

Designing an Interface for a Hospital Geographic Information System

Protiva Rahman, BS, Elisabeth Root, PhD, Susan Moffatt-Bruce, MD, PhD, MBA, Courtney Hebert, MD, MS
The Ohio State University, Columbus, OH

Introduction

Hospital acquired infections are a major cause of death in the U.S. Infection preventionists (IPs) have to access individual hospital records to find spatial and temporal overlap between patients to track infection spread, which can be tedious and mentally challenging. While there has been work in predicting outbreaks from EHR data, they do not provide any visual context to allow hospitals to make actionable decisions. Prior visual systems^{1,2} either do not show floor plans or do not involve domain experts in design and data representation. Thus, there is a need for a Hospital Geographic Information System (HGIS), which provides IPs visual cues on patient movement.

Methods

We built an interactive web prototype (Figure 1), using Python's Django framework with a SQLite database. The frontend visualizations were done with the dc.js library, which employs crossfilter and D3.js. Our prototype consisted of a panel on the left to filter the data on attributes such as admission, onset date, and pathogens, while the rest of the screen was used to overlay information on floor plans. In the panel, each attribute is presented as a histogram with linked brushing (i.e., filtering on one attribute will update distributions across others). Since performing range queries on dates can be challenging due to the large number presented in a small space, we separated each component of the date (month, date and year) in a separate histogram. Pathogens are represented as horizontal bar charts which can be filtered by clicking on the bar. In the *main display*, we first present a collapsed view of the building in the form of horizontal bars to provide a summary view (Fig 1A). The length of each bar represents the number of rooms in that floor and the opacity of the color represents the number of patients on the floor (for the selected date and pathogen filters). Each floor expands to show a layout of

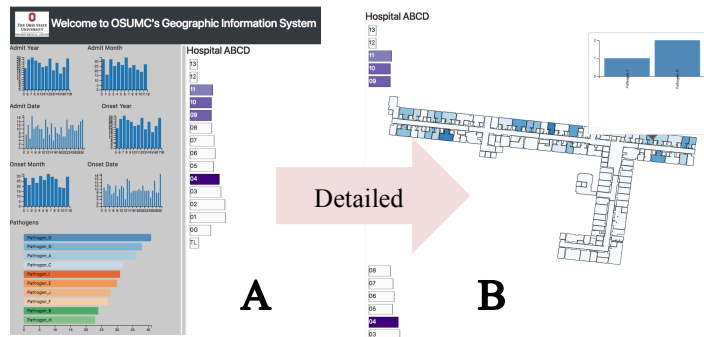


Figure 1. Interface (with synthetic data), overview followed by detailed view

on the floor (for the selected date and pathogen filters). Each floor expands to show a layout of

the floor rooms, with patient distribution in rooms. We tried two encodings for patient distributions across rooms: size and opacity. Selecting a room reveals a bar chart showing the distribution of pathogens (Fig 1B).

Results

We met with two IPs to get feedback on our design. In the panel, they disliked the linked brushing interface and splitting the date into multiple histograms. They suggested the use of text interface for this since that is the norm in EHRs. They also preferred the opacity over size for encoding patient distribution in rooms. In the main display, they liked the collapsed view and said it matched their workflow of selecting and viewing individual floors. They did not find the bar chart showing pathogen distribution to be helpful, since they investigate a single pathogen outbreak at a time. At the end, we asked them for a wish list of things that they would like to see in a HGIS. For the linked histograms, they mentioned that seeing the distribution of infection types over time would be helpful. For seeing spread of disease, they would be more interested in seeing a network diagram that links patients that had common factors (e.g. overlap in a room) and hence acquired the same pathogen. From this network, they could then drill down to the specific room and get further insights, such as distance of the room to a cleaning room.

Conclusion

We built an interactive prototype of a Hospital GIS system and got informal feedback from two of our targets users. In the future, we would like to do a formal survey of experts to evaluate the system, as well as test infection spread with and without the interface.

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References

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