

Burn Center Coverage in the United States

Final Report

Project Members

Kelly Chiczewski

Marisol Ruiz

Joel Toemy

Project Client

Dr. Julie Hwang, DePaul University

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Burn Center Coverage in the United States

SUMMARY

The Burn Center Advocacy Group is comprised of members Kelly Chiczewski, Marisol Ruiz and Joel Twomey. This project was initiated because our client Dr. Julie Hwang was interested in finding out what the current United States coverage of burn centers is like. Dr. Julie Hwang sought our expertise because she is interested in finding out what areas in the United States are currently underserved and over served with burn center locations. Dr. Hwang wished for The Burn Center Advocacy Group to evaluate the performance of burn centers in the U.S. in terms of its geographic coverage.

Dr. Hwang sought our services because she believes that by using ArcGIS software and GIS tools we can create several maps that display the distribution of burn center facilities relative to population by state and burn center facilities relative to one million population and per 100,000 miles and utilize data of travel time via automobile to trauma centers to evaluate the service area of each individual burn center.

Even though we were unable

Through our use of ArcGIS software for determining U.S. burn center coverage, we helped the client accomplish the important objective of determining what areas in the United States are in need of new burn centers and what areas are currently over served by burn centers, and with this information we can find the optimal locations for burn centers. This data would be highly beneficial to policy makers in the United States, and particularly policy makers who advocate for the improvement of public health services in the United States. This project will benefit all Americans and aid in making burn centers throughout the United States more accessible. Elected public officials should have a vested interest in this project, in order to improve the public health of their constituents.

Through our analysis we have determined the ratio of served populations compared to underserved populations for the entire United States. We have created a geocoded map of all burn center locations, a set of 1 hour transportation buffers, and population tabulations for areas inside and outside of the buffers.

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1.) INTRODUCTION

Dr. Julie Hwang Sungsoon currently teaches Geographic Information Systems through De Paul University's Geography department. Dr. Hwang received her bachelor's degree in Geography education in Korea at Seoul National University, her master's degree in GIS at U.K University of Nottingham and attained her doctoral degree from University at Buffalo in 2005. Prior to teaching at DePaul University, Dr. Hwang worked in the University of Washington where she was a GIS lecturer. Dr. Hwang is an expert in Geographic Information Systems, as well as the Burn Center Advocacy Group's client.

The entire project essentially revolved around the need to know question. Our client's main goal was also represented in our research question, which designates the Burn Center Advocacy Group to *utilize data of current burn centers in order to evaluate current and future geographic locations of burn centers throughout the United States..* However, even though a major factors for the undertaking of this project was the need to find optimal locations in the U.S. for new burn centers, our group was faced with time limitations and a limited number of members which made it highly difficult to generate a product depicting optimal burn center locations, within the course of the Winter 2007 academic quarter. Studies show that the distribution of burn center locations throughout the United States is not as effective as it should be and an appropriate method of locating optimal areas for new burn centers was needed. Throughout the United States there exist many areas that are overserved and underserved from burn centers. Usually an area is underserved because they are located in very rural areas. With the use of ArcGIS software and Network Analyst we were able to produce information that can help burn center planners, decision makers and the health sector effectively assess the most appropriate locations for new burn centers. Even though we were unable to determine what areas are most appropriate for burn center locations the data we produced, such as the maps with buffer zones depicting service area of burn centers within a 60 minute travel time, can be of great use to who ever wishes to determine the most advantageous locations for a new burn center. The sections that follow will describe the entire project in more depth and specificity. The section titled **Needs Assessment** gives a brief description about existing literature on past projects that have undertaken similar projects that measured service areas and assessed optimal locations for public health centers of various natures and this literature also serves to help us understand our client's need to know more about burn center service areas. The **Systems Requirements** section includes a breakdown of need to know questions and the information products that must be generated for each. The **Data Acquisition** section has information about where we obtained our data and what we will do with that data. The **Data Analysis** section has information about what we will accomplish with our data and what information can be generated. The **Results Section** has our information product results that depict the number of people serviced by each burn center in the U.S. within a 60 minute drive. **The Summary, Conclusions and Recommendations** summarizes what our results were and contains recommendations about what can be done with our final information products.

2.) NEEDS ASSESMENT

1.) **Background**

Our client advocates for the optimal geographic location of burn centers throughout the United States. However, given several time constraints our group came up against, this was not achieved. The intended audience of this project is policy makers in the United States, and particularly policy makers who advocate for the improvement of public health services in the United States. This project will benefit all Americans and aid in making burn centers throughout the United States more accessible. Elected public officials should have a vested interest in this project, in order to improve the public health of their constituents. Our group intends to utilize GIS tools to evaluate current geographic coverage of burn centers throughout the United States, and utilize data of travel time via automobile to trauma centers to evaluate the service area of each individual burn center. By using ArcGIS software our group created a surface map of the burn center locations, by creating a transportation buffer that shows total number of people living within that buffer that live within a 60 minute travel time from burn center.

