bicyclist thrown, run over, or with significant impact (>20mph)

Motorcycle crash > 20mph

**Level III**

ALL other injuries

---

*Pediatric < 17 years of age. Adult > 18 years of age. Geriatric > 65 years of age.*

**Scope of the Study**

Data were obtained from the NM Trauma Registry, comparing 2016 to 2019. In 2016 the trauma center was in its developmental phase, becoming designated in 2017 (three-year designation). The second data set reviewed flights from the scene of the incident within Doña Ana County to the Level One Trauma Center in El Paso, comparing 2015 (before trauma center development) to 2017 (after trauma center designation).

**Assumptions**

In conducting this study, the following assumptions are made. It was assumed:

- The data in the New Mexico Trauma Registry is accurate
- The list of trauma transports is complete
- The Doña Ana Destination Protocols were implemented correctly

**Significance of the Study**
The significance of this study is that the development of trauma centers within a trauma system allows for improved system outcomes through collaboration, resource utilization, and process improvement. The appropriate utilization of resources will improve the trauma system as demonstrated by decreasing inappropriate air medical transport to the El Paso trauma center while increasing ground transport to the Las Cruces trauma center, increasing revenue to the New Mexico Trauma System.

Chapter Two
Review of Literature

A literature review was conducted to investigate existing evidence about inappropriate air transport with trauma center development and trauma system outcomes. Various search terms were identified to describe air transport (inappropriate air transport, helicopter transport, air medical transport, air helicopters transport guidelines) and trauma centers (designated trauma centers, trauma center, trauma system). The databases searched included PubMed, CINAHL Complete, Medline, and ScienceDirect. Appropriate use of MeSH terms and combinations were applied were pertinent per database.

When searching for literature to review inappropriate air helicopter transport, there were limited resources, some dated back to 1990. Ten articles were reviewed; most were peer-reviewed research articles, others were instructive tools, books, or guidelines, and most were from quantitative data. Table 2 shows vital findings between these articles.

Table 2

Key Findings Inappropriate Air Helicopter Transport

<table>
<thead>
<tr>
<th>Year</th>
<th>Study</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>---------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2000</td>
<td>Talbert, S.</td>
<td>The development of a gold standard for determining appropriate aircraft use with measurable criteria on which to base that decision is significant, and this study was the first step taken to develop those criteria.</td>
</tr>
<tr>
<td>2010</td>
<td>Brown et al.</td>
<td>Over triage of helicopter transport may be significant in some trauma systems; in this study, helicopter transport proved to have merit and improve patient outcomes.</td>
</tr>
<tr>
<td>2012</td>
<td>Hafner et al.</td>
<td>1.3% of flights were determined to be medically inappropriate, and this large national cohort demonstrated compliance with industry standards.</td>
</tr>
<tr>
<td>2012</td>
<td>Smith et al.</td>
<td>25% of trauma patients were over triaged in a well-developed trauma system; the trauma system needs to monitor scene transport guidelines in their program.</td>
</tr>
<tr>
<td>2015</td>
<td>Crowse et al.</td>
<td>The majority indicated that the criteria recommended by helicopter air ambulance guidelines are essential in the decision to use. Over ¼ did not receive training on air ambulance use or safety within the last 24 months.</td>
</tr>
<tr>
<td>2017</td>
<td>Madiraju et al.</td>
<td>Significant over triage occurs using a complex trauma algorithm, leading to unnecessary air evacuation of the minimally injured patient at great financial cost without any significant clinical benefit over EMS ground transport.</td>
</tr>
<tr>
<td>2017</td>
<td>Gibbons, J.P., Brethnach, J. F., &amp; Quinlan, J. F.</td>
<td>25% of patients were managed in ED, indicating an acceptable level of over-triage according to ACS guidelines.</td>
</tr>
<tr>
<td>2018</td>
<td>Dhillon, et al.</td>
<td>The utilization of prehospital helicopter transport of trauma patients has decreased significantly over the last decade but has increased in elderly patients, which may have reduced mortality in this subgroup. Over triage continues to occur as almost a third of transported patients have minor injuries.</td>
</tr>
<tr>
<td>2018</td>
<td>Sebastian et al.</td>
<td>Most trauma patients transported via air were critically injured, with 1.8% over triage but could suggest high undertriage. Critically injured patient transported via air medical transport was appropriate.</td>
</tr>
<tr>
<td>2019</td>
<td>Myagi et al.</td>
<td>Over triage is a concerning problem in air medical transport; almost one-third of patients transported from the scene are discharged within 24 hours of admission. Over-triage was identified in 80% of patients.</td>
</tr>
</tbody>
</table>

**Inappropriate Helicopter Transport**

Helicopter transport is costly and controversial but remains vital in a trauma system. Inappropriate helicopter transport was referred to as over triage. One study demonstrated that significant over-triage occurred in a well-developed trauma system was costly to the system with
no significant clinical benefit over emergency medical ground transport (Madiraju, et al., 2017). Another well-developed trauma system had 25% of trauma patients over triaged, suggesting that trauma programs need to monitor scene guidelines (Smith & Sidwell, 2013).

Dhillon et al. (2018) reported that prehospital helicopter transport of trauma patients had decreased significantly over the last decade; however, it has increased with elderly patients, but still found significant over triage in one-third of patients having only minor injuries. Miyagi, Evans, and Werman (2019) reported that 80% of trauma patients were over-triaged, one-third of patients transported from the scene being discharged within twenty-four hours of admission.

