Informatics 172: Mining ER Data
Project Proposal
Feb 16, 2017

Group LAX

I. Problem Statement

Frequent flyers are one of the principal causes of overcrowding in US emergency departments (EDs). Frequent flyers are patients who visit the ED for treatment four or more times a year. It is not clear why frequent flyers visit the ED so often, but it is also highly unlikely that any patient will face a life or death emergency situation four or more times a year. Their visits to the ED may be due to both a combination of intentional and unintentional misuse possibly because of a lack of proper insurance or adequate medical knowledge. They may be homeless or chronically ill; they may also be malingering. Regardless of their reasons, frequent flyers consume valuable ED resources. Moreover, their dependency on the ED often prevents them from seeking out other options that could be more tailored and beneficial to their health needs.

II. Significance

Identifying groups of ED frequent flyers and their specific needs will help reduce ongoing UCI ED costs and resources. It is in the best interests of our client, UCI ED, to identify and categorize frequent flyers in order to facilitate interventions targeted at reducing the number of frequent flyers—and by extension, the amount of ED overcrowding. By decreasing overcrowding rates at the ED, it will also allow ED doctors to better focus their care on treating patients with life-or-death conditions, as opposed to also having to care for patients that have health issues that would be more appropriately treated in primary care, urgent care or other medical departments. Ideally, the ED should only care and provide treatment for patients that are dying or in danger of dying within a twenty-four hour period.

III. Relevant Academic Research

I. A Report on Frequent Users of Hospital Emergency Departments in South Carolina

The first relevant academic research we looked into was the South Carolina Public Health Institute (SCPHI)'s *A Report on Frequent Users of Hospital Emergency Departments in South Carolina* in 2011 with significant findings about ED frequent flyers. The report explores how the ED is often utilized and examines the characteristics of frequent flyers to better understand why they exist in EDs. SCPHI grouped the major trends for ED utilization into the following categories: visit rates, age and race, insurance status, non-urgent and preventable visits. Specifically, they found from studies that the age groups with the heaviest ED utilization came from infants and elders age 75 and older, followed by people between the ages 19-44 years old. (S, 2011). They also found that nationally, EDs were utilized twice as much by African-Americans compared to whites, but there was no correlation between Hispanics and how often they visited the ED (S, 2011). From the studies they analyzed, SCPHI also found significance for insurance status being a plausible explanation for frequent flyer visits. Medicaid patients tended to utilize the ED more frequently "than those with private insurance or the

uninsured" due to the fact that Medicaid patients have limited to no other choices for care because of how few care providers accept patients with Medicaid as insurance (S, 2011).

Furthermore, SCPHI reported that multiple national studies showed that behavioral issues and substance abuse was a major cause for people to frequent the ED. For example, these national studies included findings about how more than 50% of frequent flyers were also diagnosed with a mental health condition or substance abuse disorder and that the most frequent flyers with behavioral health diagnosis were diagnosed with schizophrenia (S, 2011). To further relate the relevance of this report to our project, the significance of clustering frequent flyers and their needs is not solely to decrease overcrowding rates at EDs, but also to help ED frequent flyers reach a better care for their health issues. The SCPHI's report supports this claim by explaining how EDs are not always the best option for patients with behavioral health issues since EDs are not staffed or equipped with the proper resources to care for their needs.

Their report concludes that "High ED utilization may not be an 'abuse' of the ED by most patients, but rather an indicator that the health care needs of these patients have not been met in their usual primary care setting' (S, 2011). THE SCPHI analysis and report is supported by data that is categorized under top diagnoses for ED Patients. This data is divided into 4 columns with age and frequent vs. infrequent users and whether or not their reasons for visiting were preventable in bold. In conclusion, the data and the findings of the report are relevant to helping us approach the problem and better understand how to sort the ED patient data we will be given by the UCI ED.