Literature Review

Our group studied several pieces of literature that gave us insight on how we could go about the project and helped us decide which GIS tools we could use to measure our need to know information products. The literature also gave us insight about other similar projects had been executed and how they went about using the data to generate information. One study written by the Academic Emergency Medicine Journal and was called “Use of A Geographic Information System to Determine Appropriate Means of Trauma Patient Transport.” This study utilized statistical data from helicopter emergency medical services (HEMS) and ambulatory services to determine the average time it took to transport a patient to a hospital and more importantly, to determine which methods produced a shorter arrival time (which increases the success rate in patient health). Patient travel time was measured by taking into account the time in various intervals. These intervals were measured as follows: notification interval, (time it takes for the patient to call 911) the response interval, (time taken for response agency to notify HEMS or ambulance) on-scene interval, (time taken for ambulance or HEMS to arrive to patient) and transport interval (time taken to transport patient to trauma center). “Minimizing out of hospital time is considered to be an important factor for trauma patient survival since expedient arrival at a trauma center may reduce patient morbidity and mortality.” Regional Helicopter Utilization Guidelines recommend that helicopters only be used to transport patients to hospitals only if it will significantly reduce arrival time to less than 30 minutes. If patients are located relatively close to the trauma center it is recommended that ground transport be used and when patients are located too far from the hospital, the use of HEMS is recommended because the transportation route would be more direct and could increase the patient’s health outcome. This study displayed a buffer map that established which areas were to make use of HEMS and which areas were to use ground transportation to transport patients to the hospital. Given the location of the patient within the buffer map, this buffer map is an important tool that helps to establish which method of transport would provide higher patient survival rates.

Another important report we looked at was generated by the American Heart Association. This study accomplished something similar to what our group wanted to accomplish. This study titled “*Driving Times and Distances to Hospitals With Percutaneous Coronary Intervention in the United States: Implications for Prehospital Triage of Patients With ST-Elevation Myocardial Infarction*” measured the proportion of adult population that had timely access to PCI (Percutaneous Coronary Intervention) hospitals by measuring 60 minute travel time. Similarly, our group came up with the total number of people living within a 60 minute travel time to a burn center in order to assess if an area was served or not by a burn center and thus generated the percent of the total U.S. population that has access to a burn center facility and the percent that does not. This study utilized the ArcGIS 9.2 software and Streetmap USA ESRI which includes data from state, interstate and local roads and for this same reason we also used Streetmap USA ESRI to produce our maps.

Another study we looked at bore striking resemblance to the one we produced. The findings of the study were that 69.2 % and 84.1% of U.S. residents had access to a trauma center within a 45 to 60 minute travel distance. The objective of the study by the American Medical Association called “Access to Trauma Centers in the United States” was to find the proportion of U.S. residents with access to trauma centers measured by a 45 to 60 minute distance in travel time to the trauma center. The study stated that while the number of trauma center facilities has increased in the United States, other studies have shown that they might be unevenly distributed throughout the U.S. The study also notes that a disparity in trauma center service areas exists because while certain population sectors in the nation are without timely access to trauma centers, thus risking life saving ability, some areas have too many trauma centers which might lead to inefficiency, underused facilities, and reduced quality of care. Like this study, we also defined burn center access as the percentage of the population that could reach a trauma center within a certain time. This study used population weighted centroids to establish points where most of an areas population was located and then the population weighted centroids were compared to the points representing trauma centers and helipads. It should be noted that our group did not include helipad bases in our study. We only included trauma center locations and number of population to measure and create a buffer of service area showing number of population located within a 60 minute travel time from burn centers.

Given the literature reviewed, it is easier to understand that given low service areas in other health service sectors, our client Dr. Julie Hwang was prompted to invest in a study that measured burn center service areas to aid in efficient allocation of future burn centers in hopes that our group could assess what areas were optimal for new burn centers. However, since our group faced a limitation of time to complete the project, we were unable to comply with that particular task. If there were more time to complete the project, our group could have generated maps depicting the best locations for burn centers.

2.) Project Goal

The original need to know question was as follows: *Research Question/Proposal- Utilize data of current burn centers in order to evaluate current and future geographic locations of burn centers throughout the United States.* However since time constraints limited the number of things we could accomplish our new research question is: *Utilize data of current burn centers in order to evaluate the total number of people living within a 60 minute travel distance from burn center. This data should be of help to other people undertaking the task of finding the best locations for new burn centers.*

Our group will examine the geography of burn center locations throughout the United States. We will examine the accessibility to the burn centers relative to their geographic location. We will achieve this by creating a surface map with transportation buffers for each burn center location. Through our visual maps and analysis we hope to create a distribution of all burn facilities relative to populations by state, and determine access to burn facilities and verified burn centers as the percentage of population that could reach a burn center within a certain time. Our group is dedicated to developing the burn center service area buffers to in hopes that this information will be of much help to others who wish to find optimal locations for new burn centers.

3.) Objectives

There were numerous steps that were taken in order for our group to achieve our goals and the goals of our client. Those steps included: collecting data from the client and outside sources including locations of burn centers, populations near burn centers, transportation accessibility to burn centers. Following the initial data collection phase, our group began to analyze the data in a systematic manner. Our group was able to obtain data regarding all of the burn centers throughout the United States from our client Dr. Julie Hwang. We were also able to obtain census 2000 data, and the street map of the United States from the x-drive available to geography students at DePaul University. Our group analyzed the data that we obtained from our client. We left the data that we obtained from the x-drive unedited. After cleaning the data regarding the burn centers we were able to begin the geocoding process. We converted our cleaned data in tabular form to a dbf file and then added the data to the ArcMap program. Then we were able to geocode the results. Unfortunately, we had to manually geocode approximately twenty of the locations, and we had to remove one of the locations because it had an incorrect address. Thus we were able to geocode 124 out of the 125 burn center locations. Next, we added in the census and street data into ArcMap. Finally, we created a service area of population that was within one hour of travel time to each of the burn centers by utilizing the network analyst extension in ArcMap. We were able to calculate this travel time by utilizing the network analyst wizard and obtaining the speed limit from the street map layer. Our end result was to create visual maps to meet the goals of our research questions. We determined the number of people in the U.S. currently served by burn centers because of their proximity to a burn center within 60 minutes travel time.