Three articles concluded that helicopter transport was appropriate Brown et al. (2010) proved in their study that helicopter transport has merit and improved patient outcomes. The other two had demonstrated that only a tiny percent of trauma patients was over triaged or inappropriate, Hafner et al. (2012), 1.3%, and Sebastian et al. (2018), 1.8%, were over triaged, suggestive of a high undertriage rate.

**Over Triage Definition**

None of the reviewed articles had a clear definition of over triage for air medical transport. Madiraju et al. (2017) defined it as patients discharged from the emergency department or admitted to observation status without injuries or in observation status. The Association of Air Medical Services (1990) wrote a position paper on the "Appropriate Use of Emergency Medical Service," which found that one-third of emergency medical personnel did not receive training on these criteria even though there are criteria. The last resource is the ACS COTs, "Resources for Optimal Care of the Injured Patient" (2014), which has guidelines on destination criteria for the injured patient in a trauma system. The "Resources for Optimal Care of the Injured Patient" (2014) states that over triage is defined as the minimally injured patients transported to the
highest level of care, which results in excess costs, and overburden to the higher level of care trauma centers. Talbert (2000), a pilot study, took the first step to identify criteria that the transporting flight crew may use to determine appropriate use of air helicopter transport.

**Trauma System Development**

The Committee on Trauma (COT), with the American College of Surgeons (ACS), published "Resources for Optimal Care of the Injured Patient" (2014), which identifies criteria for trauma centers (Level I, II, III, IV) and defines critical parts needed for a successful survey. Additionally, it outlines destination criteria for injured patients. The fundamental mission of the ACS-COT is to achieve optimal care of the injured patient with a focus on providing support and resource within an inclusive system of trauma care (Grossman, Yelon, & Szydiak, 2017).

A system approach is required to ensure optimal care. An ideal trauma system has the following components: injury prevention, access, prehospital care and transportation, acute hospital care, and rehabilitation. (COT, ACS, 2014). The COT, ACS (2014) reports that all acute care facilities should be integrated in a manner that the regional trauma system may:

1. "Make the best use of available resources"(pg. 9).
2. "Match patient needs to the facility resources"(pg. 9).
3. "Engage all acute care facilities in the management of injured patients"(pg.9).
4. “Ensure that the trauma system is functioning in the best interest of the injured patient through regional performance improvement and patient safety activities"(pg.9).
5. "Reduce the burden on the highest-level trauma center"(pg.9).
6. "Improve surge capacity in the event of mass casualty events"(pg.9).
Trauma system development has gone from individual surgeons coordinating care to multidisciplinary, multi-institutional programs integrated at a local, regional, and state level (COT, ASC, 2014). This was achieved by using a public health framework. This process uses the core function of a public health approach (COT, ASC, 2014):

- **Assessment**: Regular and systemic collection and analysis of injury-related data. Clinical data is used to evaluate resources used for care injury problems and identify potential opportunities for intervention and improvement.

- **Policy development**: Comprehensive policies and standards are developed, driven by assessment outcomes. This should be done through collaboration, data review, and identifying areas of improvement.

- **Assurance**: Provisions made are ensured through implementation, monitoring, and evaluation of systems components, resource allocations, processes, and adherence to policies and standards.

**Summary**

The articles reviewed covered a wide range of dates from 1990 to 2019. There is an inappropriate use of air medical transport, even in well-developed trauma systems. The guidelines set for the ACS are clear criteria on destination protocols and lack the definition of when to use air. The last time guidelines were reviewed for air medical transport was in 1990 by the Association of Air Medical Services, and it was noted that training was lacking. The ACS defines over triage as a decision that incorrectly classifies the patient as needing a trauma center, but after a retrospective review, it is suggested they did not (COT, ACS, 2014). Over triage results in overutilization of resources, both financial and human.
The process improvement of a certified trauma center is key to evaluating the appropriate use of air helicopter transport. Case reviews will identify opportunities that can be made to advance the use of air helicopter transport, which is key to creating revenue and cost savings for a trauma system.

Chapter Three

Theoretical Model and Methodology

Theoretical Model

Haddon’s Matrix, developed by William Haddon, has been used for over two decades, especially in injury prevention research and intervention (Barnett et al., 2005). The Haddon Matrix is a grid with four columns and three rows. The rows represent the different phases of the event; pre-event, event, and post-event, and the columns represent; host, agent/vehicle, physical environment, and social environment (Barnett et al., 2005). In Table 3 Haddon’s Matrix is adapted and applied to the process of trauma system development:

Table 3

Haddon’s Matrix Applied to Trauma System Development

<table>
<thead>
<tr>
<th>Pre-Event</th>
<th>Equipment</th>
<th>Physical Environment</th>
<th>Social Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Las Cruces, NM Trauma Center Development-2016</td>
<td>Data Collection through NM Trauma Registry</td>
<td>Acute Care Hospital</td>
<td>Acute Care Hospital</td>
</tr>
<tr>
<td>Event</td>
<td>Data Collection, review of database inappropriate air medical transport, increased ground transport increasing revenue.</td>
<td>Acute Care Hospital and prehospital scene</td>
<td>Acute Care Hospital and prehospital scene</td>
</tr>
<tr>
<td>Post-Event</td>
<td>Review of database and improvement to trauma system, decreased inappropriate air medical transport, increased</td>
<td>Regional Trauma Advisory Council for Region II, NM Trauma System</td>
<td>Regional Trauma Advisory Council for Region II, NM Trauma System</td>
</tr>
</tbody>
</table>

