

Exploratory Analysis of Temporal Variations in Hospital Capacity in Tennessee

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Background

Understanding the relationship between hospital capacity and temporal fluctuations of the surrounding population is necessary to determine available capacity as hospital demand changes throughout the day. This is important in both normal situations as well as emergency response.

Research Objectives

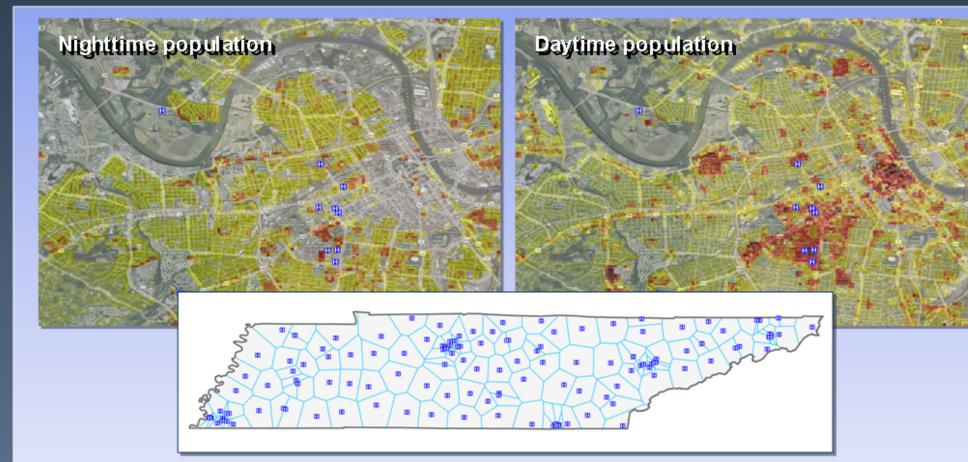
- Calculate target capacities for Tennessee hospitals using both daytime and residential population counts
- Compare calculated target hospital capacity with actual hospital capacity
- Determine correlation between population and hospital capacity for both daytime and nighttime

Data and Methodology

Using ArcGIS, Thiessen polygons were created from hospital point data to use as a surrogate for service area. The hospital data was obtained from the American Hospital Association (AHA) Annual Survey Database 2008. The Thiessen polygons were then intersected with the LandScan USA 2008 population database, which includes both daytime and nighttime population distributions. Using this data, required hospital capacity was calculated based on the temporal population differences. The calculated required capacity was then compared to the actual capacity in order to determine the correlation between hospital capacity and both nighttime and daytime population.

References

1. Assefzadeh, S. "Assessing the need to establish new hospitals." *Eastern Mediterranean Health Journey* 2.2 (1996): 334-339.
2. *AHA Annual Survey Database*. 2008. American Hospital Association. 21 July 2010 < <http://www.ahadata.com/ahadata/html/AHASurvey.html> >.



Temporal Variation of Population Surrounding Hospitals



The darker the color, the greater the daytime population is over the nighttime population. Strong differences are often found in urban areas

Analysis of Hospital Capacity

$$\text{Hospital beds} = \left(\frac{\text{Total population coverage}}{1000} \right) * BI$$

Where :

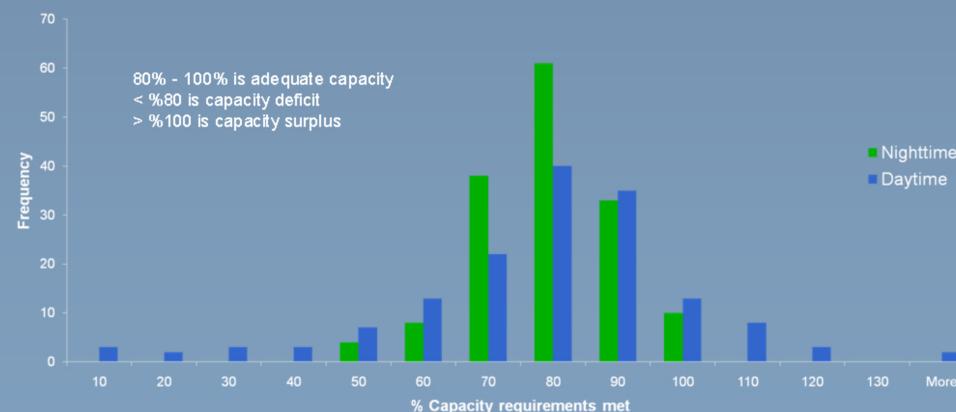
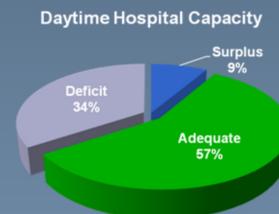
$$BI = \left(\frac{\text{Inpatient load in region per 100}}{365 * \text{Bed occupancy rate}} \right) * ALS$$

$$\text{Inpatient load} = \frac{\text{Facility admission}}{\text{Population}/1000}$$

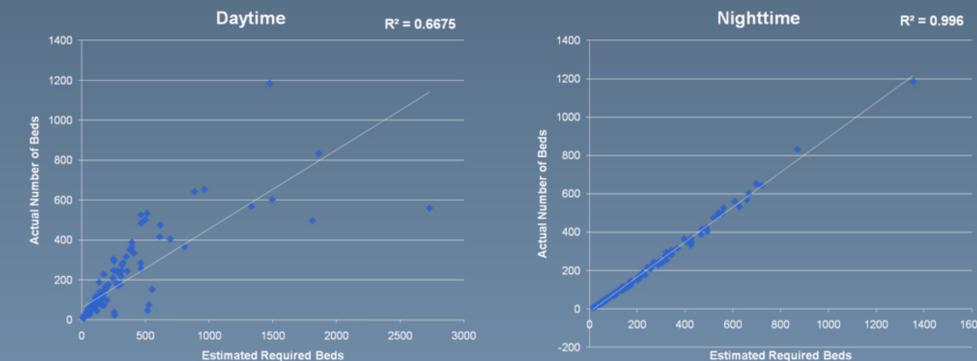
$$\text{Bed occupancy rate} = \left(\frac{\text{Inpatient days of care}}{\text{Bed days available}} \right) * 100$$

$$ALS = \frac{\text{Inpatient days of care}}{\text{Facility admissions}}$$

BI = Bed Index ALS = Average Length of Stay



Results



Conclusions

Nighttime hospital capacity is generally adequate for residential population. Capacity estimation method used is in line with what normal practices might be. Since daytime does not correlate as well, it could be that daytime movement of population is not factored into hospital locations.

Future Research Directions

- Determine how temporal population differences could affect emergency evacuation plans
- Analyze overlap between hospitals