Information Structure

The structures of the information products to be generated for each information category are as follows:

Map geocoded with every burn facility location in the United States.

- Thematic Map showing distribution of all burn facilities relative to populations.
- Using Transportation Buffer Map, determine access to *burn facilities* as the number of people that could reach a burn center within 60 minute ground travel time.

3) SYSTEM REQUIREMENTS

Introduction – The Burn Center Advocacy Group along with the support of our client are going to use the GIS mapping programs in order to achieve our goals. Our primary goal is to answer the following question: What is the proportion of population per state within one hour of travel time from the verified burn center. In the following report determine the need to know questions in order to meet our goals, and break them down by attribute. We also divide the task among the group members for time management purposes.

Data Requirements as a Conceptual Database Design:

2.1 Matrix of need to know questions cross-referenced with entity classes

	Where are the facilities located?	What areas are accessible by car within 1 hour from each facility?	What is the population inside and outside of those areas?	How the facilities are geographically dispersed based on size and services?
Entity Classes				
U.S. Burn Facilities	X	X	X	X
2000 U.S. Census			X	X
U.S. Road Network		X	X	X

2.2 Entity Relationship Modeling

Name of Entity: U.S. Burn Facilities

Entity Definition: Information on all verified U.S. burn facilities.

Attributes Needed: Locations, size, and services

Entity Relationship: Locations will be mapped using U.S. road network.

Spatial Type: Points

Temporal Character: Current

Name of Entity: 2000 U.S. Census

Entity Definition: Information from the 2000 U.S. Census

Attributes Needed: Populations for all tracts.

Entity Relationship:

Spatial Type: Raster

Temporal Character: 2000

Name of Entity: U.S. Road Network

Entity Definition: Mapped roads in the U.S.

Attributes Needed: Roads accessible within 1 hour from facilities.

Entity Relationship: Limitations of the network determine which tracts are covered.

Spatial Type: Lines

Temporal Character: Current

Derived Data Categories:

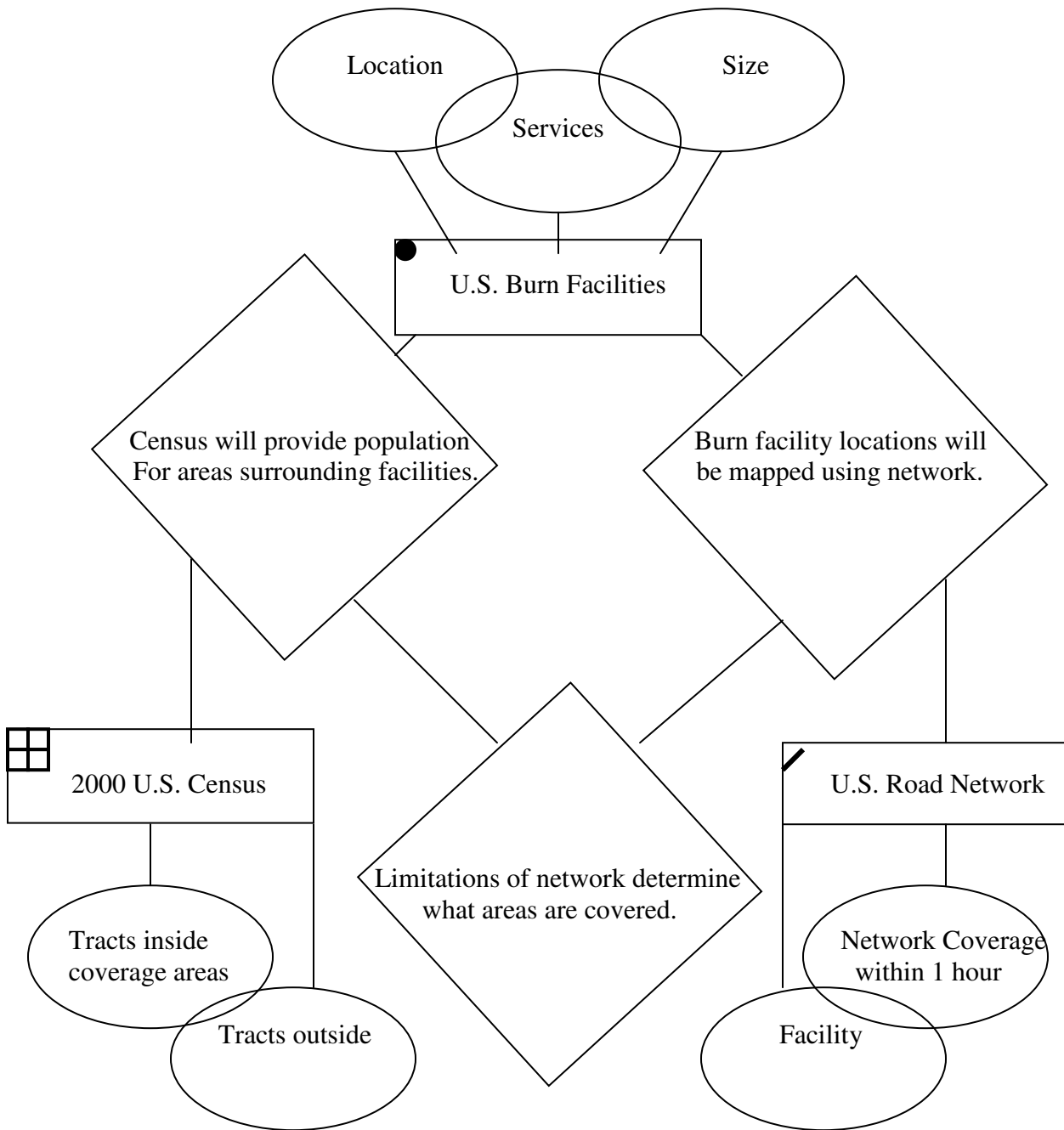
Name of Entity: National Burn Information Exchange (NBIE)

Entity Definition: Burn statistics shared between burn facilities.

