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# WES*t*: Visualizing non-Emergency Surgery Waiting Times

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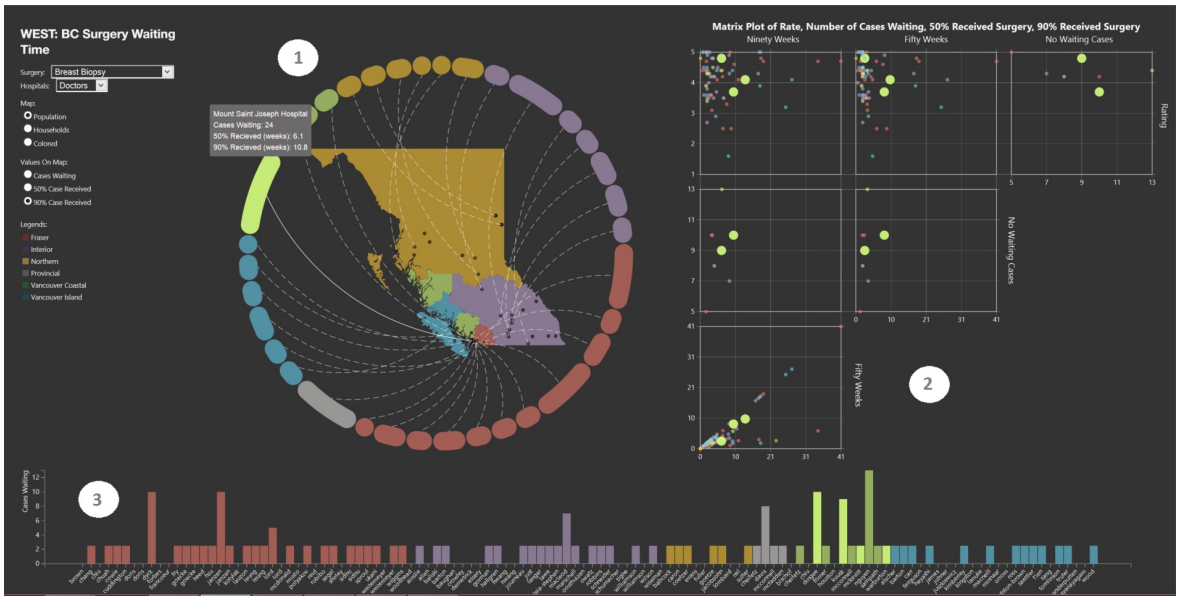


Figure 1: WES*t* overview, 1) BC map representation and hospital waiting times as arcs, 2) scatter plot of physician/hospital attributes, 3) physicians and number of waiting cases

## Abstract

We present WES*t*, a visualization for surgery waiting times applied to the province of British Columbia (BC) in Canada. This project is motivated by the long waiting time for surgeries in BC, which has the potential to put patients in danger and put extra pressure on clinicians [2]. WES*t* helps patients select a hospital and a physician, and to explore their options to get their surgery as soon as possible.

## 1 Introduction

Many visualizations on the web visualize health data, such as Mapsdata [1] showing the percentage of people who had to wait for a consultation in Greater London. Existing visualizations for exploring health-related waiting times usually focus on one dimension, time. However, these datasets have multiple facets, including geographical information and hospitals' and physicians' ratings.

Our visualization, WES*t* (available at `http://rajabiyazdi.com/BC-Surgery/`) is unique in that it includes a variety of available datasets and represents these datasets in detail, in contrast to techniques which involve a one dimensional view that may hide important information. In order to represent this variety of datasets, our visualization includes multiple visualization techniques such as a choropleth map and a node-link diagram [3] providing a more complete view of the information. Finally, we employ various techniques to improve the accessibility and readability of our visualization such as zooming, overview and detail-on-demand [5].

For this project, we focused on designing and developing a visualization for surgery waiting times, hospitals' and physicians' ratings, regions' populations, and the number of households in the province of BC. The purpose of the visualization is to represent surgery waiting times in order to: help people identify hospitals and physicians with least waiting time; and to facilitate the procedure of finding bottlenecks in surgical departments of the hospitals for hospital managers and the government.

## 2 BC Surgical and Statistic Data

In order to capture the complexity and the different factors when choosing where to get a surgery, we used four datasets in this visualization: BC surgery waiting times, BC statistic data, physicians' rating, and hospitals' rating. The surgery waiting times dataset [1] shows information about wait times for non-emergency surgeries done throughout the province of BC in six regions: Fraser, Interior, Northern, Vancouver Island, Vancouver Coastal, and Provincial. The three main dimensions are: 1) number of cases waiting, 2) 50th percentile wait time in weeks, and 3) 90th percentile wait time in weeks. The second dataset contains the population estimate and number of households in BC regions[2]. The third dataset is the physicians' rating from the RateMD[3] which is a public website where patients can rate physicians from one star to five stars. The last dataset, from the CBC website[4] contains hospitals' rating.

