Understanding and addressing the opioid crisis by integrating a public health perspective using data visualizations

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School of Nursing & Healthcare Leadership | UW Tacoma

Adjunct Assistant Professor
Biomedical Informatics & Medical Education | UW School of Medicine
Psychosocial & Community Health | University of Washington School of Nursing

Welcome!

In this part we will:

Look at public health and social determinants of health in the context of addressing pain management and the opioid use

Go over data visualization basics:
- What is data visualization and how it support understanding & decision-making
- Data visualization design & cautions

Provide examples of public health visualizations of opioid data and social determinants of health

By the end of this part of the preconference you will understand:

Why it's important for clinical sites working on pain management to understand what is going on in their communities by looking at public health data to complement clinical data

Basics of Data visualization – how it can support understanding and decision-making

Current examples of public health visualizations of opioid data and social determinants of health

―――

My Background

BS Anthropology

Red Cross

BS, MS, PhD Nursing

Prof @ University of Washington Tacoma

KATRINA RELIEF '05

Solomon Islands

EMT (almost firefighter) in LA

Informatics Postdoc

BS Anthropology

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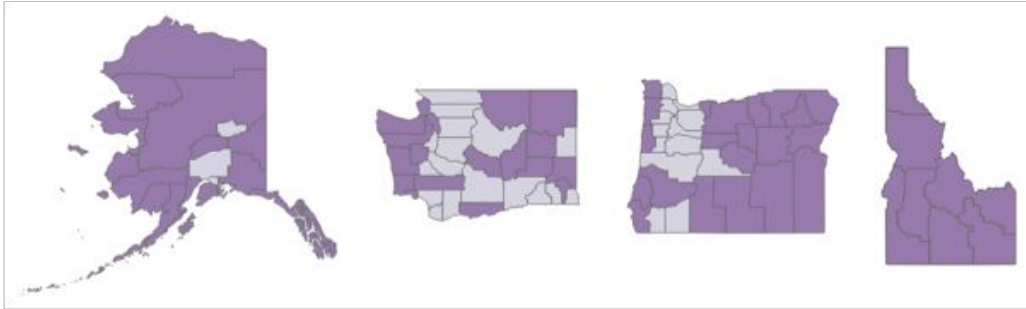EMT (almost firefighter) in LA

Informatics Postdoc

Patti Flatley Brennan
@National Library of Medicine

George Demiris
@Penn Nursing

SHARE-NW   Solutions in Health Analytics for Rural Equity across the Northwest

Goals

1. Provide data for decision-making → **Linked datasets**
2. Improve access to data → **Dashboards**
3. Increase capacity for data use and data-driven decision-making → **Training**

To address health disparities in rural communities

**Betty Bekemeier
@U of Washington Nursing**

Why look at public health?

Pain management & opioid abuse are multifaceted phenomena

Clinic

Diagnoses

Treatment plans

Episodic treatments

Patient history & demographics

Pain management & opioid abuse are multifaceted phenomena

Clinic

Diagnoses

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Patient history & demographics

Everyday life

Risk factors for pain
- Smoking
- Being obese
- Poor health
- Occupation
- Stress
- Poor mental health
- Low education
- Low socioeconomic status

Risk factors for opioid abuse
- Taking high daily doses of prescription pain relievers
- Poor mental health (e.g., depression, anxiety)
- Other substance abuse
- Rurality
- Low socioeconomic status

Clinical data only captures a fraction of the pain management & opioid use picture

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Figure 1
Social Determinants of Health

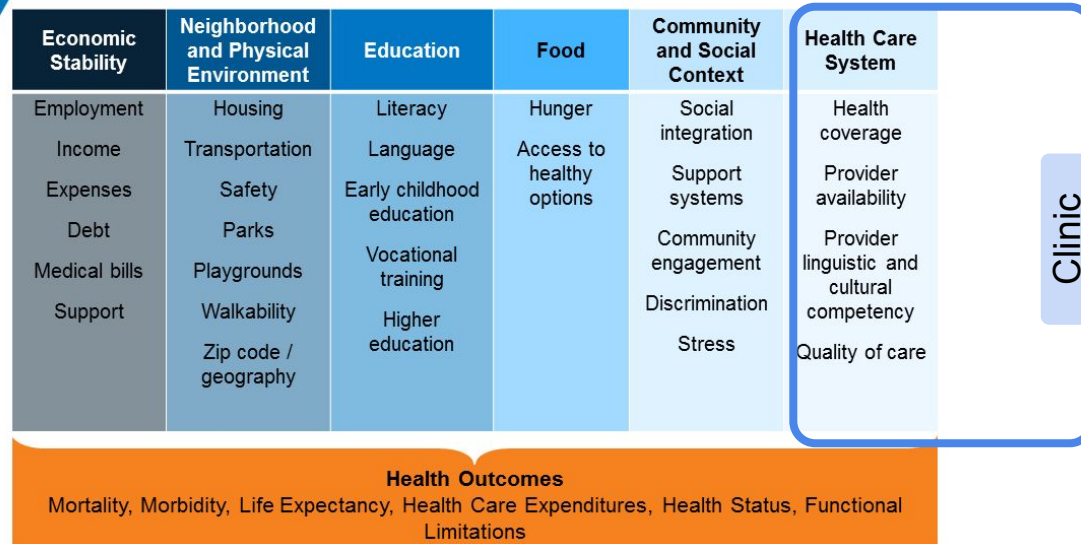| Economic Stability	Neighborhood and Physical Environment	Education	Food	Community and Social Context	Health Care System
Employment	Housing	Literacy	Hunger	Social integration	Health coverage
Income	Transportation	Language	Access to healthy options	Support systems	Provider availability
Expenses	Safety	Early childhood education		Community engagement	Provider linguistic and cultural competency
Debt	Parks	Vocational training		Discrimination	Quality of care
Medical bills	Playgrounds	Higher education		Stress	
Support	Walkability				
	Zip code / geography				

Clinic

Health Outcomes
Mortality, Morbidity, Life Expectancy, Health Care Expenditures, Health Status, Functional Limitations

https://www.kff.org/wp-content/uploads/2018/05/8802-02-figure-1.png
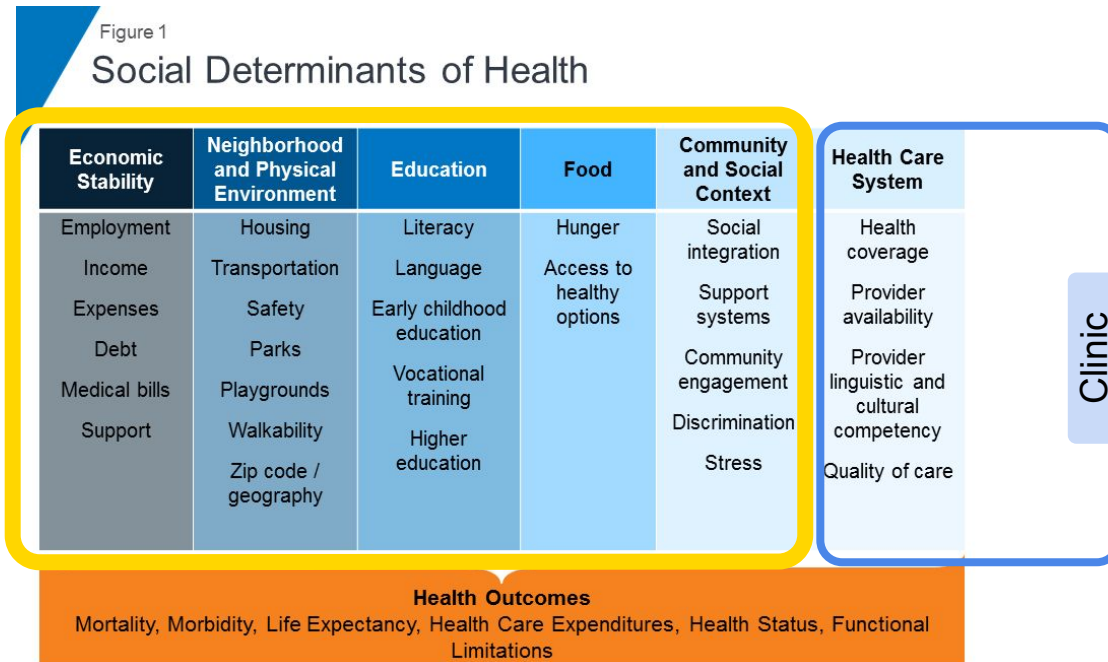
KFF
HENRY J KAISER
FAMILY FOUNDATION

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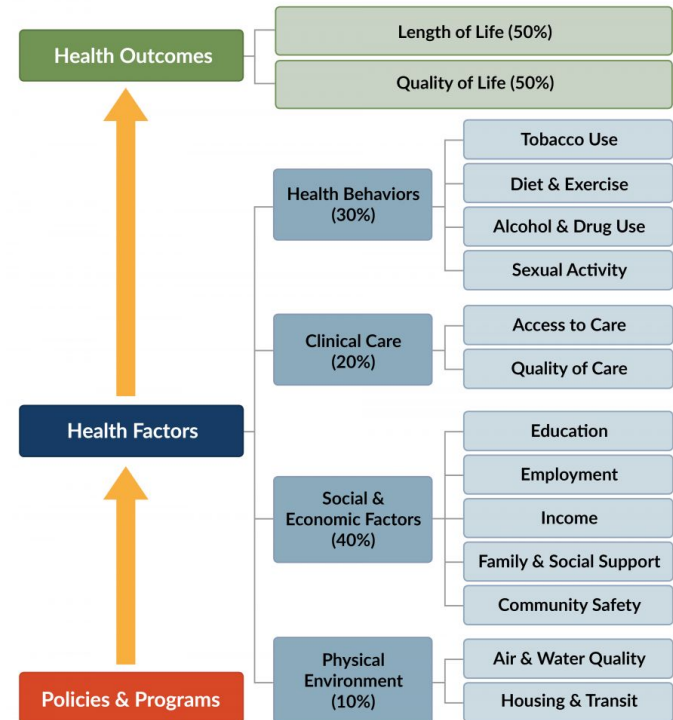| Economic Stability	Neighborhood and Physical Environment	Education	Food	Community and Social Context	Health Care System	
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There are many other frameworks of looking at the health ecosystem (especially when looking at inequities)

County Health Rankings model © 2014 UWPHI

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Clinical factors only part of what impacts a person's health

Where does Public Health come in?