Table 3
Project Study and Design

This process improvement study used two data sets. The first data set was abstracted from the New Mexico trauma registry, from 2016 and 2019, to evaluate the trauma system development for Doña Ana County. Data abstractions were obtained from the Emergency Medical Services Trauma Care Program, with the assistance of the New Mexico Department of Health (NMDOH). Data criteria reviewed had four components:

- Comparison of 2015 (developing trauma center) and 2017 (designated trauma center) 2016-2019 (cycle of three-year designation)
- Classified as Level I or Level II trauma (based of New Mexico Southwest ReTrAc Trauma Triage and Transport Guidelines)
- Within Doña Ana County (30 zip codes)
- EMS transport ground vs. medical air helicopter to the local designated facility

Once data was abstracted, a comparison was made showing that in 2016 through 2019, there was an increase in ground transport and a decrease in inappropriate air helicopter transport in Doña Ana County. Using process improvement to review resource allocations, the development of a trauma system led to the development and implementation of Trauma Triage and Transport Guidelines in Doña Ana County, impacting air medical transport. The decrease led to increase revenue to the New Mexico trauma system. Patients remained in their local community for health care.

The second set of data was abstracted from the NM Trauma Registry for the years 2015 and 2017, explicitly reviewing:
• Comparison of 2015 (no local trauma center) to 2017 (local designated trauma center)

• Scene air ambulance transport in Doña Ana County (30 zip codes)

Once data was abstracted, a comparison was made showing that in 2015 there were more scene flights before the development and implementation of Trauma Triage and Transport Guidelines. In 2017, there was a decrease in scene air ambulance transport. Patients were transported via ground ambulance within 20 minutes of the local trauma center.

Setting and Resources for Data Collection

The project took place in Doña Ana County, New Mexico. The resource utilized for this project included a collective agreement with the NMDOH for data (blinded, with no patient information) from the New Mexico Trauma Registry. The New Mexico Trauma Registry collects information about trauma patients receiving care at designated trauma centers in New Mexico. This information includes demographics, treatments, clinical outcomes and is used to evaluate the trauma centers and identify areas of improving patient care (NMDOH, n.d.). The data was abstracted using stated criteria with the assistance of the New Mexico Trauma Program Manager.

Study Population

The population studied included any trauma patient that met the criteria of a Level I or Level II trauma activation (as defined in the Trauma Triage and Transport Guidelines) and was transported to the trauma center via EMS ground versus EMS air helicopter transport in Doña Ana County.

Data & Statistical Analysis
The New Mexico Trauma Registry data compared level I and Level II trauma activations transported via ground ambulance and air medical transport in 2016 through 2019 in Doña Ana County to the local trauma center. The data from 2015 and 2017 reviewed data of scene flights in Doña Ana County. The "n" of the sample size was variably related to the phase of trauma center was developing each year and if patients met the appropriate criteria level for trauma activation. The data collected were analyzed using descriptive statistics.

For this project, it was expected that from 2016 to 2019, there would be an increase in ground transport to the local trauma center, with fewer transports via air ambulance. The rise in ground transport was expected to increase revenue to the NM Trauma System by keeping patients in their local community. There was a decrease in scene air ambulance transports between 2015 and 2017, demonstrating that more patients were transported to the local hospital via ground transport for assessment and stabilization after developing and implementing Trauma Triage and Transport Guidelines. It was also predicted that scene transport data and hospital transport data may not correlate related to scene triage from prehospital personnel.

It was expected that the two data sets would reveal the development of a local designated trauma center decreased scene air ambulance transport and increased ground transport from the developing year throughout the three-year designation. This would then demonstrate that the designation of a trauma center impacts trauma system improvement. The Trauma Triage and Transport Guidelines development would also show that through collaboration and process improvement in Doña Ana County, there is an improvement in the utilization of resources in the NM Trauma System.

**Quality and Data Protection Plan**
This study ensured that all personally identifiable patient information was excluded and there were no patient privacy violations. Any data sets with missing criteria were excluded to ensure the quality of the study was not impacted by incomplete data entered in the trauma registry.

**Ethics and Human Subject Protection**

All data collected and used for analysis were de-identified. All data collected was kept in a secured drawer in a locked office. When a computer was used for data processing, it was encrypted, and password protected. All researcher meeting with NMDOH Trauma Program Director occurred online utilizing a secured network. The research did not begin until approval was received from the Huron Institutional Review Board (IRB), determining that the research was not human research.

**Timeframes and Timelines**

Once the IRB approval was received a timeframe was established to collect and analyze the data. See Appendix C.

**Budget**

There was no budget set up for this project. The student-researcher covered all costs associated with travel to the NMDOH to meet with Trauma Program Director. Key participants at NMDOH donated their time for this project.

**Conclusion**

The development of trauma centers is critical for trauma system development. The result of a trauma center leads to collaboration with community partners and peers. Evidence-based
guidelines can be established through collaboration and process improvement and improve system outcomes and resource utilization.

