Milestone One Testing a Model for an Automated Real-Time Acuity Monitoring System in the Emergency Department

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Abstract

Can patient acuity be continuously measured with an objective scale based on network variables? Acuity has historically been measured at irregular intervals? The purpose of this project is to determine if patient acuity in the ED is correlated to patient eigenvector centrality in the network of all face to face ED interactions. A strong correlation between network position and acuity is likely, and a change in network position will likely represent a change in acuity.

Find the GitHub repository here

Backgroun & Objectives

In an Emergency Deparmtent (ED), care is delivered over a network of face to face human interactions. Patients interact with registration staff, then a triage nurse who may decide to discuss the patient with a provider, the provider may then interact directly with the patient, and so on. In this way, the network grows over time, creating a web of care that may correlate with the amount and quality of care delivered to individual patients. - The purpose of this study is to explore associations between the network of interactions that take place in the Emergency Department and individual patient acuity. To study this relationship, I will analyze the following; 1) the frequency and duration of all interactions (patients, providers, nurses, technicians, & administrators) that occur in the ED, and 2) individual patients' medical and demographic characteristics. The network structural characteristics will be assessed in relation to the industry standard acuity measure, the Emergency Severity Index (ESI), and potential confounding variables. Using this data will require specific knowledge of the R statistical packages, network analysis, and data science. See Tables 1-4 for my learning goals with respective action items, timeline, and outcomes.

Table 1: Table continues below

	Demonstrate effective use of GitHub Version Control
Action Items	Use GitHub version control throughout project development
Timeline	Ongoing
Outcome	Complete record of data management & analysis

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Table 2: Table continues below

	Demonstrate working knowledge of R Studio & R Markdown
Action Items	All data wrangling & analysis in R Studio and all milestones completed in R Markdown
Timeline	Ongoing
Outcome	Final Project, Presentation, and Website Completed in R Markdown

Table 3: Table continues below

	Create useful visualizations of data
Action Items	Apply appropriate visualization tools to analysis results
Timeline	April 26 2018
Outcome	Appropriate Tables and Graphs in final presentation and manuscript

Table 4: Table continues below

	Apply appropriate statistical methods
Action Items	Execute rigorous statistical analysis of the data
Timeline	Apeil 26 2018
Outcome	Statistical tests are appropriate to the data and research purpose and error is adequately minimized

	Interpret and communicate results
Action Items	Recognize and communicate important results
Timeline	April 26 2018
Outcome	Results discussed in the final project speak to the research question and bridge a gap in the literature

Data

For this project, I have chosen to use, with permission from Vicki Hertzberg, the same data that I am using for my dissertation research. Data were collected using a prospective longitudinal observational study design with a random sampling of two shifts per week, one day and one night, over the course of a year, from July 2009 to June 2010, for a total of 104 shifts.(**???**) This strategy was chosen to minimize sampling bias related to seasonal or weekly fluctuations in census, acuity, and ED staffing changes. The purpose of the original study was to describe contact characteristics between patients and staff in the ED of a busy urban hospital to inform cross-infection control measures. Data were collected using a radio-frequency identification system that triangulated patient and staff (nurses, providers, administrators, and clinical support staff) locations with the ED at Emory University Hospital Midtwon.

Data Wrangling:

I have requested the original/raw data, which will require cleaning and organizing to meet the needs of my research aims. Data will be maintained in private repositories in the GitHub version control platform. Patient characteristic data will be evaluated for missing or implausible data with discriptive analyses, and RFID generated networks will be included for statistical analysis if variables of network density, centrality, and a network diversity scale are distributed normally across networks.

Analysis Plan

Exploratory Analysis

Descriptive statistics of the network data as well as patient demographic data will be evaluated for asssumptions of normality. The data will be skewed in certain predictable ways due to the observed patient populations. The distribution of study subject demographics will be described in tabular format, noting irregularities and potential sources of error.