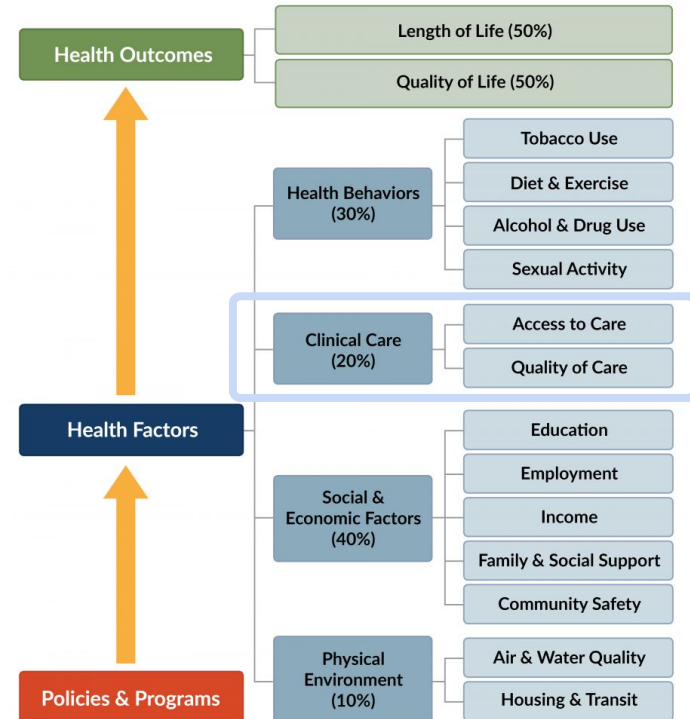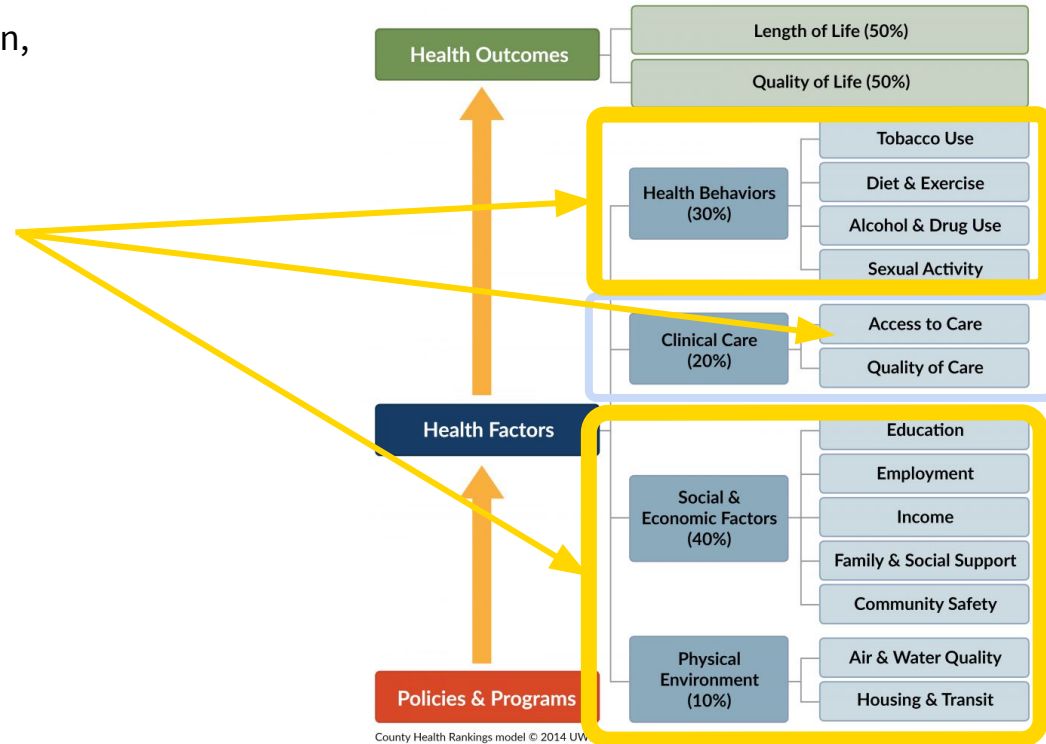Public health "promotes and protects the health of people and the communities where they live, learn, work and play" https://www.apha.org/what-is-public-health

Support policy change, community education, safety (e.g., car seat installation, restaurant inspections), health services, and other functions that impact the all health factors including those associated with clinical care (especially access)


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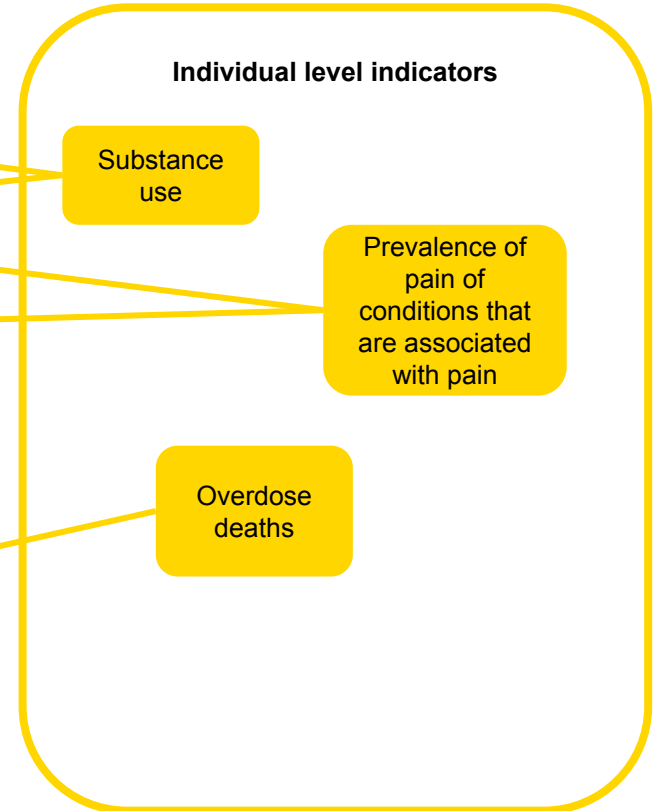

County Health Rankings model © 2014 UWPHI

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Clinical care can capture some of these data and facilitate access to these factors (e.g., health behaviors) -- public health helps do this within the larger context of a person's everyday life
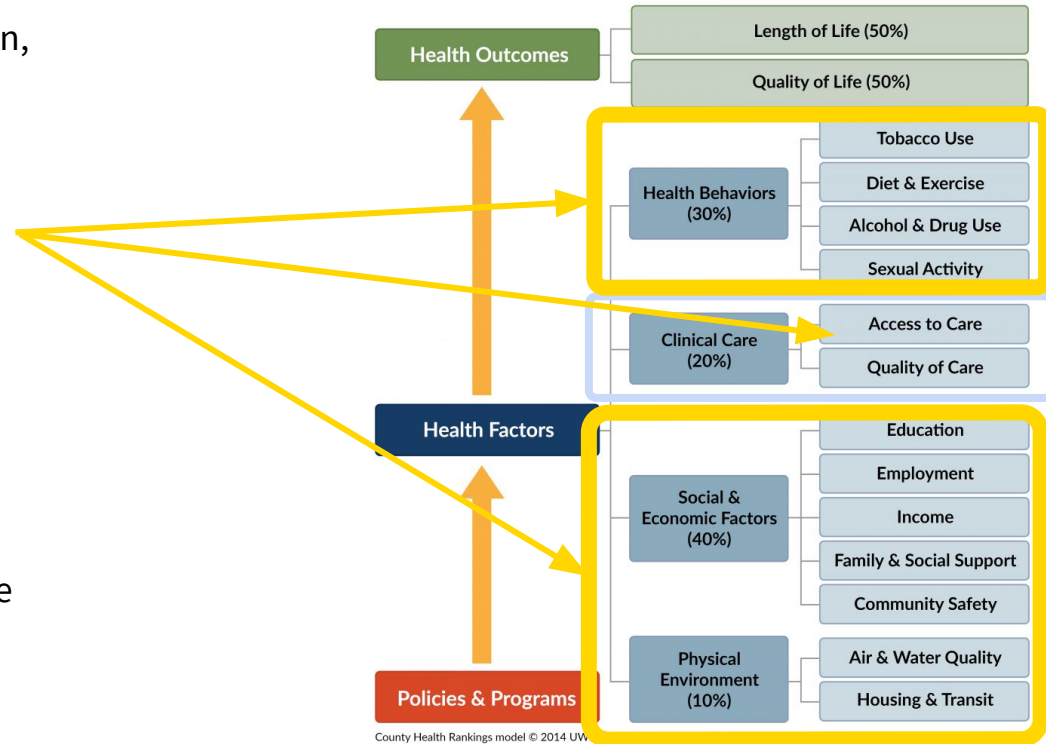
County Health Rankings model © 2014 UW

How does Public Health use data?

Public health data helps quantify these factors
- National data:
    - Behavioral Risk Factor Surveillance System (BRFSS)
    - Youth Risk Behavior Surveillance System (YRBSS)
    - National Health and Nutrition Examination Survey (NHANES)
    - National Center for Health Statistics
    - US Department of Agriculture
    - Housing and Urban Development (HUD)
    - And others (e.g., https://www.cdc.gov/DataStatistics/)
- State and local health departments
    - National Association of County and City Health Officials (NACHHO)
    - State departments of health

Individual level indicators

Substance use

Prevalence of pain of conditions that are associated with pain

Overdose deaths

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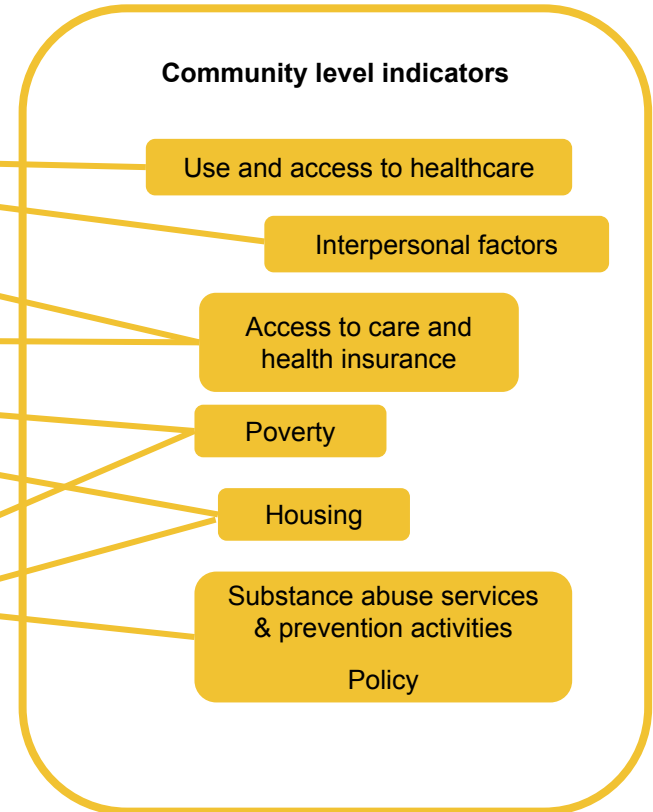
Community level indicators

Use and access to healthcare

Interpersonal factors

Access to care and health insurance

Poverty

Housing

Substance abuse services & prevention activities

Policy

How does Public Health use data?

Data quality issues: Some data is collected yearly and some monthly or quarterly, lack of data from underrepresented and rural populations

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One way to overcome data quality issues and limitations of looking at clinical data alone and public health data alone is trying to find ways to bridge the two
- Support data exchange between clinical sites and public health
- Support social determinant of health data to be collected in clinical sites

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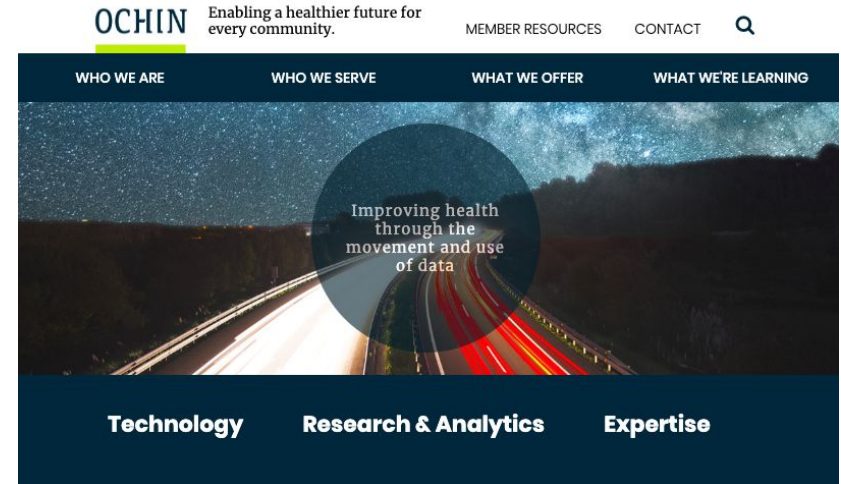
OCHIN (Oregon Community Health Information Network)
Development of electronic health record (EHR) tools for collecting, reviewing, and acting on patient-reported social determinants of health (SDH) data in community health centers (CHCs).
https://ochin.org/

What are ways in which Public Health leverages data to understand and address issues like pain management & opioids?