The development of a trauma center in Doña Ana County impacted collaboration with prehospital partners by developing trauma triage and transport guidelines, as demonstrated by decreasing inappropriate air medical transport and increasing ground transport, therefore, increasing revenue generated for New Mexico Trauma System.

**Chapter Four**

**Results and Findings**

The data collected for this study included Level One and Level Two trauma patients transported within Doña Ana County to the local trauma center in Las Cruces by either ground or air. From 2016 to 2019, there was a steady increase in ground transport with a mean percentage of air transport of 1.38% and a range of 0.9% to 1.84% (see Table 4). The data set results reveal that the implementation of the Trauma Triage and Transport Guidelines positively impacted the air and ground transport. It increased patients staying locally for trauma care, increasing revenue to the NM Trauma System.

The second data set (see Figure 2) included Level One or Level Two trauma patients triaged on the scene of the incident in Doña Ana County and flown to the Level One Trauma Center in El Paso, TX. The scene flights from 2015 (n=56), when there was no existing trauma center in Las Cruces, demonstrate a high number of scene flights. In 2017, there was a substantial decrease in scene flights (n=7), indicating the Trauma Triage and Transport Guidelines implementation was effective. Unfortunately, there was no data for the following years to demonstrate sustainability related to the COVID-19 pandemic and the re-purposing of
personnel at the NMDOH. There is a difference in air transport scene flights versus transport to
the facility in 2017, likely due to scene triage.

There was no data collected related to trauma charges. The NM Trauma Registry did not
have these data points collected. It was recognized in 2019 by the NM State Trauma Program
Director, and charges were to begin being entered during that year.

Table 4

<table>
<thead>
<tr>
<th>Year</th>
<th>Ground Transport</th>
<th>Air Transport</th>
<th>Percentage of Air Flights</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>62</td>
<td>1</td>
<td>1.61%</td>
</tr>
<tr>
<td>2017</td>
<td>349</td>
<td>3</td>
<td>0.9%</td>
</tr>
<tr>
<td>2018</td>
<td>271</td>
<td>5</td>
<td>1.84%</td>
</tr>
<tr>
<td>2019</td>
<td>513</td>
<td>6</td>
<td>1.17%</td>
</tr>
<tr>
<td>Mean</td>
<td>298.75</td>
<td>3.75</td>
<td>1.38%</td>
</tr>
</tbody>
</table>

In 2018, change in position of Trauma Program Director and Trauma Registrar

Figure 1

Ground vs. Air Transport Level I/II Trauma Patients to Local Trauma Center

2018-Position changes for the Trauma Program Director/Trauma Registrar may have impacted
data collection
Discussion

This implementation study evaluated the impact of developing a trauma center in Doña Ana County. It demonstrates how developing and implementing Trauma Transport and Triage Guidelines though the local ReTrAC decreased the occurrence of inappropriate air medical transport from the scene with trauma patients by increasing ground ambulance transport to the local trauma center. Keeping patients in Doña Ana County is believed to have generated increased revenue to the NM Trauma System though this is highly speculative as no data was entered in the system.

This study indicates that trauma center development is critical to improving local, regional, and state-wide trauma team collaboration. Multidisciplinary collaboration enhances patient outcomes by utilizing resources appropriately to assess and stabilize patients. Choi et al. (2021) report that modern comprehensive trauma systems can optimize high-quality, cost-effective care by first recognizing the injury and triaging to the appropriate trauma center.
Appropriate on scene care and triage is demonstrated by the decrease in scene flights from 2015 to 2017. Once the trauma center was developed and the guidelines for triage and transport were implemented, the patients were transported via ground to the local trauma center, as seen in the data from 2016 to 2019. This is consistent with (Choi et al., 2021) who also state that a trauma system prioritizes education, outreach, data registry collection, and coordination beyond multidisciplinary prehospital and clinical care. The improvement demonstrated in the development of the trauma center and the collaboration is also consistent Choi et al. (2021) who believed the type of improvement in a comprehensive trauma system requires strong leadership with community engagement by the trauma center locally, regionally, and state-wide.

Emergency medical services (EMS) have a vital role in triaging and transporting patients to the appropriate trauma center. Increased mortality of trauma patients is directly related to delayed EMS transport (Choi et al., 2021). Triage and Transport Guidelines provide the EMS teams with guidelines to refer to when making triage decisions. The National Highway Traffic Safety Administration sets standards for EMS and has helped promote and develop several guidelines for trauma patients (Choi et al., 2021). It will benefit the trauma systems if EMS has competencies tied to case reviews to make sure there is an understanding of the trauma triage and transport guidelines.

Appropriate triage is critical. This study identified triage as an essential piece of the effectiveness of trauma transport. Accurate triage is used to transport patients to the appropriate trauma center that has the capabilities of addressing and stabilizing the patient without risking long transport times while minimalizing costly trauma care teams (Choi et al., 2021). If patients were inappropriately being triaged and transported via air ambulance to a higher level of care that was not needed, is cost-effective. Over-triage or inappropriate triage when the patient did not
meet set criteria can cost a trauma center an excess of $136 million annually, whereas, appropriate triage, when ACS-COT guidelines are used correctly has been projected to save trauma systems $568 million per year (Choi et al., 2021). This necessarily depends on EMS having proper training on trauma triage guidelines. There is a wide range of variance of approaches across EMS systems worldwide with compliance ranging from 21% to 94%; and a need for system-wide efforts to optimize prehospital triage, from redefining trauma team activation models reducing EMS helicopter over utilization. There needs to be a standardized definition of what over-triage entails and an algorithm defining when it would be appropriate to transport the patient via air ambulance from the scene.