Attributes Needed: Recovery rate based on facility size and services.

Entity Relationship: Facility Locations and Road Network

2.3 Entity Relationship Diagram (ERD)



coverage area

Locations

Software Requirements:

		<u>Need to know Questions</u>		
Function Capabilities	Where are the facilities located?	What areas are accessible by car within 1 hour from each facility?	What is the population inside and outside of those areas?	How the facilities are geographically dispersed based on size and services?
Select by attribute	X			
Table and Shapefile Joins	X	X	X	X
Georeferencing	X			
Overlay		X	X	X
Map Display	X	X	X	X
Symbology	X	X	X	X
Analysis Tools	X	X	X	X

Personnel Requirements: The Burn Center Advocacy Group is made up of three members, all who are fully dedicated to the task at hand. Our team has chosen to self divide the task among the three group members. We have worked in a collective manner thus far and will continue to do so throughout the project. Although we have worked in a collective effort we will divide the tasks needed to complete the project and save the amount of hours spent per person on the project.

Kelly Chiczewski

- Will be the primary contact person for the group client requiring four hours of work
- Will perform the task of data collection and manipulation requiring four hours of work
- Will perform the task of geocoding requiring three hours of work
- Will contribute to Needs Assessment requiring three hours of work
- Will contribute to System Requirements requiring three hours of work
- Will ensure Final Project Presentation requiring two hours of work
- Will contribute to Data Acquisition Report requiring three hours of work

Marisol Ruiz

- Will perform the task of data collection and manipulation requiring four hours of work

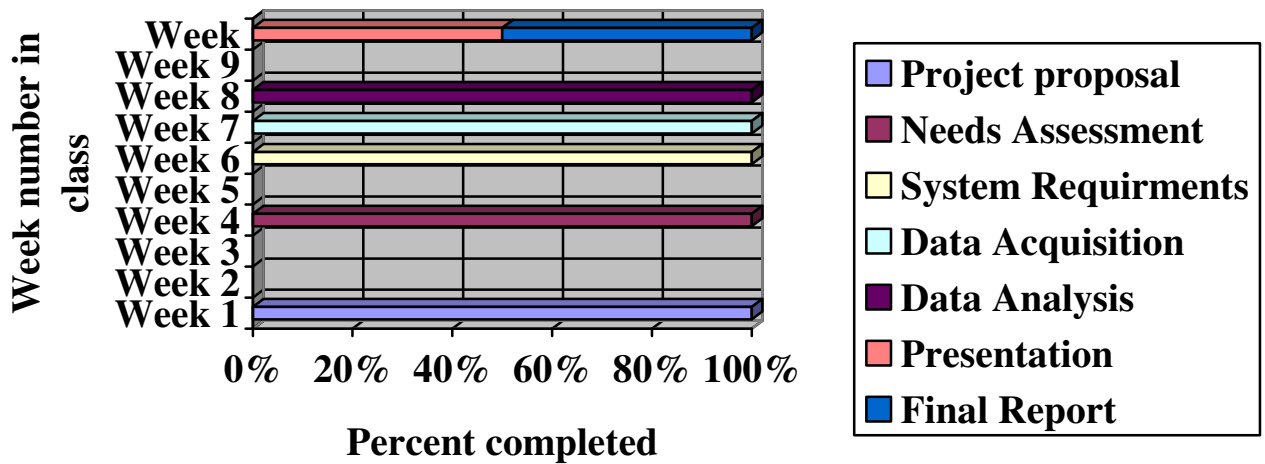
Will contribute to Needs Assessment requiring three hours of work
 Will contribute to System Requirements requiring three hours of work
 Will contribute to Data Acquisition Report requiring three hours of work
 Will contribute to the map creation and analysis requiring three hours of work
 Will contribute to the completion of the final report requiring two hours of work
 Will contribute to the completion of the final project requiring three hours of work

Joel Toemy

Will be the primary contact person for the group client requiring four hours of work
 Will perform background research for the literature review requiring three hours of work
 Will perform the task of data collection and manipulation requiring four hours of work
 Will perform the task of map creation and analysis
 Will contribute to Needs Assessment requiring three hours of work
 Will contribute to System Requirements requiring three hours of work
 Will contribute to Data Acquisition Report requiring three hours of work

Timing:

Timing of tasks to be completed



The timing chart above is the Gantt format. It is describing the steps that need to be taken for the completion of the task, and the deadlines according to the week of class. There are seven steps to the completion of this project, all of which have different deadlines. Our group will collectively work of each section of the project. Each step of the project is broken down by task in the personnel requirements section. The Table

below elaborates on the graph above providing the exact date that each step of the project must be completed by, the amount of time that it will take to accomplish, and which member of the group will be responsible for that section of the project.

1	Project Proposal	January 16, 2007	2 hours	Kelly, Joel, Marisol
2	Needs Assessment	January 30, 2007	10 hours	Kelly, Joel, Marisol
3	Systems Requirements	February 13, 2007	15 hours	Kelly, Joel, Marisol
4	Data Acquisition	February 20, 2007	7 hours	Kelly, Marisol
5	Data Analysis	February 27, 2007	7 hours	Joel, Marisol
6	Presentation	March 20, 2007	8 hours	Kelly, Joel, Marisol
7	Final Report	March 20, 2007	10 hours	Kelly, Marisol

Institutional Requirements:

The data consists of an Excel file that tabulates 126 burn centers in the United States and lists 13 attributes, among them are, address, hospital ID, number of beds per facility, and the longitude and latitude of each location.