What is data visualization?

What is data visualization

No established definition

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No established definition

In general, data visualization is using visual encodings to represent data or information

Line graph

Bar chart

Choropleth

Infographic

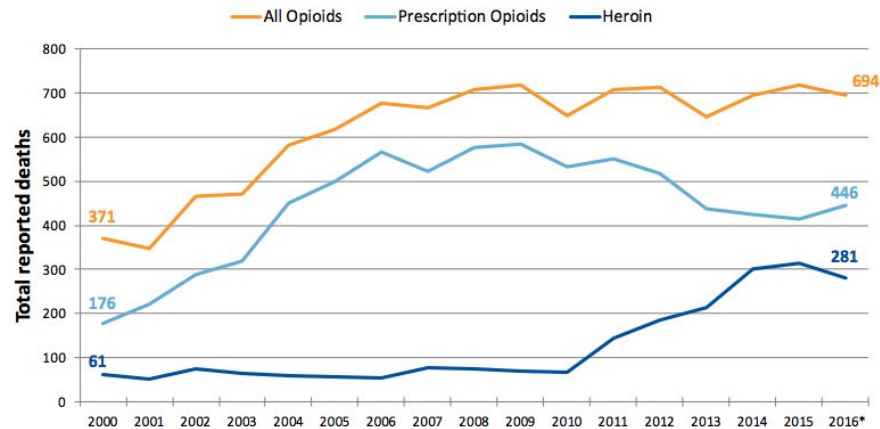# What is data visualization

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http://queue.acm.org/detail.cfm?id=1805128

Opioid Overdose Deaths in Washington

— All Opioids   — Prescription Opioids   — Heroin

Total reported deaths

694
446
281

371
176
61

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016*
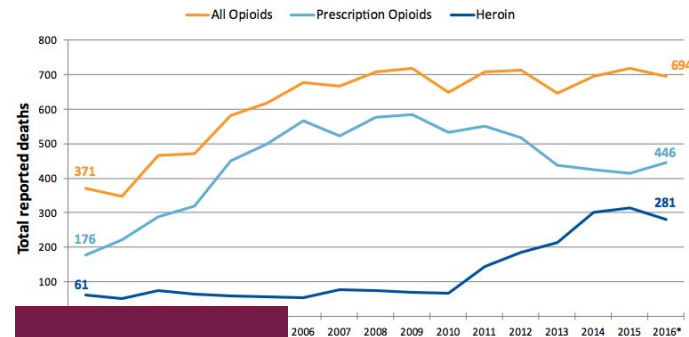
SOURCE: WASHINGTON STATE DEPARTMENT OF HEALTH

...UM WITH "PRESCRIPTION OPIOIDS" AND "HEROIN" AS IT INCLUDES ADDITIONAL CATEGORIES NOT DEPICTED
...CAUSE OVERDOSE DEATHS MAY INVOLVE MULTIPLE TYPES OF OPIOIDS.

What patterns do you see?

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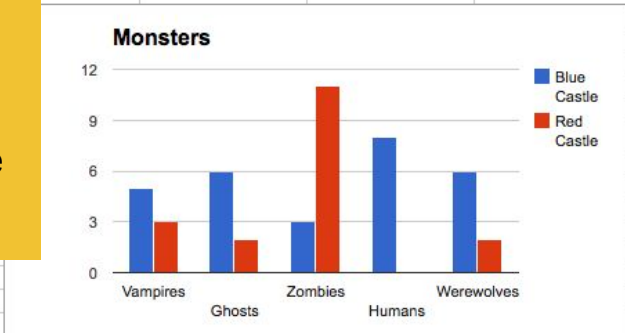
Monster Spreadsheet - finished

File Edit View Insert Format Data Tools Help   All changes saved in Drive

$ % 123 ▾   Arial   ▾ 10 ▾ B I S A ▾

	A	B	C	D
1		Blue Castle	Red Castle	
2	Vampires	5	3	
3	Ghosts	6	2	
4	Zombies	3	11	
5	Humans	8	0	
6	Werewolves	6	2	
7				
8	Total Count	28	18	
9	Total $/night	2800	1800	
10				

For which categories are there more in the blue castle than the red?

https://web.stanford.edu/class/cs101/table-spreadsheet.png

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Can support decision making

How do we create visaulizations for dashboards to support decision-making?

Identify purpose of how user uses data

Analyze

Understand

Persuade

Analyze

Basic understanding of raw numbers and find patterns in data

Analyze

Basic understanding of raw numbers and find patterns in data

"Among all children the percent of those who are obese is between about 12 and 18%.
There are greater percentages of boys than girls who are obese at all ranges."

Figure 2. Prevalence of obesity among children and adolescents aged 2–19, by sex and age: United States, 2009–2010

[1]Significant increasing linear trend by age ($p < 0.005$).
SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2009–2010.
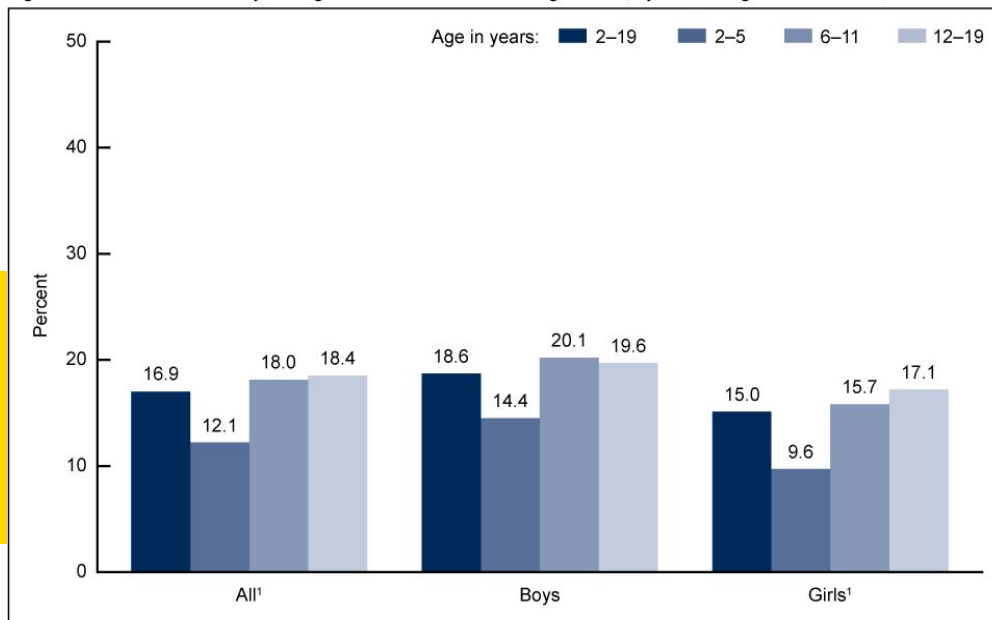
Understand

Analysis with context

Use reference ranges, benchmarks, indicators, etc to bring more meaning to the visualization

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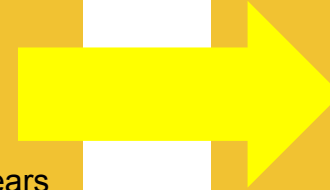
Age in years: 2–19, 2–5, 6–11, 12–19

All[1]
16.9, 12.1, 18.0, 18.4

Boys
18.6, 14.4, 20.1, 19.6

Girls[1]
15.0, 9.6, 15.7, 17.1

[1]Significant increasing linear trend by age (p < 0.005).
SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2009–2010.

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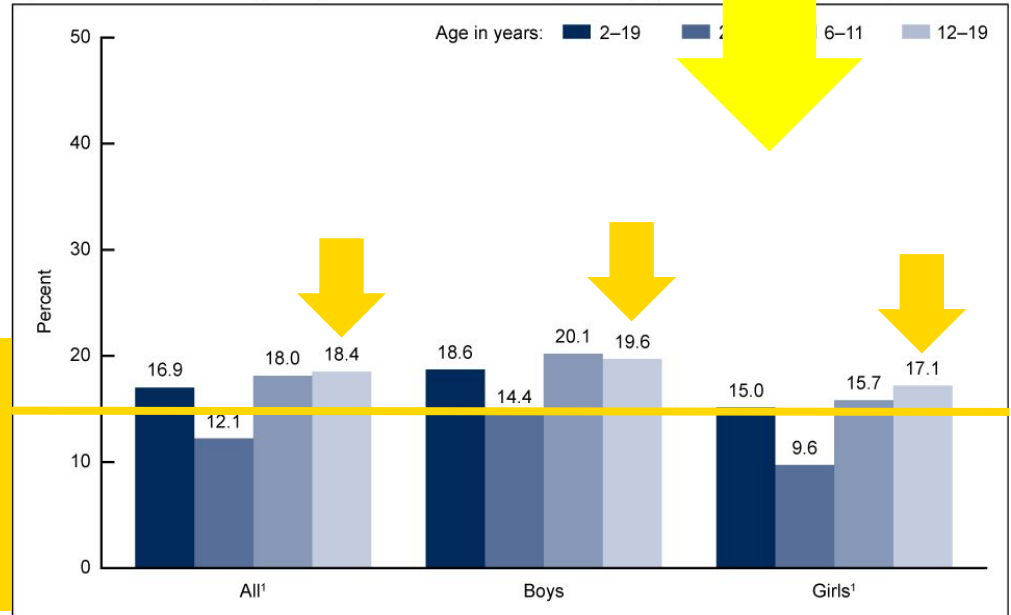
Objective NWS-10.3

Reduce the proportion of adolescents aged 12 to 19 years who are considered obese

Target: 14.5%

https://www.healthypeople.gov/2020/topics-objectives/topic/nutrition-and-weight-status/objectives

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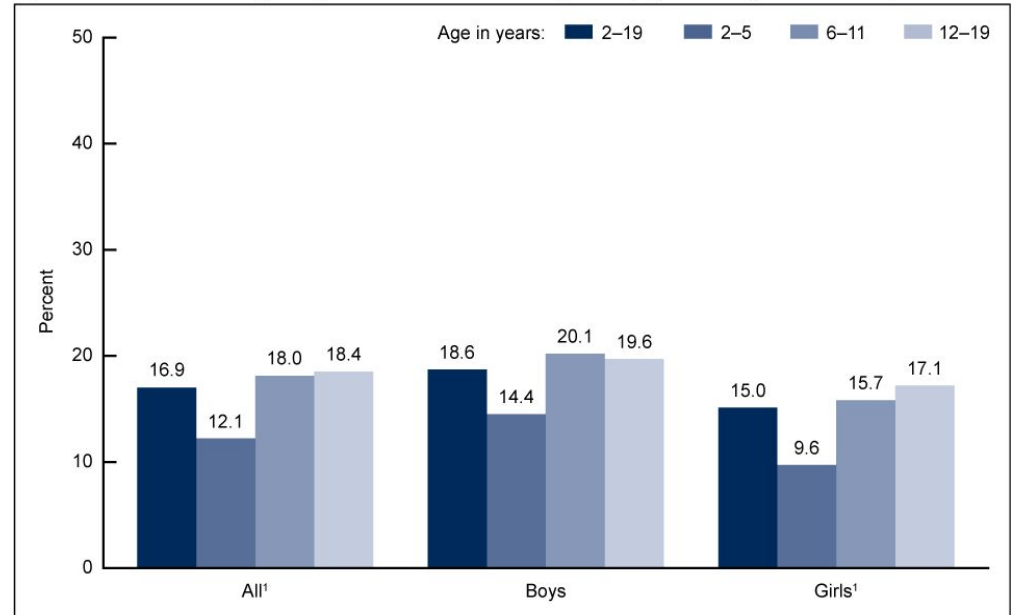SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2009–2010.