The pre-event planning was essential for the initial trauma center development and gathering data to understand the importance of collaboration and triage transport guidelines. During the program development, the trauma center began collaborating with prehospital personnel and other trauma centers in the region and expanding the Trauma Triage and Transport Guidelines. During the time, the guidelines were reviewed, data was continuously collected, process improvement was beginning, and the guidelines began to be implemented. The last component of Haddon's Matrix, the post-event, is when the trauma center data is reviewed, and the guidelines prove effective. The ReTrAC extends these guidelines to the region with continued data collection and process improvement.

As is the case with many retrospective studies, data heavily depends on the data collected by others. In the case data entered by the Trauma Registrars into the trauma registries was critical to the evaluation. Trauma performance improvement is a requirement for a trauma center, and the most crucial part of process improvement is data. This is one central element that drives trauma system development clinical care advances and is utilized in the National Trauma Data
Bank (Arabian et al., 2015). This study demonstrated the inability to abstract trauma charges, as it was not identified that these were not being collected until 2019 which is consistent with the findings of Arabian et al., (2015), who identified a lack of uniformity in data ICD-10 coding impacting data collection.

Finally, it is important to recognize the unintended consequences of small changes in a trauma center. In 2018, a role change at the local trauma center resulted in possible incomplete data collection that year. There was a lack of a backup system for data collection. Arabian et al. (2015) concluded in their study of validation of the data in trauma registries that there should be an examination of the accuracy of the data, it should be standardized, and training to be provided to the trauma registrars. Trauma registrar training should be required, perhaps with a certification for the state of NM. The NMDOH should perform a full review of the trauma data annually to ensure that all the necessary data points are provided.

**Implications for Practice**

Developing a trauma system, including individual trauma centers, fosters an interprofessional collaboration approach. WHO (2010) Study Group on Interprofessional Education and Collaborative Practice developed "The Framework for Action on Interprofessional Education and Collaborative Practice," which acknowledged sufficient evidence that effective interprofessional education allows for effective collaborative practice. If health systems can strengthen their collaborative approach, it will ultimately improve health outcomes. When a trauma center begins development, it establishes relationships with EMS, air, ground, police, fire departments, other trauma centers and hospitals in the region, and internal collaboration between departments (emergency room and surgery).
Multidisciplinary collaboration allows each team member to understand better each other's roles and responsibilities in the trauma patient's care. Once this occurs, these teams can develop evidence-based care and protocols, working together to achieve better outcomes for the trauma patient. They understand how to optimize the skills of each team member, share case reviews, and provide better care to the patients and the community, which results in the health system becoming strengthened, leading to improved outcomes (WHO, 2010).

Developing the Trauma Triage and Transport Guidelines at the ReTrAC (regional level) validated that working with prehospital personnel, designated trauma centers within the region, and improving trauma system utilization by taking the trauma patient to the appropriate facility promptly.

**Limitations and Strength of the Study**

The major strength of the study was interprofessional collaboration that occurred during the development of this trauma center. That collaboration led to producing evidence-based Trauma Triage and Transport Guidelines, which decreased inappropriate air transport from the scene while increasing ground transport to the local trauma center. These protocols were then shared with the entire southern region of the state.

There were six identified limitations of the study. Most importantly, it is questionable if data was correctly entered by the trauma registrar. There was no cost data related to the charges, so there is no conclusive evidence of increased revenue to the state. In 2018, there were program-level leader changes that may have resulted in missed data. There is no standard definition for overtriage, allowing multiple meanings to be used, leading to inconsistency. There was an inability to demonstrate sustainability due to positional changes at the NMDOH that resulted from the ongoing pandemic. Finally, since 2014, the ACS COT has not updated the "Resources
for Optimal Care of the Injured Patient”; however, a new version is scheduled for release in 2022. This version will address nine new standards, including education for trauma registrars (Fojut, 2022).

**Suggestions for Further Research**

This study clearly identifies gaps in the available research. First, there needs to be standardization of the prehospital protocols for EMS, including competencies to ensure educational understanding which requires greater evidence. Air medical transport overtriage lacks definition and standards, which need further evaluation to utilize this resource in the trauma system appropriately. It is essential for the trauma registrar training/certification to be validated and required to improve data collection accuracy. Data fields need to be studied to ensure each trauma system collects data that can be utilized across all trauma systems for performance improvement.

