Why Graphical Displays of Data?

1. Almost all the potential learning from data is available through graphs
2. Everyone can participate in learning
3. Interpretation fully utilizes current knowledge
4. Pictures convey information more systematically
5. Pictures can identify minute but important details that might be missed in summary statistics
6. Graphs are usually easy to prepare
Edward R. Tufte


- Professor Emeritus at Yale
- Author and publisher of 7 books
- Received 40 awards for content and design
- Provides practical design principles for graphical excellence

Tufte’s classic works

Charles Joseph Minard’s dramatic account of Napoleon’s Russian campaign of 1812 (drawn in 1861)

This graphic shows six variables simultaneously: the size of the army, its location on a two-dimensional surface, direction of the army’s movement, and temperature on various dates during the retreat from Moscow.

Tufte (page 40) concludes that this map “may well be the best statistical graphic ever drawn.”

In September of 1854 Dr. John Snow used a dot (or location) map to plot the location of deaths due to cholera in central London. The red dots indicate the location of water pumps. The black bars ( - ) indicate the total number of deaths in the area. Snow observed that the deaths due to cholera occurred primarily around the Broad Street water pump. He had the handle of the contaminated pump removed thus ending the cholera epidemic that claimed over 500 lives.
Graphical Excellence: Principles

- **Substance and integrity**
  - Provide important information, never mislead by way we scale, sample, frequency

- **Statistics**

- **Design principles**
  - use the least ink to present the greatest amount of information in the smallest space

"It is better to violate any design principle than to put graceless or inelegant marks on paper."

--Edward Tufte

Is this a Good Visual Display of Data?

<table>
<thead>
<tr>
<th>Attending MD’s Do Work-up Outside ED</th>
</tr>
</thead>
<tbody>
<tr>
<td>280</td>
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<td>279</td>
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<td>265</td>
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<tr>
<td><strong>Before</strong></td>
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<td><strong>After</strong></td>
</tr>
</tbody>
</table>
Integrity: Scaling is Very Important

- **Bar Charts**: typically start scale at 0 and continue past highest bar
- **Scatter Plot**: scaled to the data: no “white space”
- **Run and Shewhart Charts**:
  - Scaled such that data uses about half of the graph’s scale with remaining 50% of scale as white space on either side of data
  - If data cannot go beyond an absolute such as 0 or 100 then don’t extend the scale past these numbers

*Figure 6.1* Appropriate Vertical Scale

*Figure 6.2* Vertical Scale Too Small

*Figure 6.3* Vertical Scale Too Large

Graphical Excellence: IH 23-11

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  - Provide important information, never mislead by way we scale, sample, frequency

- **Statistics**

- **Design principles**
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Graph Principle: Greatest Amount of Information

- Allow for visual comparisons
- Show the data
- Integrate words with the data
Improving LOS for Patients Admitted from the ED

**Average Waiting Times:**
All Primary Care Clinics in VHA System

- Small Multiples: Overall System and 22 Districts
- The graphs for each VSH are called small multiples. They are designed for a quick visual comparison of the data from each VSH. The graphs are all presented on the same waiting time scale (0 to 100 days) and time scale (400 - 12/01).

**Improving LOS for Patients Admitted from the ED**

- Quick-look x-rays
- Work-up done on floor
- Bed ahead
- Individual responsible for bed control
- Goal

**Graph Details:**
- LOS (minutes)
- Week:
  - 2/16/98
  - 3/16
  - 4/13
  - 5/11
  - 6/8
Graph Principle: Least Ink

- Data ink is the non-erasable core of a graphic
- Minimize markings (uninformative ink) not directly related to the data

Graph Principle: Most Info-Least Ink
How Simple Could You Get It?

Percent of Inpatient Readmissions within 31 Days

<table>
<thead>
<tr>
<th>Month</th>
<th>Percent</th>
</tr>
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<tbody>
<tr>
<td>Sept. 05</td>
<td>7</td>
</tr>
<tr>
<td>Oct. 05</td>
<td>2</td>
</tr>
<tr>
<td>Nov. 05</td>
<td>2</td>
</tr>
<tr>
<td>Dec. 05</td>
<td>3</td>
</tr>
<tr>
<td>Jan. 06</td>
<td>1</td>
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<tr>
<td>May. 06</td>
<td>1</td>
</tr>
<tr>
<td>Jun. 06</td>
<td>1</td>
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</tbody>
</table>
Week 1:
Kickoff Meeting

Added time slots - RN white/grease board

Added Family Practice.
Test the Hospitalists newly developed
"Patient Contract/Discharge Instructions" Form.
Slot times for all patients.

Piloted
Ticket to Discharge

Week
Placed on 8A grease board
"Missed Opportunity" control chart
Immediate Feedback Staff tool

Added Discharge
Checklist with
Discussion with other
disciplines on their
actions for discharge.

Further discussion on
merging
documentation and
contract form.

PM Huddle at
change of shift

(% of Scores of Excellent and Very Good on a 5 Point Scale)
Graphical Excellence

“The theory of visual display consists of principles that generate design options. The principles should not be applied rigidly; they are not logically or mathematically certain. It is better to violate any design principle than to put graceless or inelegant marks on paper.”

--Edward Tufte