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Healthy People 2020

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"The prevalence of boys who are obese is further away from the target value than girls, therefore…"

Figure 2. Prevalence of obesity among children and adolescents aged 2–19, by sex and [...] United States, 2009–2010

Age in years: 2–19   [...]   6–11   12–19

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Visual representation that is engaging and provides elements needed to make a decision and compels someone to take action

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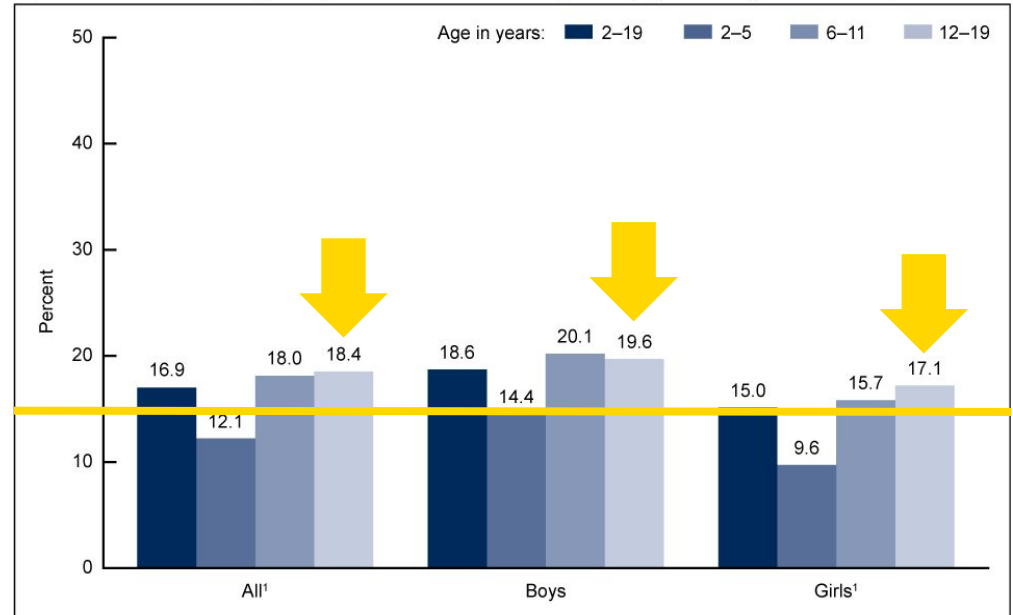
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Persuade

Visual representation that is engaging and provides elements needed to make a decision and compels someone to take action

We need interventions to reduce obesity among teenage boys
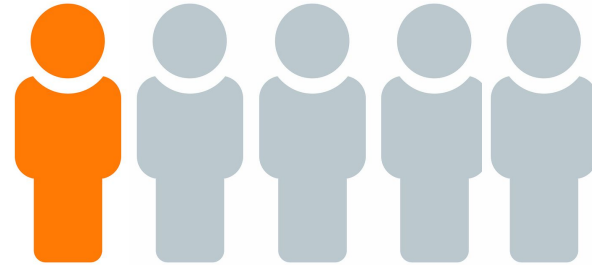
About 20% of boys 12-19 years old are obese

This percentage is above the CDC target of 14.5%

What are examples of PH visualizations and dashboards?

More and more examples are coming out especially regarding opioids

Purpose of most: to analyze

Little information available beyond just the data
(often presented in maps)

Census Tracts Social Determinants of Health Dashboards

Social Determinants of Health Map by Census Tracts

Social Determinants of Health Data Table by Census Tracts

Social Determinants of Health - Census Tracts (2012 - 2016)

Indicator Selector
Poverty

Indicator Definition
Percent of individuals living at or below 100% of the Federal Poverty level

Hover over the map area for more information

ACH Region: **King**
Counties included: **King**
Census Tract: **53033004400**
% of indicator population **(Poverty): 35.5%**
Percent of individuals living at or below 100% of the Federal Poverty level

% of indicator population
0.0   78.3

© OpenStreetMap contributors

Indicator notes:
These indicators are from the American Community Survey 2012-2016 https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t)

Data and Statistical Reports > Health Data Visualization > Opioid County Overdose Dashboard

Opioid Overdose Dashboards - County

https://www.doh.wa.gov/DataandStatisticalReports/HealthDataVisualization/OpioidDashboards
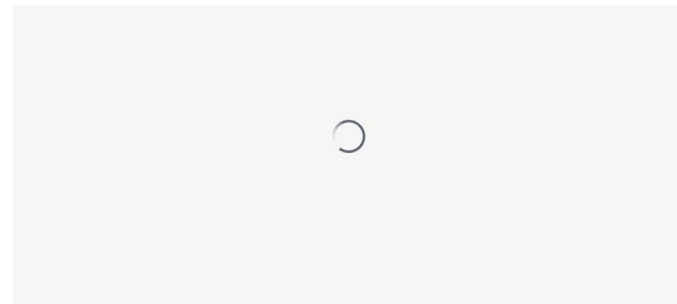
Drug Overdose Deaths in the United States

SOCIO DEMOGRAPHIC

Race / Ethnicity

Age

Educational Attainment

Disability Status

ECONOMIC

Median Household Income

Poverty Rate

Unemployment Rate

Accident-prone Employment

‹ LIST OF COUNTIES

Drug Overdose Rate

Deaths per 100k pop. ages 15-64 by county

- 60+
- 35 – 60
- 25 – 35
- 19 – 25
- < 19
- Insufficient Data*
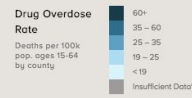
Overdose Type: All Drugs | Opioids

Timeframe: 2007 - '11 | 2012 - '16

State / County: Counties ▾

Urban / Rural: All ▾

Zoom: − +

Map Overlays ▾

King County, WA

17.8
Overdose Mortality Rate
Deaths per 100k pop. ages 15-64

VIEW DETAILS
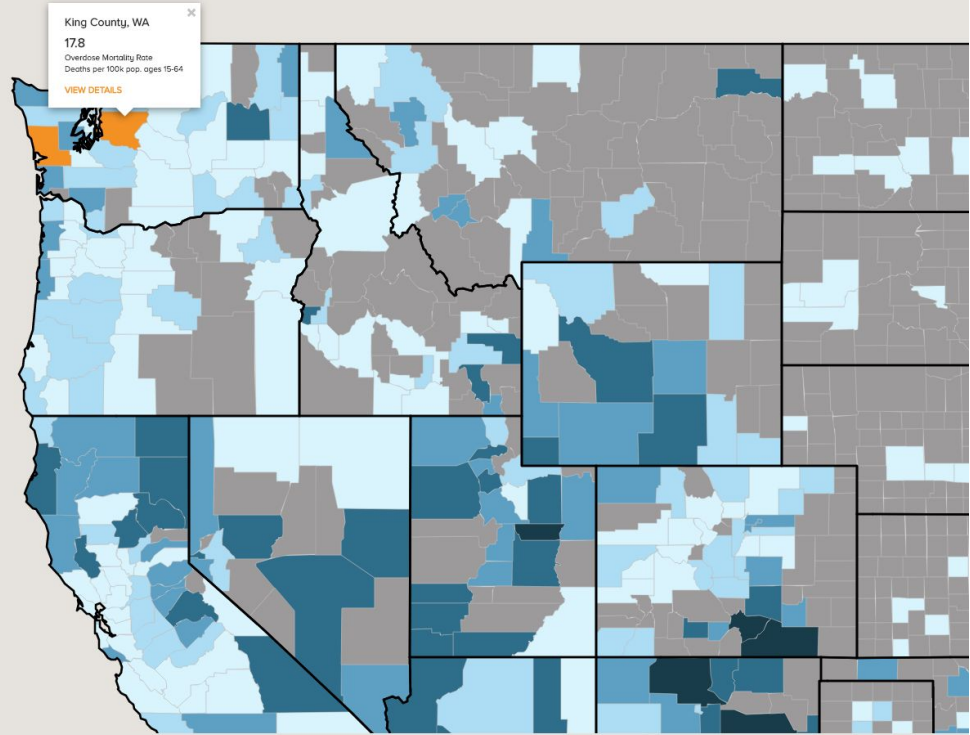
SHARE

INTRODUCTION HOW TO USE THE TOOL METHODOLOGY & DATA MORE INFORMATION

NORC at the UNIVERSITY of CHICAGO

USDA

https://opioidmisusetool.norc.org/

CDC dashboard

Washington Summary Information

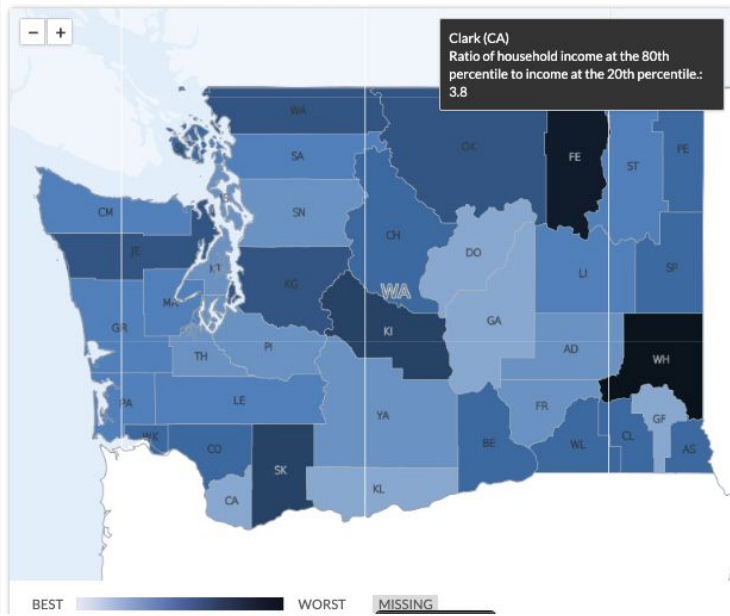|	
Top U.S. Performers:	3.7 (10th percentile)
Range in Washington (Min-Max):	3.6-6.9
Overall in Washington:	4.5
Years of Data Used:	2012-2016
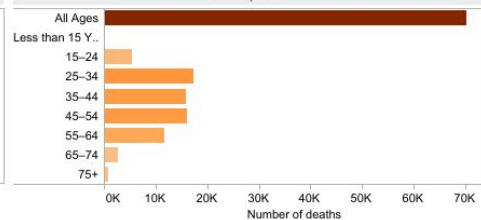
Income inequality

Ratio of household income at the 80th percentile to income at the 20th percentile.

The 2018 County Health Rankings used data from 2012-2016 for this measure.

Map | Data | Description | Data Source | Policies

Clark (CA)
Ratio of household income at the 80th percentile to income at the 20th percentile.: 3.8

BEST ▭ WORST MISSING

Washington 2018 ▾ | Select another state ▾

Overview | Rankings | **Measures** | Downloads | Compare Counties | Select a county ▾ | 🖶 Print ⟳ Help

Select a Measure:

Washington Summary Information

Range in Washington (Min-Max):	8-26
Overall in Washington:	15
Years of Data Used:	2014-2016

🍸 An Alcohol and Drug Use measure

Drug overdose deaths

Number of drug poisoning deaths per 100,000 population.