II. Emergency Department Use in New York City: A Survey of Bronx Patients

The second relevant academic research we inquired into was the *Emergency Department Use in New York City: A Survey of Bronx Patients* published in *Issue Brief*, on November 2000. The Center for Health and Public Service Research at New York University conducted interviews with 669 ED patients ages 18 to 55 at four hospitals in the Bronx. They asked the patients about the reasons that they came to the emergency department. They found that only 13.7 percent of respondents came to the ED because of an emergency condition, whereas 34.1 percent of respondents reported that it was the convenience and level of service that attracted them to the ED. They then asked the patients of the duration of their condition or if they had any illness prior to their ED visit. They found that 60 percent of respondents had been ill at least three days prior to their ED visit. They proposed that if there was alternatives to EDs that did not require patients to wait an extended period of time before getting treated, offered convenient hours and staffs who treated patients with respect, there would be a large chance that these frequent ED visitors would seek care in those sites. They also suggested that improving primary care could be a potential solution to reduce the number of preventable ED visits. Specifically, being responsive to patients' needs, developing infrastructure, re-engineering service, "making primary care available at nights and on weekends", increasing the telephone consultation could all be used to develop primary care system, and thus fundamentally diverting non-emergent patients from EDs toward primary care facility (Billings, 2000).

III. Redefining Frequent Emergency Department Users

The third relevant academic research paper we looked into was the "Redefining Frequent Emergency Department Users" published by George Washington University in *Issue Brief*, on April 2014. The author discusses the misconceptions about frequent flyers and proposes solutions on how this varied and complex issue can be solved. The paper explains how complex the problem with frequent flyers is by talking about the economic, social, medical, mental, and political standpoints. Also, it provides multiple examples of hospitals where interventions were conducted in order to help pinpoint better solutions. For example, in a clinical case management conducted in San Francisco General Hospital, patients were assigned to a social worker wo each possessed a comprehensive case management model. Each model entailed several different kinds of problems with the correct service that it could benefit from. Ultimately, frequent flyers are only part of more complex problem and the underlying issues need to be address before and form of progress can be made (Waldner, 2014).

IV. Existing Solutions and Gap Analysis

Frequent flyers are not unique to UCI ED. There are frequent flyers in many or most emergency departments and some EDs have attempted to address the issue.

NYU Center for Health and Public Service Research has developed an algorithm to help classify types of ED utilization. The data from almost 6,000 ED records was abstracted and each case was classified as either Non-emergent, Emergent/ Primary Care Treatable, Emergent-ED Care Needed- Preventable/ Avoidable- Emergency, or Emergent-ED Care Needed- Not Preventable/Avoidable- Emergency. NYU Center for Health and Public Service Research obtained data that contained information on "initial complaint, presenting symptoms, vital signs, medical history, age, gender, diagnoses, procedures performed, and resources used in the ED." The NYU algorithm is a powerful information-based solution to the problem of ED frequent flyers, but attempts to validate and apply it in a hospital setting have had mixed results. Ballard (2010) and Gandhi (2014) report that the algorithm was moderately successful at identifying and categorizing ED frequent flyers in the original Bronx sample and on a nationwide sample, but follow-up studies by Jones (2013) indicate that the algorithm is insensitive to changes in patterns of ED utilization--which limit its usefulness as a basis for targeted interventions--and a recent evaluation by Jeffery (2016) reveals that the algorithm does not perform well on populations that differ substantially from the original Bronx sample it was trained on.

Other systems exist that attempt to automatically intervene when they encounter frequent flyers. The Kaweah Delta Health Care District implemented a system to identify these individuals by creating an algorithm that uses discharge data, especially primary diagnoses, to identify the frequent flyers. If the system determines that a patient has made an unnecessary ED visit, it automatically sends them an explanatory letter. The system automatically enrolls patients who have had three inappropriate ED visits in Kaweah Delta's Bridging Care Program, which helps connect them with community medical resources. By and large, the system succeeds at

rerouting frequent flyers to urgent care centers instead of the ED. However, the system relies principally on ED doctors' primary diagnoses, which do not always identify or encompass underlying chronic illnesses. Thus, it is not very effective at reducing ED visits from chronically ill frequent flyers.

V. Proposed Novel Innovation

Our proposed innovation attempts to build on the work of the existing solutions. Our clients will supply us with a variety of data in a structured format. The various types of data we intend to work with are detailed in the list below.