Data Provider

- Dr. Julie Hwang, Assistant Professor in Geography and GIS at DePaul University and GEO 242: Geographic Information Systems II course instructor.

4.) DATA ACQUISITION

4.1) Introduction: The data for our data acquisition report was obtained from the geography files on hand at DePaul University, from our client Dr. Julie Hwang, and from the network analyst for our transportation data. Our database started as excel files, which are being converted into dbf files for geocoding purposes, and shape files containing the census data and transportation data. Our goal is to manipulate the data that we have obtained in order to meet our goal of answering the question: what is the proportion of population per state within one hour travel time from the verified burn center?

4.2) Data Source Steps: Of paramount importance in figuring out what steps to take when searching for data, a meeting with Burn Center Advocacy Group client Dr. Julie Hwang was arranged. During the meeting with Dr. Julie Hwang, project needs were discussed, to know what kind of data was to be obtained. Dr. Hwang expressed her need to find optimal geographic location of burn centers throughout the United States in order to assess areas of the United States that are underserved, and over served by burn center facilities. Dr. Hwang stated that she would like for the Burn Center Advocacy Group to concoct a geocoded map with every burn facility location in the United States, a thematic map depicting (all and verified) burn center facilities relative to population and location by measuring burn centers per million populations and per 100,000 square miles. Dr. Hwang also wanted to determine service area based on travel time. The Burn Center Advocacy Group was told by client Dr. Hwang that this service area based on travel time could be obtained by utilizing (60 day free evaluation copy) Arc GIS 9.2's Network Analyst software. Using Network Analyst, our group must make a transportation buffer map that shows access to burn center via travel time taken per certain percentage of population in an area to closest burn center facility. The data that was to be used to produce Dr. Hwang's information needs were given to the group by herself. Dr. Hwang supplied the group with one data set, as well as other literature. The data set is Verified Burn Centers which is an Excel file, and the various pieces of literature are in the form of PDF files. The data that the Burn Center Advocacy Group gathered were Census Data 2000 and Transportation Data, both as shape files. Census Data 2000 was obtained from the U.S. Census Bureau American Fact Finder and Transportation Data was obtained from Arc GIS 9.2 Network Analyst.

4.3) Fitness for Use: Each of the data sets described above are critical to the end result of our project. Each of the data sets plays a critical role in the end result of our project. First the Verified Burn Center data is the foundation of our project. It provides us with the locations of each verified burn center in the United States. The limitations with this data set are that there are many other burn centers that are not considered verified, but our group is only working with verified burn centers. Therefore our final outcome may not be exactly true to reality. This critical data will be depicted as a dot on our final maps and report. The Census data from the year 2000 is critical to our final project. It depicts population statistics in the United States from the year 2000. The limitations with this data set are that the data is from the year 2000; therefore it is quite out of date considering population standards. The final data set, transportation data, is the cornerstone of our final project. We will use this data to find out the amount of people that have access to verified burn centers within one hour of travel time. The limitations with this data is that

travel times may vary significantly from state to state and city to city skewing our data if that is not accounted for. Our data meets the needs of the client, and is exactly what she has hoped for as a final outcome.

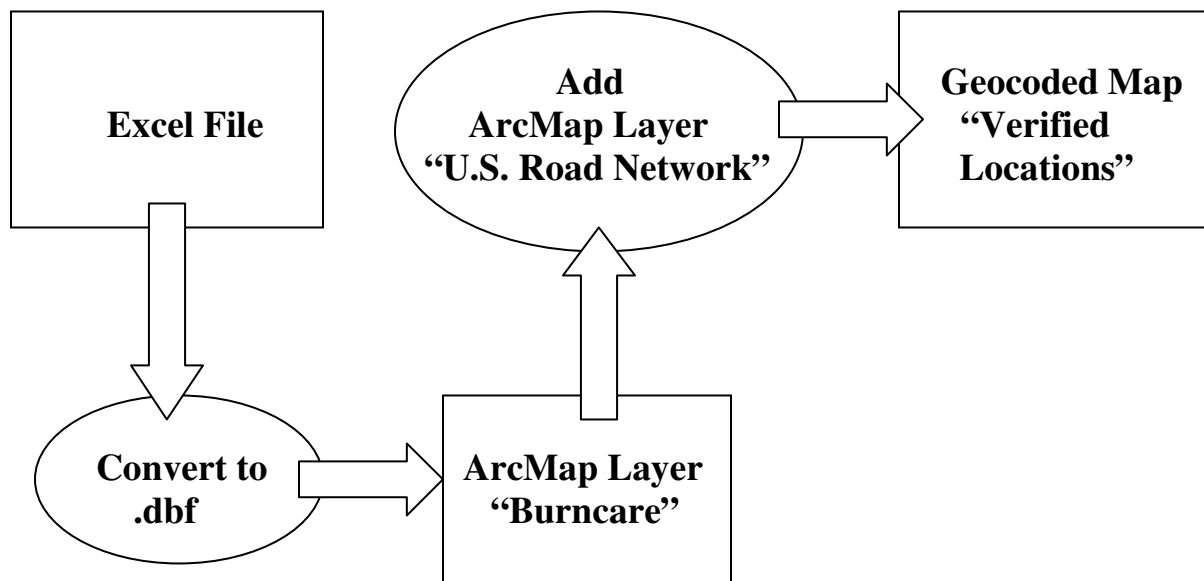
4.4) Data Acquisition Constraints: There is a significant amount of data that could have contributed to our project that we were unable to obtain including: transportation data regarding emergency vehicles such as ambulances and emergency helicopters, and individual burn victims statistics. The emergency vehicle transportation data would have been significant because more people may have quicker and more reliable access to verified burn centers if they were in an emergency transportation vehicle. Background information regarding individual cases of burn victims would have been useful to our project, and would have helped us to understand the severity of this project. These data acquisition constraints have limited our project to the one main need to know question and project goal. Unfortunately, our limited number of group members has also prevented us from collecting more data and expanding out project goals.