The 2018 County Health Rankings used data from 2014-2016 for this measure.
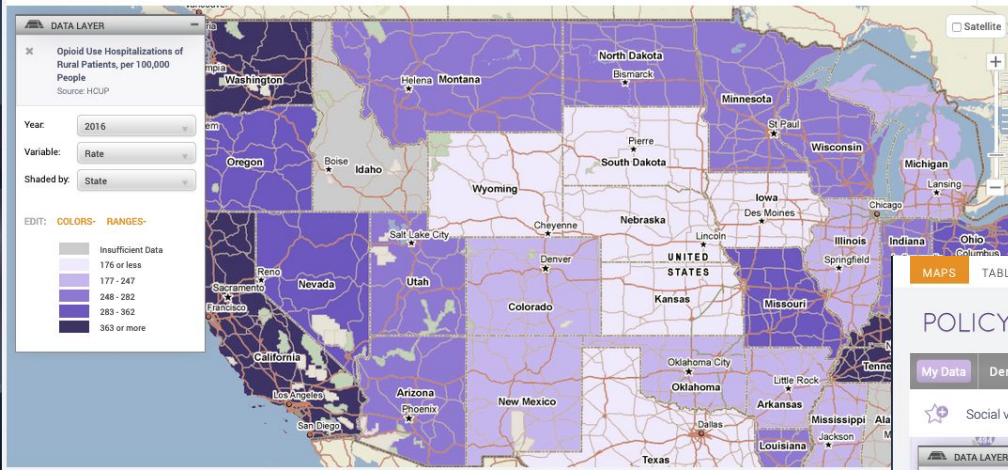
Data | Description | Data Source

Place ⇅	# Drug Overdose Deaths	Drug Overdose Mortality Rate
Adams		
Asotin	16	24
Benton	89	16
Chelan	22	10
Clallam	43	19
Clark	185	13
Columbia		

http://www.countyhealthrankings.org

Institute for Health Metrics and Evaluation (affiliated with UWash | Global Health) http://www.healthdata.org/results/data-visualizations

Average Immunization Completeness for Children 19-35 Months Old by State, 2016
Note: Data shown for states where county-level immunization rates are available
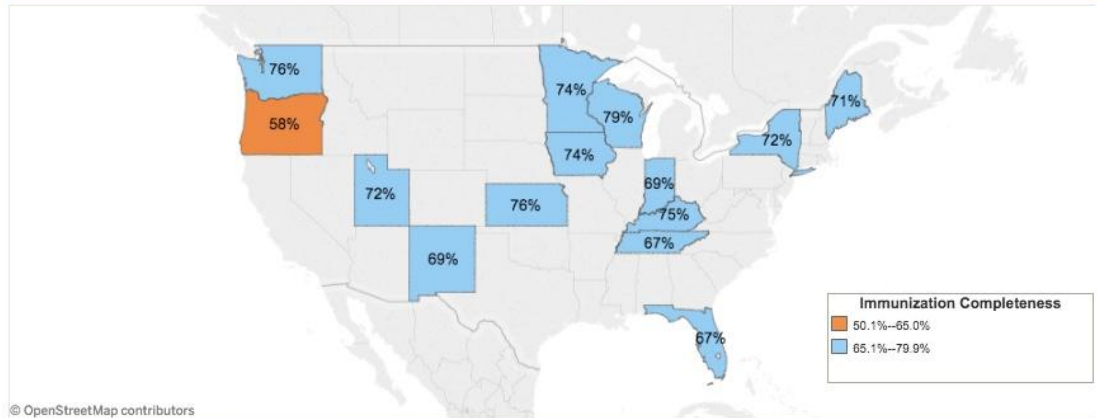
PHAST: Public Health Activities & Service Tracking (based @UWash)
https://phastdata.org

Examples in the medical literature
https://www.ncbi.nlm.nih.gov/pubmed?term=((public%20health)%20AND%20visual*)%20AND%20dashboard
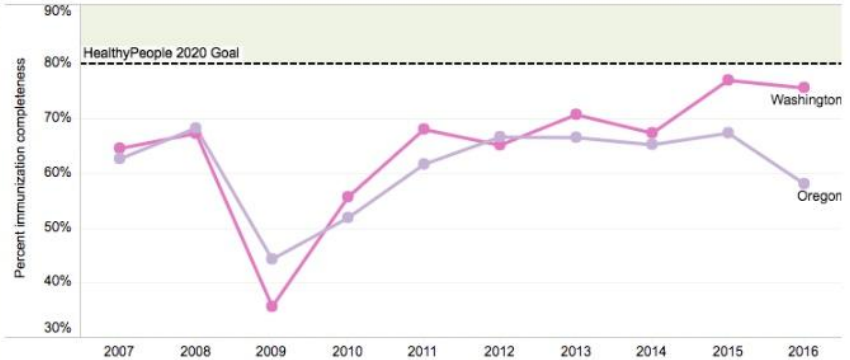

PubMed | ((public health) AND visual*) AND dashboard

Create RSS   Create alert   Advanced

Format: Summary ▾   Sort by: Best Match ▾   Per page: 20 ▾   Send to ▾

Search results

Items: 1 to 20 of 81   << First   < Prev   Page 1   of 5   Next >   Last >>

1. Visual analytics **dashboard** to explore the relationship of unscheduled treatment interruptions and variations in airway management for children undergoing external beam radiation therapy.
Chua P, Hill-Kayser C, Ahumada LM, Jalal A, Simpao AF, Lingappan AM, Jawad A, Rehman MA, Gálvez JA.
Pract Radiat Oncol. 2017 Sep - Oct;7(5):e339-e344. doi: 10.1016/j.prro.2017.01.008. Epub 2017 Jan 20. No abstract available.
PMID: 28428018
Similar articles

2. The impact of home care nurses' numeracy and graph literacy on comprehension of visual display information: implications for **dashboard** design.
Dowding D, Merrill JA, Onorato N, Barrón Y, Rosati RJ, Russell D.
J Am Med Inform Assoc. 2018 Feb 1;25(2):175-182. doi: 10.1093/jamia/ocx042.
PMID: 28460091
Similar articles

3. **Dashboard** visualizations: Supporting real-time throughput decision-making.
Franklin A, Gantela S, Shifarraw S, Johnson TR, Robinson DJ, King BR, Mehta AM, Maddow CL, Hoot NR, Nguyen V, Rubio A, Zhang J, Okafor NG.
J Biomed Inform. 2017 Jul;71:211-221. doi: 10.1016/j.jbi.2017.05.024. Epub 2017 Jun 1.
PMID: 28579532   **Free Article**
Similar articles

4. A visual **dashboard** for moving **health** technologies from "lab to village".
Masum H, Singer PA.
J Med Internet Res. 2007 Oct 22;9(4):e32.
PMID: 17951216   **Free PMC Article**
Similar articles

SHARE-NW

Currently in year 2 of 5

Developed paper prototypes of
visualizations to include in dashboard
Meeting with potential end users for
them to give feedback on the
visualizations

Pulling from current dashboard
examples, visualization literature, and
user needs assessments

Also developing trainings to support
use of the dashboard and
understanding about health
disparities
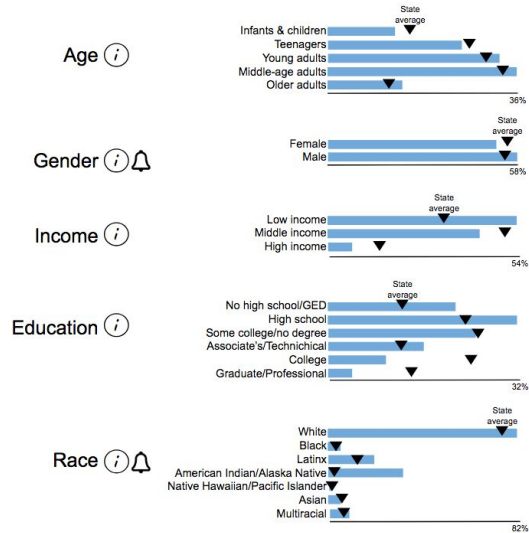
What are some nuts and bolts of data viz I need to make my dashboard?

Data viz nuts and bolts

Data types

Color

Avoiding bias and misleading visualizations

Data viz nuts and bolts

Data types

Color

Avoiding bias and misleading visualizations

Data types

How variables are classified in programing languages

Also important when we develop visualizations

How you can visualize data is dependent on data type

Quantitative
- Numeric
- **Interval**: location of zero is arbitrary
  - E.g., Dates, latitude
- **Ratio**: zero fixed
  - E.g., Counts, amounts ($), physical measurements (length)

How you can visualize data is dependent on data type

Quantitative
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Nominal
- Categorical without order
- Includes binary categories (e.g., no/yes)
- Examples: Ethnicity, diagnosis

How you can visualize data is dependent on data type

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- **Ratio**: zero fixed
  - E.g., Counts, amounts ($), physical measurements (length)

Nominal
- Categorical without order
- Includes binary categories (e.g., no/yes)
- Examples: Ethnicity, diagnosis

Ordinal
- Categorical with order
- Examples: Educational attainment

Stage 0
- Carcinoma in situ – Early form

Stage I
- Localized

Stage II
- Early Locally advanced

Stage III
- Late Locally Advanced

Stage IV
- Metastasized
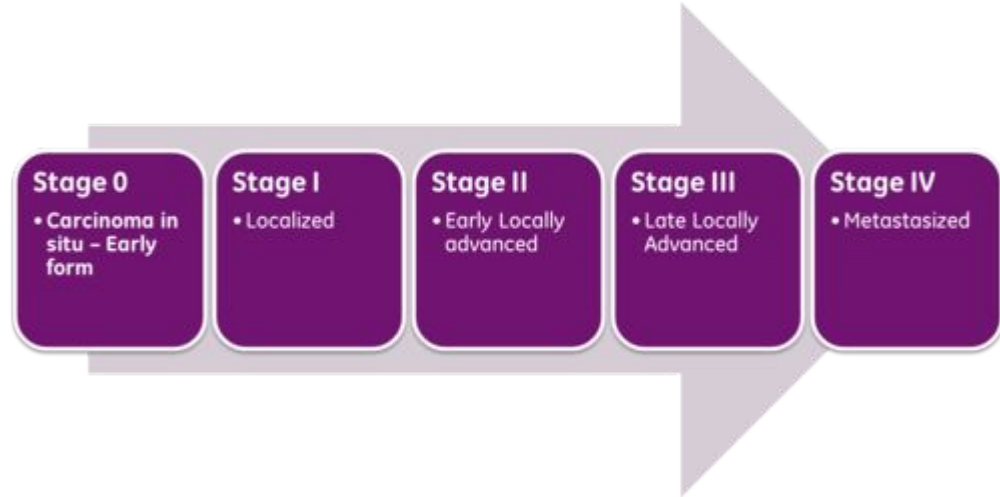
Why do data types matter?