**Concluding Remarks**

This study indicates that developing a trauma center in Doña Ana County decreased air ambulance transport by increasing ground ambulance due to interprofessional collaboration and the Trauma Triage and Transport Guidelines development. Even though there was no data on the cost of each trauma patient in the registry, it is evident that there was an increase in volume over the four years. When a trauma center begins its journey on the path to the designation, it promotes data collection through the trauma registry, collaboration with prehospital personnel and surrounding facilities, and process improvement. This leads to hospitals being required to work together within a region and ensure standardization of care. As demonstrated in this study, interprofessional collaboration improved system care and utilization of resources, ultimately improving the NM Trauma System.
References


Committee on Trauma, American College of Surgeons. (2014). *Resources for optimal care of the*


New Mexico Southwest Regional Trauma Advisory Council. (2018). *NM SW ReTrAC Trauma triage and transport guidelines* (Region II EMS Trauma and Health Systems Development) [Guidelines]. NM SW ReTrAC.


https://www.who.int/publications/i/item/framework-for-action-on-interprofessional-education-collaborative-practice
Appendix A: IRB Approval

Notification of Not Human Research Determination

To: Nikki May
Link: 21-461
P.I.: Roberta Lavin
Title: Trauma Center Development Improves NM Trauma System
Description: The committee reviewed this submission and assigned a determination of Not Human Research. For additional details, click on the link above to access the project workspace.

The University of New Mexico • MSC08 4560 • 1 University of New Mexico • Albuquerque, NM 87131-0001 • Phone 505.272.1129 • Fax 505.272.0803 • hsc.unm.edu/research/hrpo • Fitz Hall B71
Appendix B: Affiliation Agreement – UNM School of Nursing & New Mexico Department of Health

ACADEMIC AGREEMENT

This Agreement is entered into by and between New Mexico Department of Health, hereinafter referred to as the "Department," and the Regents of the University of New Mexico, for its public operation known as the Health Sciences Center, specifically for the College of Nursing, hereinafter referred to as the "Program."

WHEREAS: The Program is conducting a planned course of study and experience leading to the completion of degrees in nursing and,

WHEREAS: The Program wishes to provide experience for its nursing students/residents in situations where a desirable quality of client service is practiced and,

WHEREAS: The Department operates offices and facilities statewide, in which such student/resident experience may be obtained;

THEREFORE: The Department and the Program agree as follows:

ARTICLE 1: PERIOD OF AGREEMENT

This Agreement will become effective on July 1, 2018 and will terminate on June 30, 2022. This Agreement may be renewed for additional terms upon Agreement of the parties.

ARTICLE 2: PROGRAM

The program of nursing undertaken will conform to the requirements of all articles in this Agreement and the requirements of the program description. The Program and the Department will agree on the Scope of Work and the Program will confirm the agreed Scope of Work by letter from the Program to the Department Contact's office at least one month before the actual starting date of the students/residents. The Program will assume full responsibility for the educational programs of the students, including planning, administration, matriculation, promotion, graduation and final evaluation. The Program will assign appropriate faculty members with responsibility for student teaching.

ARTICLE 3: RESPONSIBILITY FOR PATIENT CARE

The Department will at all times retain responsibility for the care of its patients. Neither Program faculty nor student/resident will be expected to replace Department staff in the conduct of Department's activities.
The Program will submit, along with this signed Agreement, a proposed scope of practice for students/residents to be approved by the Department prior to placement of students/residents.

ARTICLE 4: DEPARTMENT FACILITIES

December, 2013

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The Department will provide access to its facilities, libraries, equipment, and supplies to the Program for purposes of providing experience in the clinical setting where available.

ARTICLE 5: NUMBERS OF PARTICIPATING STUDENTS/RESIDENTS

Department reserves the right to withhold placement of Program students/residents, and to determine the maximum number of students/residents who can be accommodated at any given time in Department offices or facilities.

The Program will provide to the Department the names of the students/residents who intend to participate. Department and Program staff will work jointly in developing the following:

a) Specific plans for days and hours of student/resident participation;
b) Specific plans for orientation and supervision of student/resident;
c) Designation of specific clinical and patient care activities;

ARTICLE 6: CONDUCT IN FACILITIES

The Department reserves the right to evict from its facilities, either temporarily or permanently, any student/resident or employee of the Program whose conduct:

a) Poses a hazard to Department's patients or property;
b) Disrupts the orderly conduct of the Department's activities, or
c) Is inconsistent with laws, regulations, policies, protocols, and/or procedures governing provisions of Department service.

ARTICLE 7: STATUS OF STUDENT/RESIDENT

The participating students/residents are not employees of the Department under this Agreement. No retirement, paid leave, bonding, use of state vehicles, insurance or other employee benefits from the Department shall accrue to the students/residents as a result of this Agreement.

At the discretion of the Department, the students/residents may participate in continuing education programs conducted for Department staff. The Program will retain responsibility for personal and career guidance and counseling of its students/residents.

The participating students/residents shall be classified as Department workforce as that term is defined under the HIPAA Privacy Rule 45 C.F.R. § 160.103.

ARTICLE 8: GENERAL AND PROFESSIONAL LIABILITY

December, 2013

\[\text{\textcopyright V Initials 2}\]
As between the parties, each party will be responsible for liability arising from personal injury or damage to persons or property occasioned by its own agents or employees in the performance of this Agreement, subject in all cases to the immunities and limitations of the New Mexico Tort Claims Act (Section 41-4-1, et seq., N.M.S.A. 1978), and any amendment thereto. Both parties understand that they are not indemnifying each other.

The Program shall provide that all participating students/residents have personal medical insurance coverage that is adequate for any health risks that might result from their participation under this Agreement.

The Program agrees that during the term of this Agreement, the Program shall maintain medical malpractice/professional liability insurance for faculty, residents and students in those amounts required by the New Mexico Tort Claims Act. The Program shall furnish proof of such coverage to the Department upon request.