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[1] `https://swt.hlth.gov.bc.ca/`
[2] `http://www.bcstats.gov.bc.ca/StatisticsBySubject/Demography.aspx`
[3] `https://www.ratemds.com/bc/vancouver/`
[4] `http://www.cbc.ca/news2/health/features/ratemyhospital/hospitalratings.html`

## 3 Tasks

When analyzing surgery waiting times, a patient might need to perform a number of tasks. Patient tasks might vary depending on their goal. From our previous experience, we created a list of tasks that we think are important for analyzing our dataset. Our proposed visualization assists patients in performing these tasks. Also, our visualization could help hospitals and the government analyze the hospital needs for equipment and allocate enough funding to balance surgery waiting lists. Below we list the tasks that we think are important for patients, hospitals, and government.

**For patients:**

- **P1** Find the nearby hospitals.
- **P2** Find hospitals with fewer cases waiting for a surgery.
- **P3** Compare hospitals' waiting times and ratings for a surgery.
- **P4** Compare physicians' waiting times and ratings for a surgery.
- **P5** Find physicians with fewer cases waiting for a surgery.

**For hospitals and government:**

- **H1** Compare a regions' population to its number of waiting cases.
- **H2** Compare a regions' number of households to its number of waiting cases.

## 4 WES*t* Visualization

Our goal is to go beyond existing multi-dimensional and multi-typed tables from which it is difficult to get insights. To do this we sketched ideas, used visualization design guidelines [5], and investigated visualizations for similar datasets. Then, we developed WES*t* by means of iterative design. The resulting visualization consists of an overview and a comparison view.

### 4.1 Overview

The overview (Figure 1) shows the hospital waiting times for a requested surgery. This view consists of three representations, driven by the extracted tasks: a map of BC, a scatter plot matrix, and a bar chart. The black dots on the map represent hospitals' locations to help patients find hospitals in their region (P1). To ease comparison between hospitals waiting time, the hospitals are represented by arcs on the circle periphery (P2). The length of each arc is computed by dividing each hospital waiting time by the total waiting time for the requested surgery among all and proportioned to 360°.

The scatter plot matrix is used to represent all the hospitals attributes: number of cases waiting for the requested surgery since 31 March 2015, 50%, 90% completed cases waiting time (weeks), and hospitals' rating. This will ease the process of comparing hospitals (P3). On the left side of the view, one can change the scatter plot view from hospital to physician. This changes the scatter plot points' values to physicians' waiting time and rating (P4). Furthermore, by hovering over hospital's arc, highlighted hospital circles will become larger and more easily distinguishable.

The bar chart at the bottom shows all the physicians' name who perform the requested surgery and the number of cases waiting for them (P5). To fulfill H1 and H2, we added an option to choose regions' population and households in addition to color map. The choropleth technique is used for this view and the values are mapped based on the regions population or household numbers.

All three visualizations are linked, by hovering over any of the components in the overview page, the corresponding items, physicians' name, and hospital representations will be highlighted. Also, more detailed information such as number of cases waiting, 50%, and 90% completed cases waiting time will appear in a tooltip [5].

### 4.2 Comparison view

One can click on hospitals in the overview to select these for comparison. This view gives an extra opportunity to compare hospitals and physicians in more detail. It consists of three main components: a map of BC with the selected hospitals to compare, a radar chart of waiting times, and a physician waiting times bar chart (Figure 2). The radar chart on the right represents the number of weeks in which 50% and 90% cases received their surgery, and the number of cases waiting. Hovering over any arc on the map highlights the corresponding triangular area in the radar chart.

Figure 2: Comparison view: comparing selected hospitals in detail. 1) BC map representation with selected hospitals 2) radar chart of hospital attributes, 3) physicians' name and number of waiting cases

In addition, one can look at the information about physicians operating in the selected hospitals. Each bar chart at the bottom of the comparison view shows the number of cases waiting for all the physicians in a hospital. We added hospitals' name to the bar chart legend to discriminate between hospitals with the same color. Also, the scale of the y-axis is set to the maximum scale among multiple bars, making it possible to compare in between charts.

## 5 Discussion and Future Work

We designed WES*t* with focus on patients' needs and we think patients usually look for one surgery at a time and are less likely to be interested in comparing different surgeries. That is why WES*t* is currently limited to showing only one surgery. However, this may be useful for hospitals or the government to compare waiting times of several surgeries and balance their facilities and human resources. In addition, our system loads data from the BC government website, however, some patients may not agree with the method hospitals use to report surgery waiting times. For example, hospitals do not take into account the waiting time to see a specialist and/or to run necessary diagnostic procedures before the surgery. As a result, future work could include allowing people to actively collaborate in this visualization by entering their own data on the website and contribute to the database [4].

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