Data types help us figure out which types of visualizations are appropriate

Recommendations based on research

- Based on previous research there are several recommendations based on the type of data you're using and number of variables you're using
- We will focus looking at 1-2 variables but these recommendations can be extended to looking at 3 or more variables

WS Cleveland, R McGill. Graphical perception: Theory, experimentation, and application to the development of graphical methods. Journal of the American statistical association. 1984;79(387):531-554.

http://vis.stanford.edu/files/2010-MTurk-CHI.pdf

Recommendations based on research

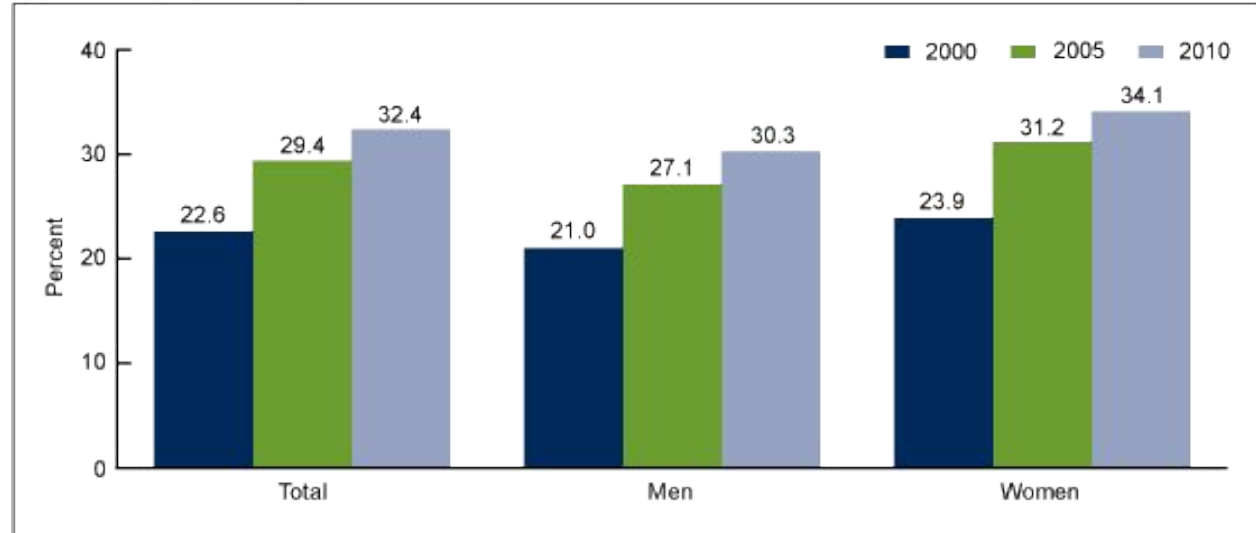1. 1 or more nominal or ordinal variables:

   X-axis: variables

   Y-axis: n or %'s

This table tells you the makeup of your sample

Use this to see if there are over/underrepresented groups and how your sample compares to a similar population

Figure 1. Percentage of adults aged 18 and over whose physician or other health professional recommended exercise or physical activity, by sex and year: United States, 2000, 2005, and 2010
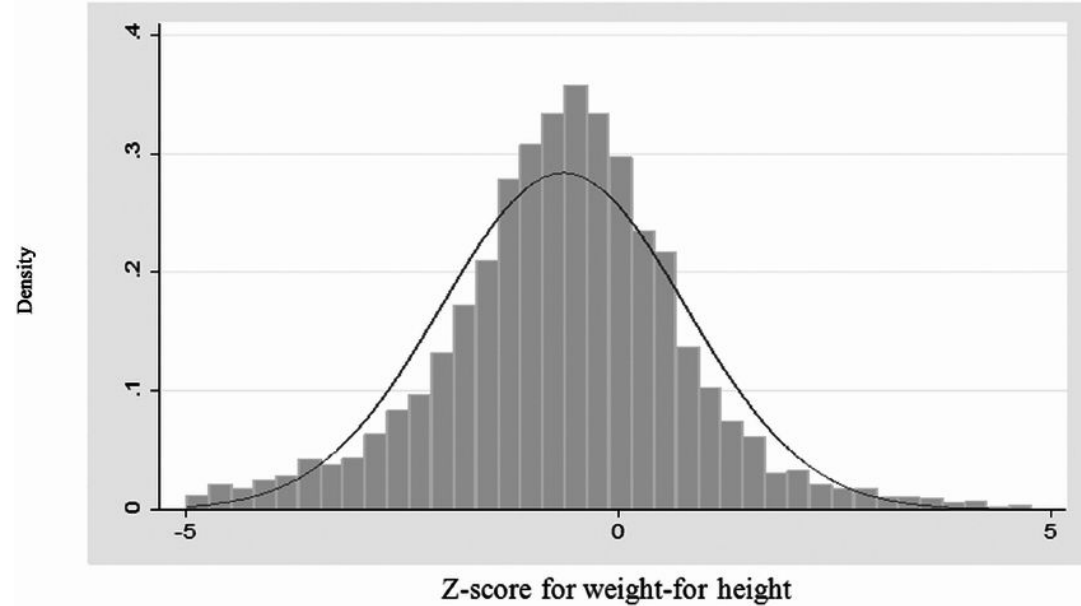
Recommendations based on research

1. 1 or more nominal or ordinal variables:
   bar chart
2. 1 quantitative ratio variable:
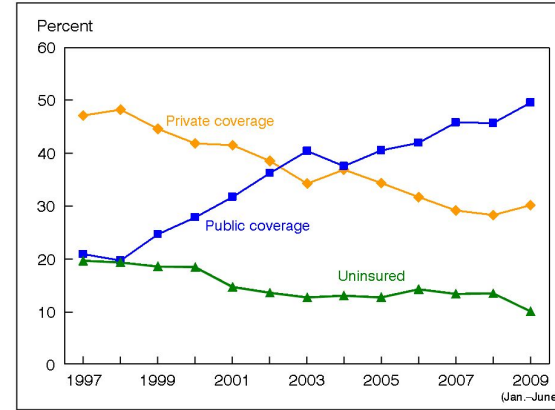   **histogram**

This histogram tells you the distribution of the values for a variable

Use this to see if the distribution is normal which informs your statistical analyses

Recommendations based on research

1. 1 or more nominal or ordinal variables:
   bar chart
2. 1 quantitative ratio variable:
   histogram
3. 1 quantitative ratio variable and years: **line graph**
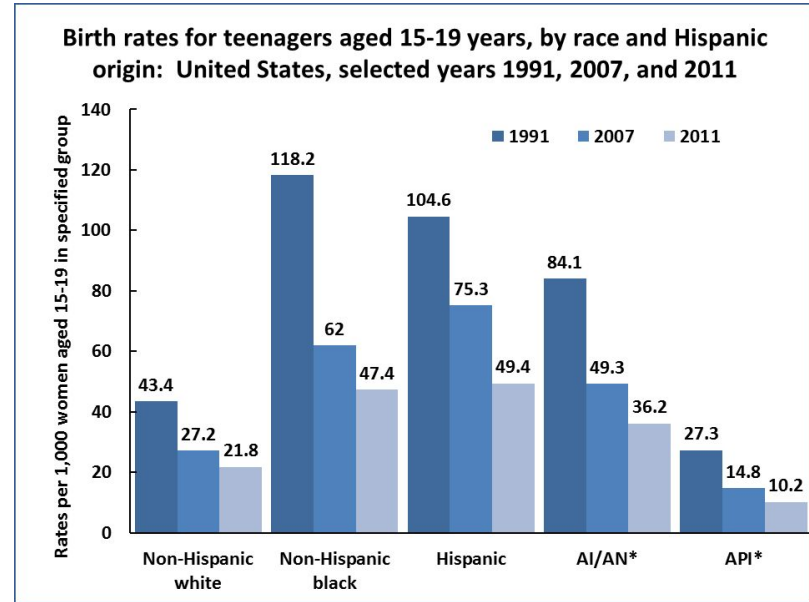
Recommendations based on research

1. 1 or more nominal or ordinal variables:
    bar chart
2. 1 quantitative ratio variable:
    histogram
3. 1 quantitative ratio variable and years: **line graph**
4. 1 quantitative ratio variable and 1 nominal or ordinal variable:
    bar chart

This bar tells you if there are differences between groups

Birth rates for teenagers aged 15-19 years, by race and Hispanic origin: United States, selected years 1991, 2007, and 2011

Rates per 1,000 women aged 15-19 in specified group

■ 1991   ■ 2007   ■ 2011

Non-Hispanic white: 43.4, 27.2, 21.8
Non-Hispanic black: 118.2, 62, 47.4
Hispanic: 104.6, 75.3, 49.4
AI/AN*: 84.1, 49.3, 36.2
API*: 27.3, 14.8, 10.2

Recommendations based on research

- Visualization experts tend to **discourage use of pie charts** unless you have few (2-4) slices and they are easy to tell apart
- People may use pie charts because
  - They're Widely used
  - Often one of the top recommended visualization options in programs
- **Instead: use a bar chart**
  - Quicker more accurate understanding of the same data

More accurate

Less accurate

http://vis.stanford.edu/files/2010-MTurk-CHI.pdf
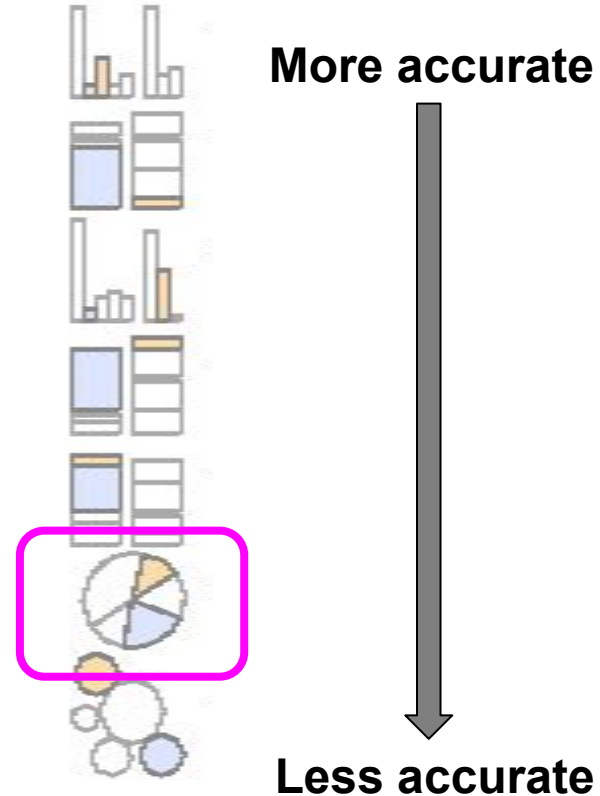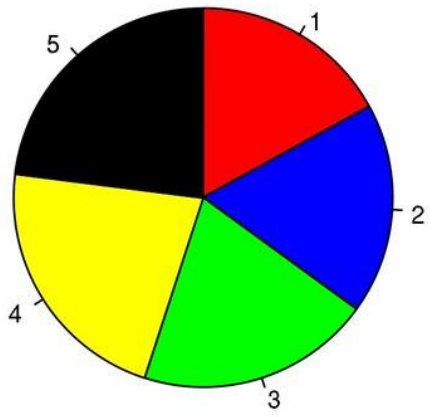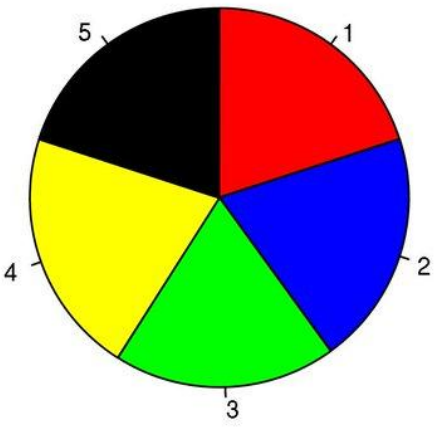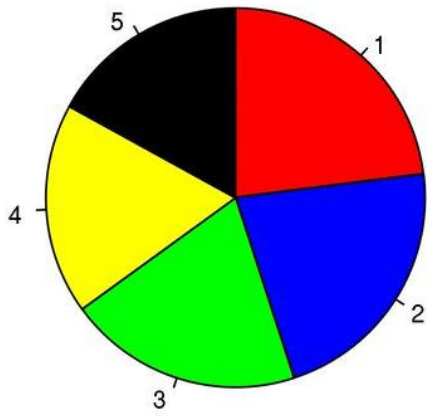
A
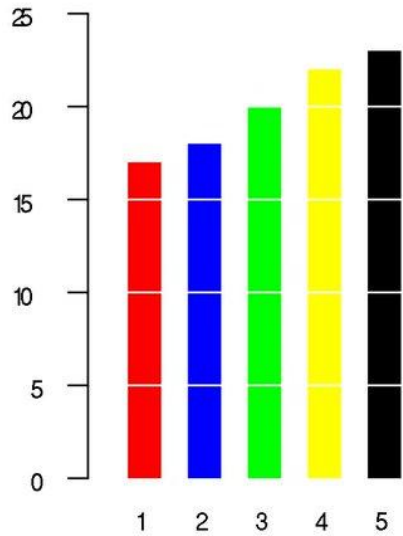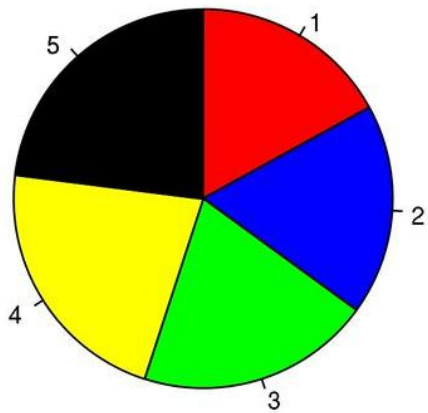
B
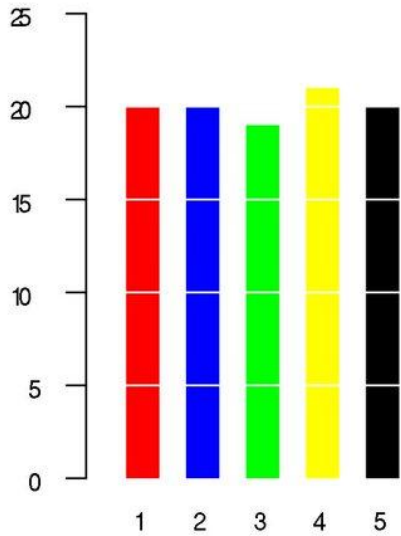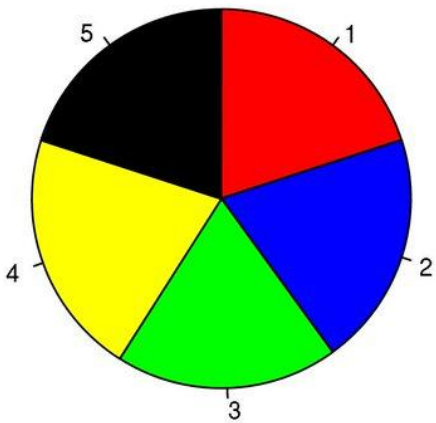
C
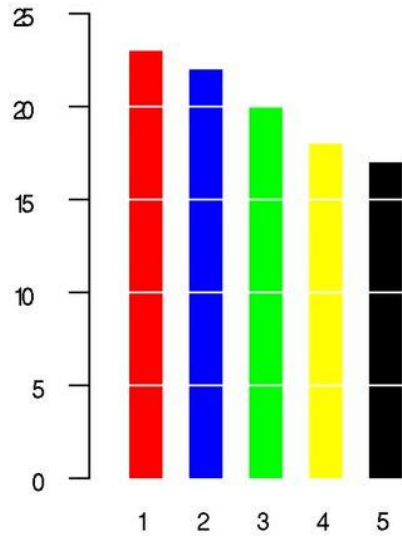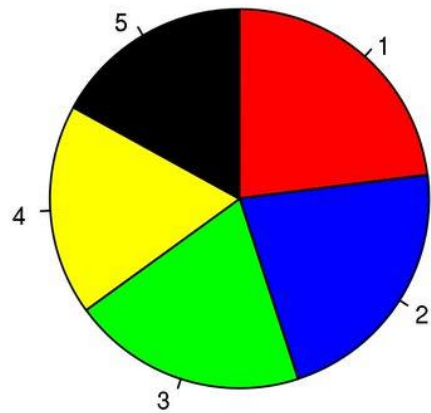
Data viz nuts and bolts

