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) (Hoot, 2008). Frequent flyers are patients who visit the ED for treatment four or more times a year (Grover, 2009). 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. Part of the problem is that EDs may not have the resources to identify these individuals, leading to a barrier in developing various interventions to address the issue. As noted by our clients, Andrew Wong, MD, MBA and Maxwell Jen, MD, the frequent flyers' visits may be due to both a combination of intentional and unintentional misuse. Patients might intentionally misuse the ED if they are malingers or lack proper insurance. Patients might unintentionally misuse the ED if they do not understand the healthcare system and lack adequate medical knowledge. They may be homeless or chronically ill. Regardless of the reasons, frequent flyers consume valuable ED resources, and their dependency on the ED often prevents them from seeking other options that could be more tailored and beneficial to their health needs. ED frequent flyers is not a unique problem. It exists in most of the emergency departments including the UCI ED. The UCI ED has a list of structured and unsorted data on their frequent flyers, but has never taken any actions to approach this problem. There is currently no system in place to identify who these frequent flyers are or to address their needs, but their goal is to determine the primary drivers for their ED frequent flyers in order to devise their own targeted interventions and decrease the overcrowding rates at UCI ED.

II. Significance

Identifying groups of ED frequent flyers and their specific needs will help reduce ongoing UCI ED costs and resources. Identifying and categorizing frequent flyers is a necessary first step for developing effective interventions targeted at reducing the number of frequent flyers—and by extension, the amount of ED overcrowding. By decreasing overcrowding rates at the UCI ED, it will also allow their 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, EDs should only care and provide treatment for patients who are dying or are in danger of dying within a twenty-four hour period.

III. Relevant Academic Research

To better understand our problem and narrow down popular characteristics found between ED frequent flyers, we evaluated different published research about frequent flyers in the EDs. We found similar general characteristics on ED frequent flyers across multiple research articles that are relevant to our sample population of the UCI ED's frequent flyers.

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

South Carolina Public Health Institute (SCPHI)'s *A Report on Frequent Users of Hospital Emergency Departments in South Carolina* 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). Nationally, EDs were also utilized twice as much by African-Americans than whites, but there were no correlation between Hispanics and how often they visited the ED (S, 2011). 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).

SCPHI also 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. Their data and findings of the report helped us approach the problem of sorting our own frequent flyer data for the UCI ED.

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

In *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 their patients for the reasons that they came to the ED and 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. When the patients were asked of the duration of their condition or whether or not they had any illnesses prior to their ED visit, they found that 60 percent of respondents had been ill at least three days before their ED visit. The research center proposed that if there were alternatives to EDs that did not require patients to wait an extended period of time before getting treated and offered convenient hours and staffs who treated patients with respect, there would be a large chance that these ED frequent flyers would seek care at 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

George Washington University's *Redefining Frequent Emergency Department Users* in *Issue Brief* 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. 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 who 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 a more complex problem and the underlying issues need to be addressed before any 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 most of the emergency departments, and some of them have attempted to address this 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 if any ED patient has made an unnecessary ED visit for the third time, 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. Approach and Proposed Innovation

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. Our proposed innovation attempts to build on the work of the existing solutions. Our clients, Andrew Wong, MD, MBA and Maxwell Jen, MD, 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
- Gender, height, weight, age
- Presenting vitals
- BP
- BP Map
- HR
- RR
- Temperature
- SpO2
- ETOH Daily Intake
- ETOH Frequency
- ETOH Binge
- Time and date of service
- ICD-10 Code
- Medications
- +/-PMH
- +/-PSH
- Allergies
- +/- Social history
- Primary and Secondary Insurance
- Zip code
- Employment
- Race/ethnicity
- Other specialty clinic visits
- Mode of transportation
- Disposition
- Tobacco Use
- Visit Diagnosis
- Chief Complaint
- Visit Prescriptions
- Visit Radiology Orders
- Visit Medication Orders
- Visit Lab Orders
- Specialty Visits

Ideally, we will use the above data to create clusters of anywhere from 2-6 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 will create map-based visualizations using ArcGIS. We hope this analysis will expose various “hidden” groups of frequent flyers in the data. 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 a variety of types of structured data, especially data that the literature indicates is strongly correlated with ED overuse. In principle, our solution can be generalized to any other hospital provided we receive the same data from them. 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.

Part III: Devising Targeted Solutions

Once we identify groups of frequent flyers from the structured ED data, if time permits, 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.

IX. 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

X. 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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