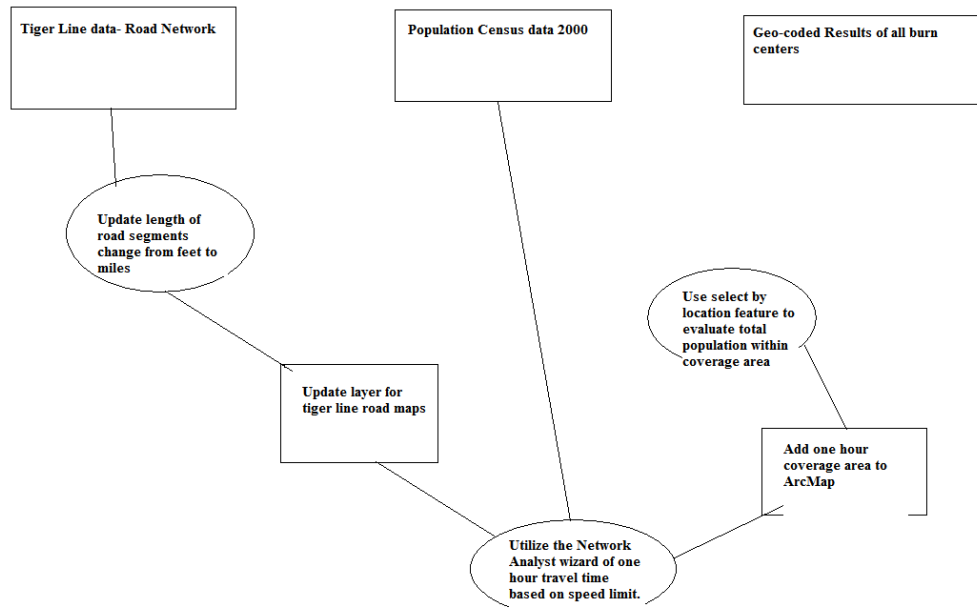
5.) DATA ANALYSYS

Introduction:

The Burn Center Advocacy Group has carried on the project with the client's goals and need to know questions in mind, in order to effectively achieve our objectives and answer the need to know questions. Our client's main goal is represented in our problem statement/research question, which designates the Burn Center Advocacy Group to *utilize data of current burn centers in order to evaluate current and future geographic locations of burn centers throughout the United States.* We will evaluate the location of burn centers throughout the United States by measuring the distribution of burn centers by population and by relative location to population using Arc GIS 9.2 Network Analyst. Using Network Analyst, our group must determine what areas are accessible by car within one hour of each burn center facility and use this information to determine what areas are over served and under served by burn center facilities. The client, Dr. Hwang has also asked for our group to measure success and failure rate of burn cases per burn facility, in relation to burn center access per burn case, in order to find if any relationship exists between burn case success or failure and burn center access.

Flow Chart:





Analysis Plan: What is the proportion of population per state within one hour travel time from the verified burn center?

There are many different data analysis steps that our group needs to take in order to answer our need know question that is posed above. First we were able to obtain and edit an excel file with the names and locations of every verified burn center in the United States from our client. Next we cleaned and normalized the data according to the following questions. Is the data in the Normal Form? Does cell have only one value? Is a column is on the same subject? Is each row unique? Is an attribute value stored in the right data type? Is the adequate width given to the field? Is the file in the proper format? Is the column header located at the first row? Once we have successfully answered each of these questions, then we convert the file into a database file (DBF), for geocoding purposes. Next we load the dbf file into ARC map and begin the geocoding process. We will use United States reference data from U.S. Census Bureau TIGER/Line for geocoding. We will continue to geocode each verified burn center by using the editor tool and ARC map. After the geocoding process we will create a new layer and overlay the population census tract data. In order to determine coverage area of burn centers

based on population data and tiger line data. In order to accomplish the task we utilized the network analyst extension. First we start three sets of unedited data including the tiger-line road network road population data, population data from the 2000 census, and our geocoded results. The first operation is to update the lengths of the road segments by changing the unit of measurement from feet to miles. Next we are going to create the service area based on distance. This will provide us with more information about the level of service provided by each burn center location based on distance. There are 124 burn center locations that are we were able to create a service area. We created a new service area from the Network analysis extension by the location of each of the burn centers. Using the Network analysis wizard we were able to create a one hour travel time coverage area based on the speed limits given in the street maps. After we completed the coverage area we were able to obtain the results and calculate the total amount of population that has access to burn centers within one hour of travel time.