Data types

Color

Avoiding bias and misleading visualizations

Color

We could spend the whole day talking about the biology, psychology, and cultural conceptualizations of color

We will focus on two things that are often things to consider in PH data viz
1. Color vision inclusiveness
2. Gradients

Color vision inclusiveness

Color blindness can affect a person's ability to see
certain colors (usually green and red)

tritanomal   dueteranope   protanope   tritanerope

normal trichromat |_____ dichromats _____|

http://blog.usabilla.com/wp-content/upl
oads/2015/11/colorblind_01_03-1.jpg

https://medlineplus.gov/colorblindness.html

Color vision inclusiveness

Color blindness can affect a person's ability to see certain colors (usually green and red)

This can be an issue given that many visualizations use red and green to indicate bad (red) or good (green) related to western cultural norms

Figure 3: Infographic depicting blood pressure values and criterion categories using a stoplight analogy.

Blood Pressure

142 / 83

Systolic

Diastolic

Figure 5: Infographic of Maria's level of chronic stress compared to that of other women in her age group.

Chronic Stress

Maria
Low

Other women in Maria's age group
Very High

Figure 4: Infographic of Maria's sleep and energy as compared to that of other women in her age group.

Sleep and Energy

Excellent
Very Good
Good
Fair
Poor

Maria
Very Good

Other women in Maria's age group
Poor

Figure 6: Infographic of (a) Maria's days of exercise per week as compared to that of other women in her age group and (b) Victor's self-rating of overall health as compared to that of other men in his age group. The icons in these infographics were employed in two qualitatively different ways that affected comprehension.

Days of Exercise Per Week

Maria

Other women in Maria's age group

Your Overall Health

Poor   Fair   Good   Very Good   Excellent

Victor
Very Good

Other men in Victor's age group
Fair

https://www.ncbi.nlm.nih.gov/pubmed/26174865

Color vision inclusiveness

Color blindness can affect a person's ability to see certain colors (usually green and red)

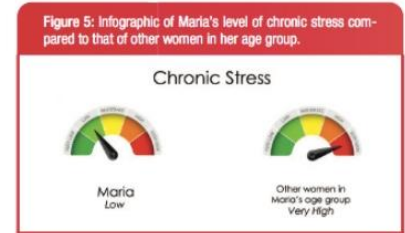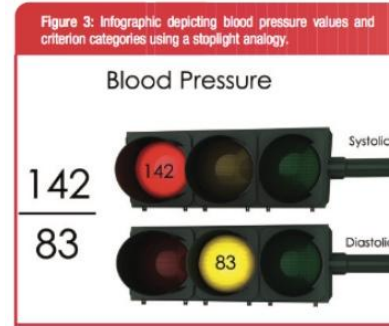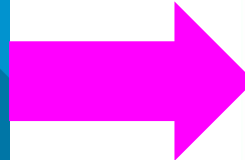This can be an issue given that many visualizations use red and green to indicate bad (red) or good (green) related to western cultural norms

Solutions:
- Use safe colors like orange and blue
- Engage potential users of your viz to see if color selection is an issue based on ability to see colors and cultural cues about what the colors mean
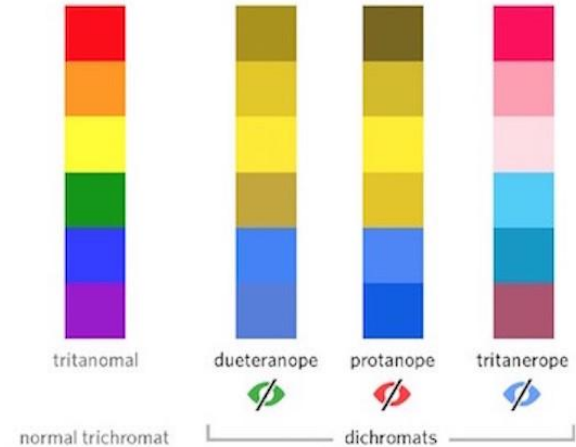
http://blog.usabilla.com/wp-content/uploads/2015/11/colorblind_01_03-1.jpg

There are many resources on color in viz if you want to learn more
E.g., Chapter 4 of
https://www.amazon.com/Information-Visualization-Third-Interactive-Technologies/dp/0123814642

Gradients

Often the default for
quantitative variables
to use a color gradient
to indicate a
quantitative value

Gradients

Often the default for quantitative variables to use a color gradient to indicate a quantitative value

Problem: Hard to tell differences in colors

Gradients

Often the default for quantitative variables to use a color gradient to indicate a quantitative value

Problem: Hard to tell differences in colors

Select below to viz... a health indicator in the ... nd chart

Percent Uninsured

Below state average | **Ab... state**

Click on a county ... map to view its health ind... profile

What's the difference between those two colors? Does that difference matter?

basemap created with mapbox

Gradients

Often the default for quantitative variables to use a color gradient to indicate a quantitative value

Problem: Hard to tell differences in colors

Select below to vizualize a health indicator in the map and chart

Percent Uninsured

Below state average   Above state average

Click on a county in the map to view its health indicator profile

Where is this county on the gradient?
Does that position on the gradient have meaning?
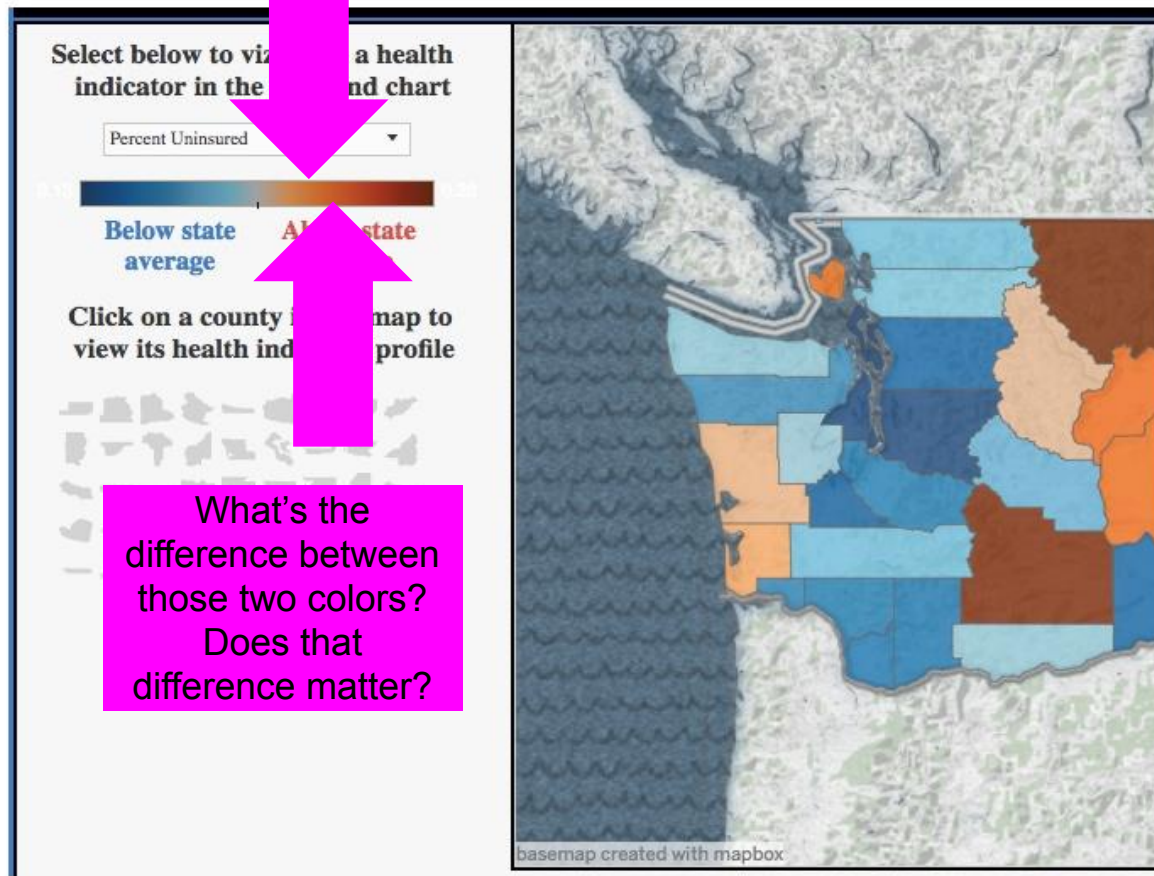
basemap created with mapbox

Gradients

Often the default for quantitative variables to use a color gradient to indicate a quantitative value

