Visualization of Health Care Data

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What is Visualization?

The question is not what you look at, but what you see.” (Henry David Thoreau, 1851)

Many an object is not seen, though it falls within the range of our visual ray, because it does not come within the range of our intellectual ray, i.e. we are not looking for it. So, in the largest sense, we find only the world we look for. (Henry David Thoreau, 1857)

We cannot see anything unless we are possessed with the idea of it, and then we can hardly see anything else. (Henry David Thoreau, 1858)
What is **Information Visualization**?

“Using Vision to Think”

(Readings in Information Visualization: Using Vision to Think; Card, Mackinlay, Shneiderman; 1999)

“The use of computer-supported, interactive, visual representations of abstract data to amplify cognition.”
Historical Perspective of Visualization

William Playfair: 1700s

One year trade data for Scotland
17 trading partners exports and imports
From Commercial and Political Atlas (1786)

Time-series line graph
England 18th century imports/exports
From Commercial and Political Atlas (1786)

Turkish Empire: proportions located in Africa, Europe, Asia
before 1789
From Statistical Breviary(1801)
Historical Perspective

Florence Nightingale

Coxcomb chart 1854-1856 Crimean War

Diagram of the Causes of Mortality
In the Army in the East

1. APRIL 1854 to MARCH 1855

2. APRIL 1855 to MARCH 1856

The areas of the blue, red, & black wedges are each measured from the centre as the common vertex.
The blue wedges measured from the centre of the circle represent areas for: deaths from Preventable or Mitigable Zymotic diseases; the red wedges measured from the centre; the deaths from wounds; & the black wedges measured from the centre; the deaths from all other causes.
The black line across the red triangle in Nov 1854 marks the boundary of the deaths from all other causes during the month.
In October 1854; & April 1855, the black area coincides with the red.
in January & February 1855; the blue coincides with the black.
The entire areas may be compared by following the blue, the red & the black lines enclosing them.

Lack of sanitation
Other
Wounds from war
Historical Perspective
Charles Minard
Loss of men in French army in Russian campaign 1812-1813
Visualization in Health Care

Examples

Number of Types of Procedures Per Year

Number of Procedures in 2014

Number of Procedures in 2014

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All examples courtesy of Leigh Ann Herhold.
Interactive Visualization

• Human input
• Improve presentation and understand data
  – Choose options from a list
  – Color changes
  – Zoom in on point of interest
  – Expand (drill down) on information
Use of information visualization

- Finance
- Accounting
- Petroleum industry
- Engineering
- Genetics
- CDC maps, timelines
United States Cancer Statistics: An Interactive Cancer Atlas (InCA)
1999–2012 Cancer Incidence and Mortality Data

Footnotes:
* Rates are per 100,000 persons and are age-adjusted to the 2000 U.S. standard population (19 age groups – Census P25-1130).
† Data are from selected statewide and metropolitan area cancer registries that meet the data quality criteria for all invasive cancer sites combined. See registry-specific data quality information. Rates cover approximately 99% of the U.S. population.
‡ Invasive cancer only
DoD Exploratory Study

• What information and knowledge are in EHRs?
• Explore interactive visualization of large sets of health data to better understand what is in the data.
  – Duke EHR data
  – BT data
  – Simulated data from DoD
• February 25, 2013 – August 24, 2015
DEDUCE Data
BTS Visualization

Harrow vs. other London Suburbs...
AHLTA Data vs Simulated Data
T2D Visualizations
PathMap
PTSD Visualization

PTSD Data: 2127 patients

Axis threshold

Current group

Group operation

ICD-9 Diagnoses
Category

Pharmacy Orders:
AHFS Class

Allergies:
Allergen Type

Culture Results:
Organism Category

Social History:
Gender

Map width

Group 1: MENTAL DISORDERS: 1513, 71%
Group 2: DISEASES OF THE MUSCULOSKELETAL SYSTEM AND CONNECTIVE TISSUE: 556, 26%

ICD-9 Diagnoses
Category
Subcategory
Diagnosis Code

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Best Visualizations for Specific Data Elements

- Confounding variables
  - Age
  - Work experience
  - Individuals vs populations
  - Experience seeing information visually
  - Orientation to facts versus trends

Used to looking at pictures and for patterns in what is seen.
Challenges of Information Visualization

• Usability
  • Legends
  • Labels
  • Color
  • Size of graphical representations
  • Placement of axes
  • Ease of understanding at a glance
  • Amount of data represented
  • Size of display
Challenges of Information Visualization

- Manage massive amounts of data
- Display temporal data
- Complexity of data
- Display categorical and numerical data
- Manage “clutter”
- Missing data
- Inaccurate data entry
- Training time

Normalization scheme
“We cannot see anything unless we are possessed with the idea of it, and then we can hardly see anything else.”

- Numerous disease-specific applications
- Population health
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Thank you!

Questions?