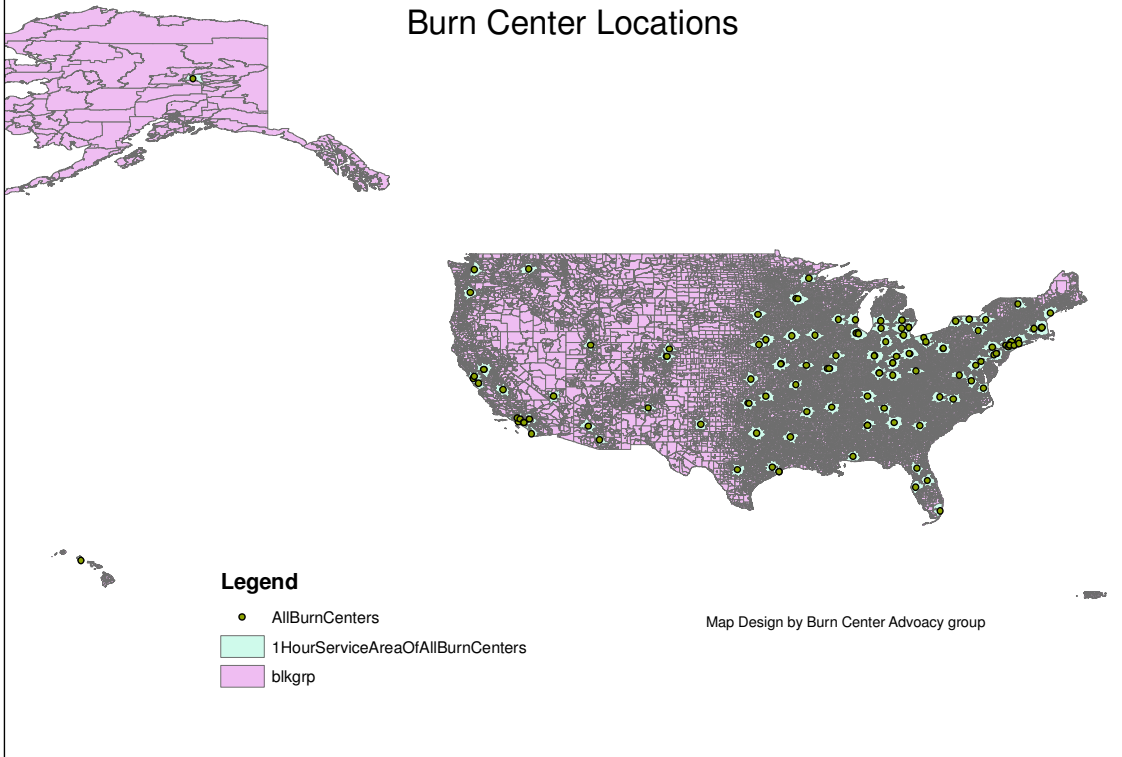
6.) RESULTS

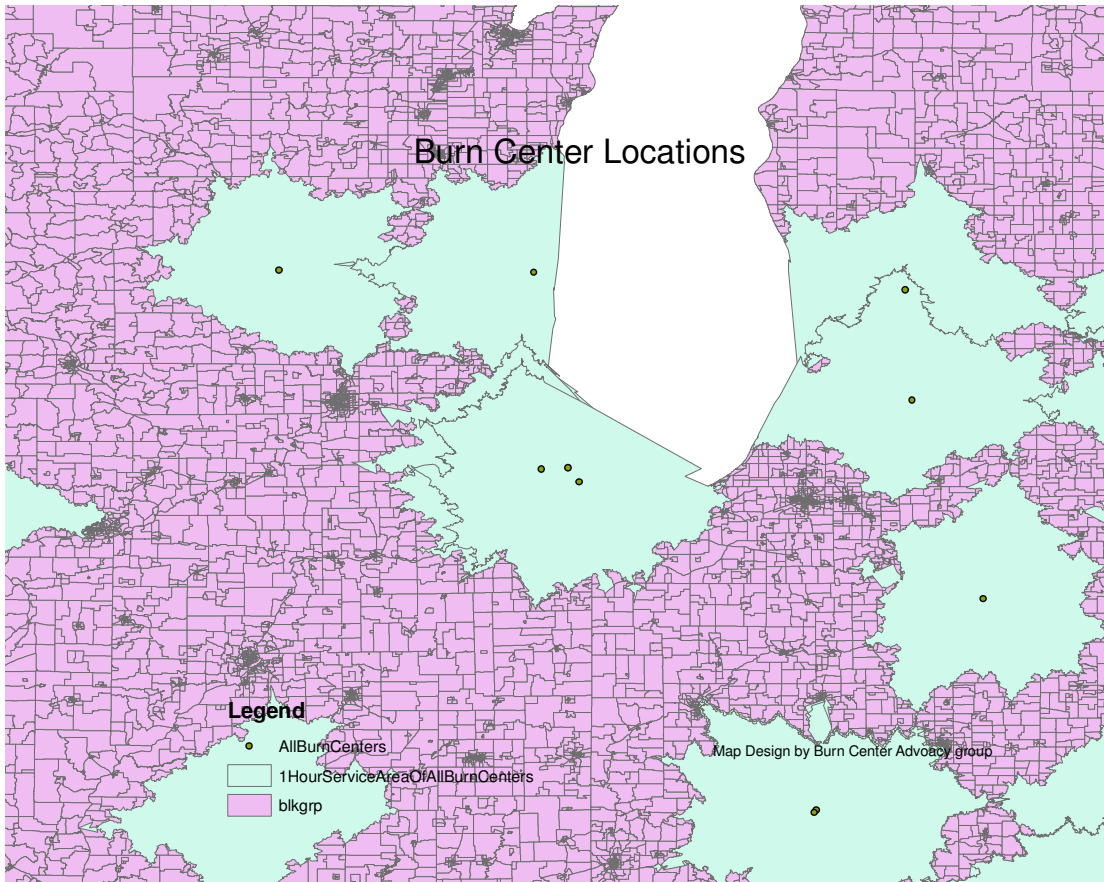
Introduction: By creating transportation buffers, we were able to isolate those census block groups that are accessible within 1 hour from a burn center. Then we were able to compare the populations of those census block groups with all the census block groups to get a proportion of the entire populations served by burn centers.