Variables needed for final analysis:

- Network Variables
- *Patient eigenvector centrality* (dependant varialbe of interest)
- Network density
- Network clustering coefficient
- Network diversity scale??
- Staff variables
- Title (nurse, provider, technician, administrator)
- Patient variables
- *Acuity* (ESI, independant variable of interest)
- Commorbidities (index)
- Gender
- Age
- Race
- Ethnicity
- Arrival mode (ambulance v. walk-in)
- Education (if available)
- Disposition (admission v. discharge)
- Length of stay (common measure of quality in the literature used for comparison)
- Time before first provider contact (common measure of quality in the literature used for comparison))

Analysis

Muliple linear regression will be used for the final analysis to assess the correlation between patient acuity and patient centrality. Relationships will be evaluated visually (see below) as well as statistically to an alpha of 0.05.
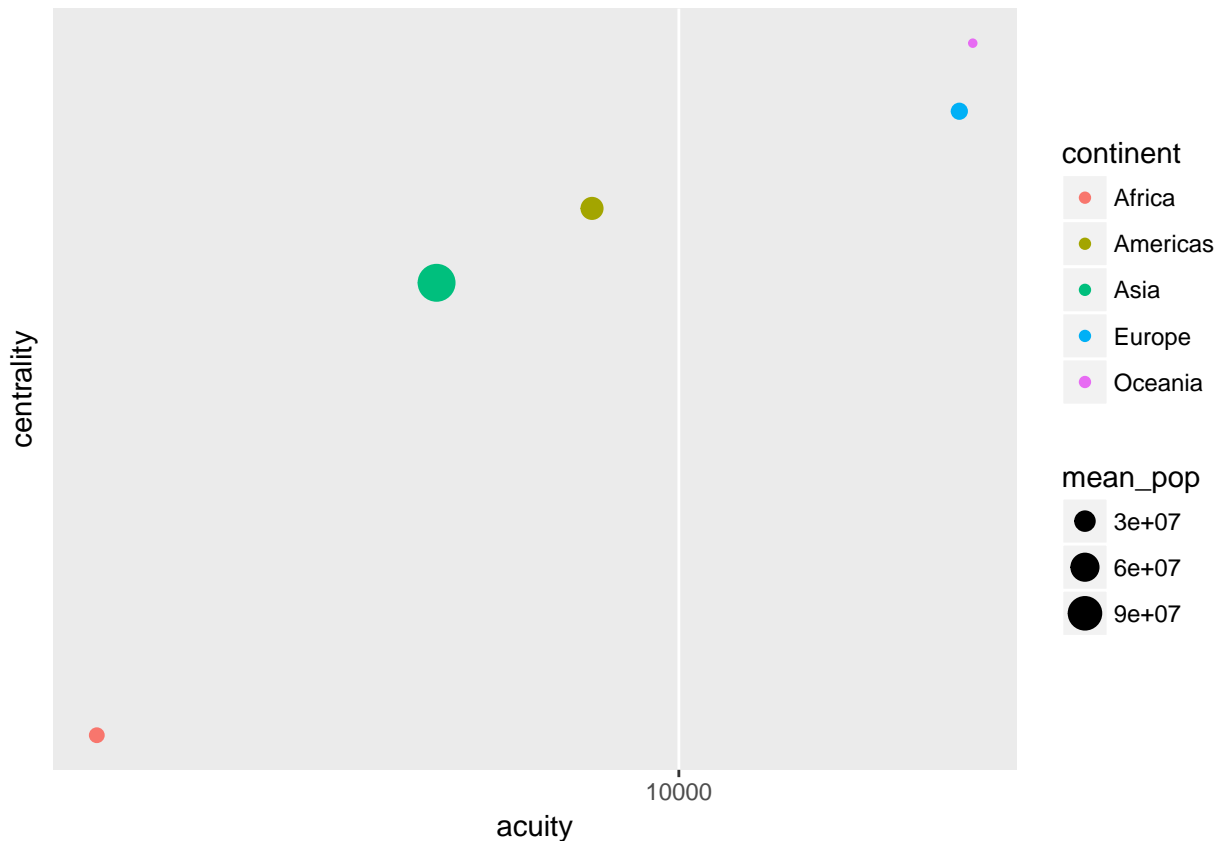
Schedule

Milestone 1: February 14th, 2018 -Objectives Milestone 2: March 15th, 2018 Final Proposal: April 26th, 2018

Results

Results will be discussed with the visual supplementation of network graphs. This allows the reader to understand concepts that may be difficult to grasp through text alone.

Discussion

Allocating staff resources in an Emergency Department is an ongoing challenge. How can these results begin to offer solutions to ED staff and patient management?

What were my primary limitation (both expected and unexpected)?

Conclusion

Did I meet my learning objectives? How would I design a better study next time?

References