- MRN
- ESI level
- Language
- International travel
- Diabetes
- Height, weight, age,
- Presenting vitals
- Time and date of service
- ICD-10 Code
- Medications
- +/-PMH
- +/-PSH
- Allergies
- +/- Social history
- Insurance
- Zip code
- Employment
- Race/ethnicity
- Other specialty clinic visits
- Mode of transportation
- Disposition

Ideally, we will use the above data to create clusters of anywhere from 2-5 groups of frequent flyers with similar needs by using data analysis tools such as R, SPSS, or Excel. To the extent that geographic information is available, we can create map-based visualizations using ArcGIS or graphical visualizations using D3 or Tableau. Revealing these needs will lead to the possible interventions the UCI ED can take to address frequent flyers and decrease their ED overcrowding rates. Depending on the proposed intervention, an additional goal for our team might be to test the effectiveness of the intervention (subject to time and availability of resources).

Previous solutions discussed in Section IV are limited primarily by two factors: first, they are not portable (that is, they do not trivially work for any hospital or any dataset); second, they do not make use of all the available data. We will overcome the first factor by obtaining data directly from UCI ED. Our solution will thus necessarily produce results customized to the client. We intend to overcome the second factor by making full use of *all* the data available to us. The literature we reviewed indicates that frequent flyers repeatedly visit the ED as a result of a combination of factors, and that the information available from a primary diagnosis often fails to adequately encompass them. We expect to have access to a wide enough variety of data that we will be able to sketch a comprehensive picture of UCI ED's frequent flyers. This in turn will allow us to propose highly-targeted solutions.

VI. Approach

Part I: Literature Review

Our first step will be to review literature about frequent flyers in the emergency room to determine what types of frequent flyer are most common and what characteristics are significant. This will help guide our subsequent analysis of the data and narrow down how we will decide to group the patient data from the UCI ED in order to find possible correlations. It will also provide us an opportunity to test whether the taxonomy of frequent flyers described in the literature is borne out by the data collected from UCI ED.

Part II: Data Analysis

The bulk of our project will be analyzing the data we receive to develop our own taxonomy of frequent flyers. We expect our clients, Andrew Wong, MD, MBA and Maxwell Jen, MD, to send us an unsorted, but structured dataset containing a variety of information about each frequent flyer, including (but not necessarily limited to) presenting vitals (e.g., height, weight, age), known health issues, employment, recent travel history, insurance information, race/ethnicity, reason for visiting the ER, treatment received, lab results, etc. If necessary, we will subdivide the dataset according to qualitative criteria. Then we will use statistical software (R, SPSS, etc) to conduct multiple correlation testing on the provided data to see if we can identify factors that are strongly correlated with each other. We hope this analysis will expose various "hidden" groups of frequent flyers in the data. We also intend to visualize the data if possible, especially on maps or graphs (using ArcGIS, D3, Tableau, etc.), subject to the availability of useful location data.

Part III: Devising Targeted Solutions

Once we identify groups of frequent flyers from the structured ED data, we will attempt to devise group-by-group solutions to reduce the number of frequent flyer visits. For example, if we determine that a nontrivial group of frequent flyers come from the same neighborhood, are low-income and have respiratory problems, we might recommend that the hospital send someone into that neighborhood to conduct tests on the air quality.

VII. Project Timeline

Team Formation/First Meeting/Establish Roles - 1/31

Project Synopsis - 2/2

First Meeting with Client - 2/8

Find Relevant Literature Reviews - 2/16

Project Proposal - 2/16

Data Analysis - 2/24

Preliminary Project Website - 2/28

Final Project Website - 3/24

Final Project Report - 3/24

VIII. Management Plan

Emile Shehada: CEO, Project Manager

Kathy Pang: CTO, Web Designer and Developer, Analyzer

Grace Choi: CCO, Researcher, Writer

Calvin Chau: Researcher, Analyzer

Peipei Nie: Researcher, Web Designer

Nestor Gomez: Researcher, Copy Editor

Christian Amaya: Web Designer and Developer, Analyzer

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