Findings: The service population is 190,344,882 and the total population was 295,385,748. This ratio of the two tells us that 64% of the population had access to a burn center. Therefore there are 36% of the population that does not have access to burn centers within one hour of travel time. There is also a concentration of burn centers in numerous locations, causing an overlap of the one hour travel time. For example, there are three burn centers in the Chicagoland area. Thus the coverage areas of these burn centers overlap. This indicates that the population in this area is overserved. This can also be seen in Southern California, where there are 5 burn centers in this area. There are also areas in the coverage area that are not populated. This mostly includes bodies of water, such as oceans, rivers and lakes.

The results that we obtained can be utilized for creating a better more effective method of opening new burn centers. For example, given that we concluded that the ratio of population with access to burn center, we have also found that 36% of the population has no access to a burn center within a 60 minute drive. The areas that have a relatively good number of residents and have no access to a burn center within a 60 minute drive might also attain access to a burn center, but via helicopter emergency medical services (HEMS) travel. If access to a burn center via air travel is not feasible, the area can be considered for the construction of a new burn center. From the burn center coverage map we can clearly see that there is some clustering of burn centers, and this can be a problem with the quality of service because it can cause unfair and ineffective burn center coverage in the U.S.

Burn Center Locations





The two maps depicted above portray the results of our project. The first of the two maps is of the locations of all burn centers in the United States, with the one hour travel time coverage area. As mentioned in the results area there is a clustering of burn centers in different areas of the United States. For example, the second map depicts the Chicagoland area. As you can see in this map, there are three burn centers in the Chicagoland area, and the coverage area of these three burn centers is overlapped. This creates an over served population.

7.) SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

To aid our client's purpose of determining burn center service area in the United States, we have produced a geocoded map of burn center locations, analyzed the street network data to produce 1 hour drive time buffers, and populated the map with census block groups to determine what percentage of the U.S. population is currently served by burn centers. We have been able to determine that 64% of the population is served, leaving 26% underserved.

Time constraints and personnel shortages, however, kept us from producing a more elaborate and multi-faceted product. Because we were unable to produce a map that depicted optimal locations for new burn centers, we did not accomplish the initial objective of our client. However the burn center service area map we were able to create should be of great use to the client.

We recommend that our product be used to create more products that will help further assess the performance of burn centers in the U.S. First, another analysis may be necessary to include transportation other than personal vehicles. Ambulances and helicopters would increase the distances within reach of burn centers. Also, our product does not take into account individual capabilities of burn care facilities. A product that weighted the services and sizes of each location would provide even further analysis. The ultimate goal would be a product that shows how recovery from burn incidences deteriorates over distance traveled for emergency burn care.

8.) TECHNICAL APPENDICES

Appendix A- Dr. Julie Hwang and Crystalyn Cepican were our two main contact people for the data and guidance throughout this project. Without these two people we could have never completed this endeavor.

Appendix B-

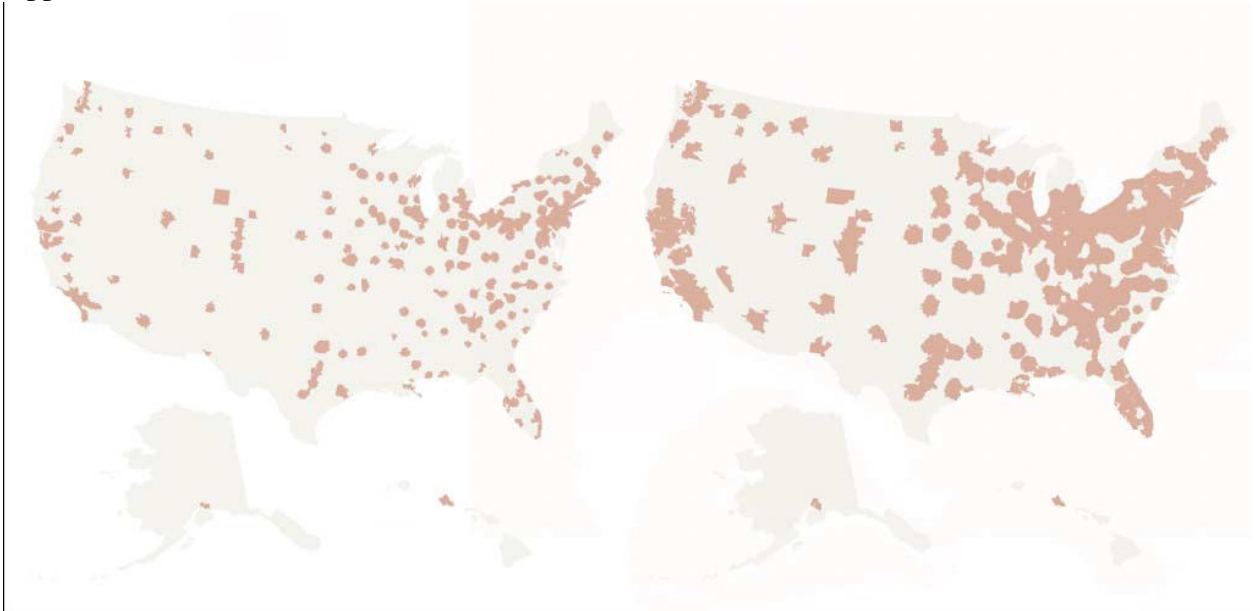


Figure 1. Areas of the United States With Access to Level I or II Trauma Centers by Ambulance or Helicopter

This article was crucial to the methodology that was used by our group. In comparison the results that we obtained are very similar to the results that were obtained in our article. This indicated that a large quantity of the population is not only underserved by burn centers, but it is also underserved by level II and level III trauma centers.

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