ARTICLE 9: RELATIONS WITH LICENSING BOARDS

The Program will be responsible for notifications to Licensing Boards of execution of the Agreement, and subsequent changes hereto, termination, or other matters relating to the degree program conducted by the Program.

ARTICLE 10: STUDENT/RESIDENT EVALUATION

Upon request of the Program, the Department agrees to participate in joint evaluation of the students/residents.


A. The Department shall maintain complete confidential records for the benefit of clients, sufficient to fulfill the provisions of the Scope of Work, and to document the services rendered under the Scope of Work.
B. The Program shall protect the confidentiality, privacy and security of all confidential information and records and shall not release any confidential information to any other third party without the express written authorization of the client or the Department.
C. The Program shall comply with the Federal Health Insurance Portability and Accountability Act of 1996 (HIPAA), the Health Information Technology for Economic and Clinical Health Act of 2009 (HITECH Act) and applicable regulations and all other State and Federal rules, regulations and laws protecting the confidentiality, privacy and security of information.
D. Student/Resident Access to Client Information:
   1. The Program shall provide students/residents with training and instruction in the requirements pertaining to the privacy and security of an Individual's medical information, and in the requirements of HIPAA Privacy Rule, 45 CFR Parts 160 and 164, and the HITECH Act; and
   2. The Program shall certify to the Department that each student/resident has demonstrated competency in the requirements of HIPAA privacy and security by the student's/resident's passing of a uniform, objective examination designed to demonstrate the student's/resident's full understanding of the requirements.

December, 2013

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E. In addition, students/residents may be required to undertake HIPAA and HITECH Act training from the Department to understand the Department of Health's privacy and security policies and procedures which implement HIPAA and the HITECH Act.

F. The parties agree to comply with the requirements as provided for in HIPAA and the HITECH Act.

ARTICLE 12: PRODUCT OF SERVICES: COPYRIGHT

All materials developed or acquired by the Program and its students/residents under this Agreement shall be available to the Department and one copy shall be delivered to the Department within sixty (60) days of final preparation of all such materials; the Department shall have a perpetual non-exclusive royalty-free use of any materials published and copyrighted as a result of this Agreement.

ARTICLE 13: STUDENT/RESIDENT INSTRUCTION

Program will ensure that prior to clinical placement each student/resident has had instruction in occupational exposure to blood borne pathogens, protective procedures to avoid contamination and procedures for decontamination in case of exposure, or potential for exposure to infectious materials or potentially infectious materials.

ARTICLE 14: AMENDMENTS

Any changes in the procedures, objectives, requirements, renewal, or other provisions of this Agreement will be formalized by written instrument executed by the parties hereto, and will be attached and incorporated as part of this Agreement.

All information obtained from patients, their records or computerized data is to be held in confidence and no copies of patient records shall be made. It shall be required that the Program instructs student/resident on the confidentiality provisions of this Agreement. No student/resident may identify patients in papers, reports, case studies or otherwise without first obtaining permission from the Department and the patient.

ARTICLE 15: TERMINATION

Each of the parties hereto may terminate this Agreement by serving written notice to the other at least thirty (30) days prior to intended date of termination. Student's participating in a clinical rotation at the time of termination will be permitted to complete the rotation under the terms of this Agreement.

ARTICLE 16: PROOF OF PROTECTION AGAINST CERTAIN INFECTIOUS DISEASES

All participating students/residents and instructors who will be present in clinics, offices, facilities where patient care is provided are required to provide proof of immunization or immunity against the following diseases:

<table>
<thead>
<tr>
<th>Disease</th>
<th>Documentation Required</th>
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<tr>
<td>A. Hepatitis B</td>
<td>Serologic evidence of immunity or completed vaccination as recommended by the Advisory Committee on Immunization</td>
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December, 2013

Initials 4
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<th>Practices</th>
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<tbody>
<tr>
<td>B. Measles</td>
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<td>Serologic evidence of immunity or completed vaccination (MAR) as recommended by the Advisory Committee on Immunization Practices</td>
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<td>C. Mumps</td>
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<td>Serologic evidence of immunity or completed vaccination (MMR) as recommended by the Advisory Committee on Immunization Practices</td>
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<tr>
<td>D. Rubella</td>
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<tr>
<td>Serologic evidence of immunity or completed vaccination (MMR) as recommended by the Advisory Committee on Immunization Practices</td>
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<tr>
<td>E. Pertussis</td>
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<tr>
<td>Receipt of a single dose of Tdap (Tetanus, diphtheria, acellular pertussis) vaccine.</td>
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<tr>
<td>F. Influenza</td>
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<tr>
<td>Receipt of influenza vaccination for the current influenza season if it is available in the community at the time of the rotation.</td>
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<tr>
<td>G. Varicella</td>
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<tr>
<td>Serologic evidence of immunity or completed vaccination as recommended by the Advisory Committee on Immunization Practices</td>
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The Program will furnish a list of students/residents by name confirming that the students/residents have complied with these to the appropriate Department student/resident supervisor 15 days before the students/residents begin participating in clinical activities, utilizing the DEPARTMENT Documentation of immunity and tuberculin skin testing for professional students/residents {Exhibit A}. The Program is responsible for assuring that students/residents have appropriate documentation of protection against the above listed diseases. The Department does not provide vaccine or serologic testing for students/residents.

ARTICLE 17: SCREENING FOR TUBERCULOSIS

The Program shall ensure that prior to clinical placement, each student/resident who will be present in clinics, offices or facilities where patient care is provided will be screened for tuberculosis by either a tuberculin skin test (TST) or by a blood test (IGRA). The TST shall be a two-step TST unless there is a documented TST in the prior year. The Program will furnish a list of students/residents by name confirming that the students/residents have complied with these to the appropriate department student/resident supervisor 15 days before the students/residents begin participating in clinical activities, utilizing the DEPARTMENT Documentation of immunity and tuberculin skin testing for professional students/residents {Exhibit A}. The Program is responsible for assuring that students/residents have appropriate documentation of screening for tuberculosis. The Department does not provide screening for tuberculosis for students/residents.

ARTICLE 18: NON-DISCRIMINATION

The Department and the Program agree that neither will discriminate against a beneficiary of services provided by the Department in the performance of this Agreement against any individual on the bases of age, sex, race, color, religious belief, national origin or disability.

ARTICLE 19: INDEPENDENT CONTRACTOR STATUS

December, 2013
The parties agree that they are independent contractors. In no event shall this Agreement be construed as establishing a partnership joint venture or similar relationship between the parties and nothing contained in this Agreement shall be construed to authorize either party to act as agent to the other. The Program and the Department shall be liable for their own debts, obligations, acts and omissions, including the payment of all required withholding, social security and other taxes or benefits. No student/resident shall look to the Department for any salary, insurance or other benefit.

ARTICLE 20: COMMUNICATIONS BETWEEN THE PARTIES

The authorized representatives to whom routine matters DEPARTMENT connected with this Agreement will be directed are:

REGENTS OF THE UNIVERSITY OF NEW MEXICO, FOR THE COLLEGE OF NURSING

Contact Name: Carolyn Montoya, Interim Dean
University of New Mexico Health Sciences Center
College of Nursing
MSC 09 5350, 1 University of New Mexico
Albuquerque, NM 87131-0001
and
University of New Mexico Health Sciences Center
Office of Clinical Contract Services
MSC 12 7120
1 University of New Mexico
Albuquerque, NM 87131-0001
Attn: Contract Specialist

ARTICLE 21: THIRD PARTIES

Nothing in this Agreement, express or implied, is intended to confer any rights, remedies, claims, or interests upon a person not a party to this Agreement.

ARTICLE 22: ELIGIBILITY FOR PARTICIPATION IN GOVERNMENT PROGRAMS

Each party represents that neither it, nor any of its management or any other employees or independent contractors who will have any involvement in the services or products supplied under this Agreement, have been excluded from participation in any government healthcare program, debarred from or under any other federal program (including but not limited to debarment under the Generic Drug Enforcement Act), or convicted of any offense defined in 42 U.S.C. Section 1320a-7, and that it, its employees, and independent contractors are not otherwise ineligible for participation in federal healthcare programs. Further, each party represents that it is not aware of any such pending action(s) (including criminal actions) against it or its employees or independent contractors. Each party shall notify the other party immediately upon becoming aware of any pending or final action in any of these areas.

ARTICLE 23: Student/Resident Education Records

December, 2013

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To the extent that either of the parties create and/or maintain records concerning the students or residents participating in the program covered by this Agreement and those records constitute "education records" within the meaning of applicable state and federal laws, rules, and regulations governing the same, the parties agree that they will maintain the confidentiality of such student's or resident's education records in a manner which complies with such applicable federal and state laws, rules, and regulations.

ARTICLE 24: Entire Agreement

This Agreement represents the entire understanding between the parties and supersedes any prior agreements or understandings with respect to the subject matter of this Agreement.

IN WITNESS WHEREOF, the parties hereto have set their hands.

REGENTS OF THE UNIVERSITY OF NEW MEXICO, FOR THE COLLEGE OF NURSING

Cardlyn Mo toya, PhD, NP, FAANP, FAAN
Interim Dean, College of Nursing

Date

Approved as to form:

Katherine Miefert,
Associate University Counsel
Office of University Counsel

Date

December, 2013
Exhibit A

Documentation of immunity and tuberculin skin testing for professional students/residents placed in New Mexico Department of Health offices or facilities. Send completed form to the DEPARTMENT staff person who will be supervising the students/residents via fax or regular mail (not email) 15 days prior to the student/resident start date.

Program Name
Contact Name: __________________________ Phone: __________________________

NM DEPARTMENT location where students/residents will be placed:


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<tr>
<th>Student/Resident Name</th>
<th>HPA A</th>
<th>Bloodborne Pathogens</th>
<th>Pertussis Date</th>
<th><strong>Measles Immunity</strong></th>
<th>Mumps Immunity</th>
<th>Hepatitis B Immunity</th>
<th><strong>Varicella Immunity</strong></th>
<th>Tuberculosis Testing (1ST OR IGRA)</th>
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<td>Date</td>
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<td><strong>V= vaccine</strong></td>
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*Two-step TST should be done, unless there is documentation of a two-step TST in the prior year.

+If TST was positive or IGRA was positive/indeterminate, provide documentation of assessment of status (e.g., CXR, sputums, treatment completed).

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December 2013
## Appendix C: Gant Chart Timeline

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