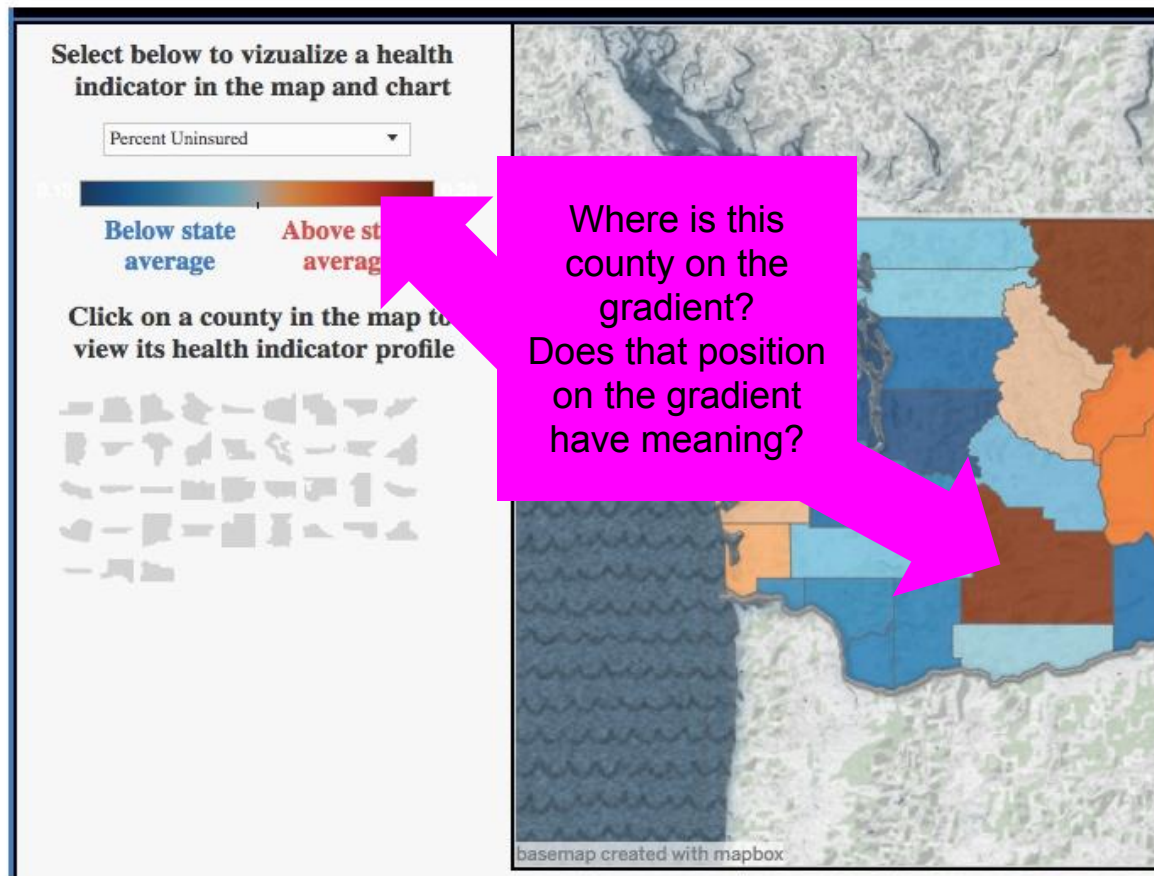**Problem**: Hard to tell differences in colors

Solution: Use one color with steps that differ in saturation and that have meaning

Select below to vizualize a health indicator in the map and chart

Percent Uninsured

Below state average   Above state average

Click on a county on the map to view its health indicator profile

basemap created with mapbox

Below state average

At state average

Above state average

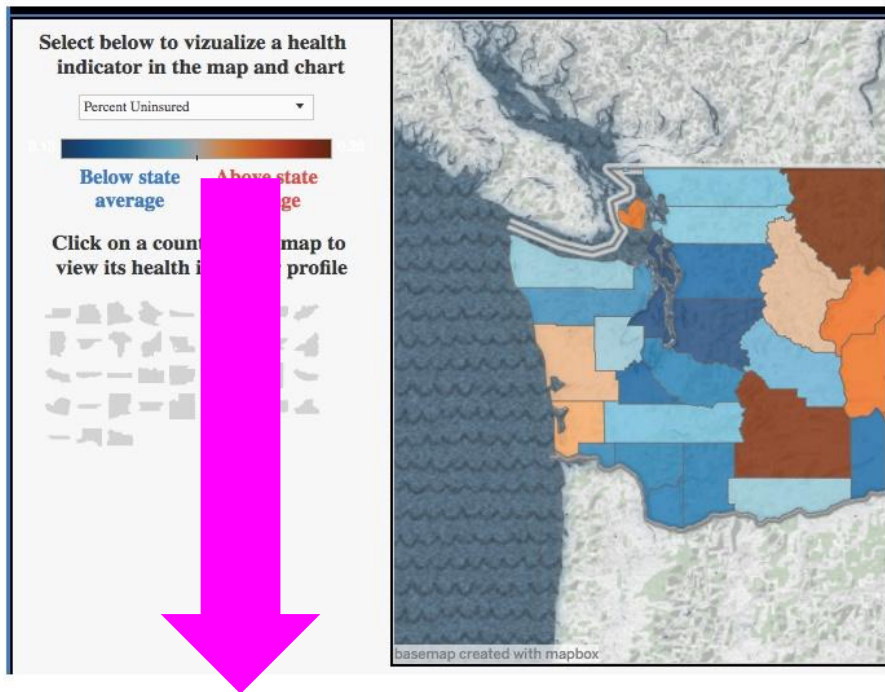Rationale: State average (compare to what's "normal")

Gradients

Often the default for quantitative variables to use a color gradient to indicate a quantitative value
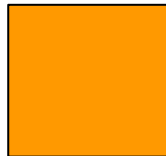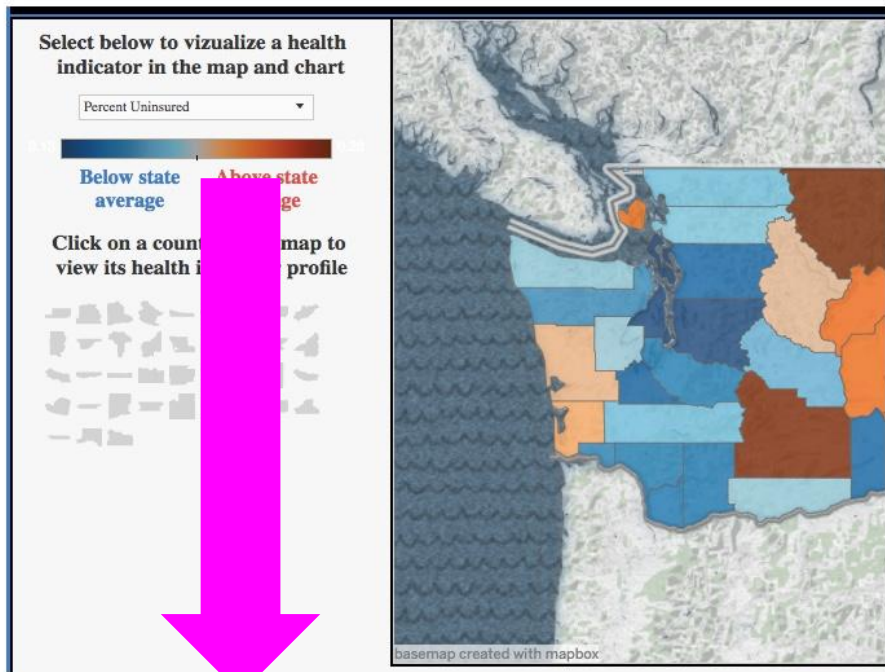
Problem: Hard to tell differences in colors

Solution: Use one color with steps that differ in saturation and that have meaning

Select below to vizualize a health indicator in the map and chart

Percent Uninsured

Below state average

Above state average

Click on a county in the map to view its health indicator profile

basemap created with mapbox

| 1st tertile | 2nd tertile | 3rd tertile |

Rationale: Equal proportions across steps (statistical basis)
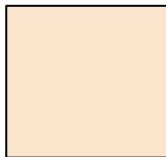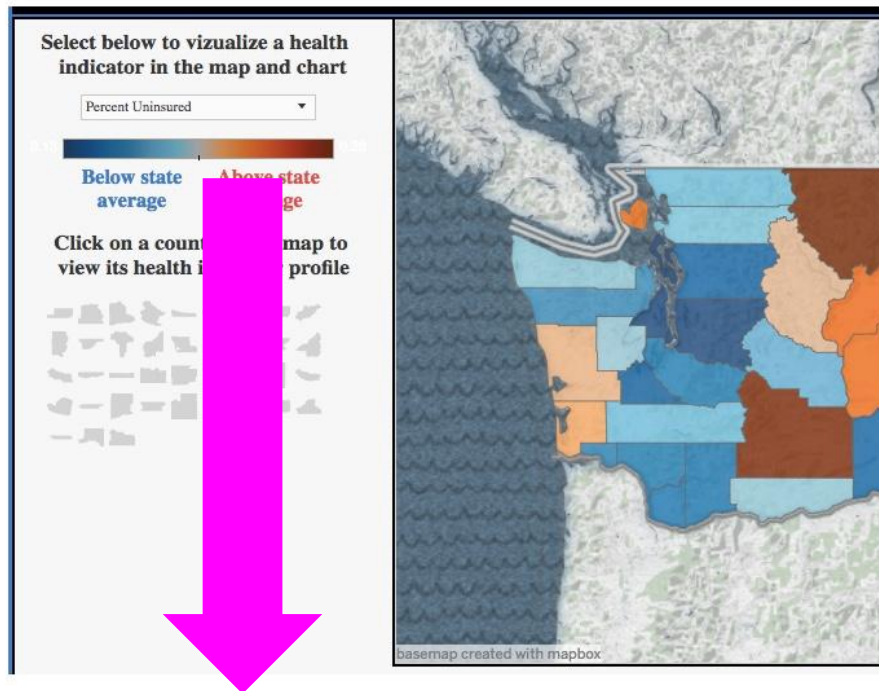
Gradients

Often the default for quantitative variables to use a color gradient to indicate a quantitative value

Problem: Hard to tell differences in colors

Solution: Use one color with steps that differ in saturation and that have meaning

Select below to vizualize a health indicator in the map and chart

Percent Uninsured

Below state average — Above state average

Click on a county in the map to view its health indicator profile

basemap created with mapbox

0% uninsured (Healthy People 2020 Goal)

>0& and <17% uninsured (between Healthy People 2020 Goal and baseline)

>17% uninsured (exceeding Health People 2020 baseline)

Rationale: Based on if meeting a target or baseline

https://www.healthypeople.gov/2020/leading-health-indicators/2020-lhi-topics/Access-to-Health-Services/data
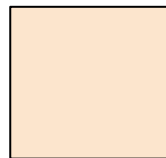
Gradients

Often the default for quantitative variables to use a color gradient to indicate a quantitative value

Problem: Hard to tell differences in colors

Solution: Use one color with steps that differ in saturation and that have meaning

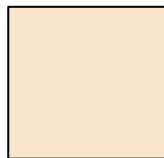## Gradient takeaways

Use steps instead of gradient

3-4 steps best (people can't tell differences between steps if more than 4)

Use 1 color for single variable and change saturation (light to dark)

Have rationale for steps

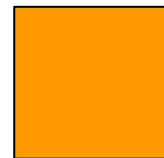|		
0% uninsured (Healthy People 2020 Goal)	>0& and <17% uninsured (between Healthy People 2020 Goal and baseline)	>17% uninsured (exceeding Health People 2020 baseline)

Data viz nuts and bolts

Data types

Color

Avoiding bias and misleading visualizations

Misleading viz

Visualizations can consciously or subconsciously be misleading

WITH GREAT POWER COMES GREAT RESPONSIBILITY

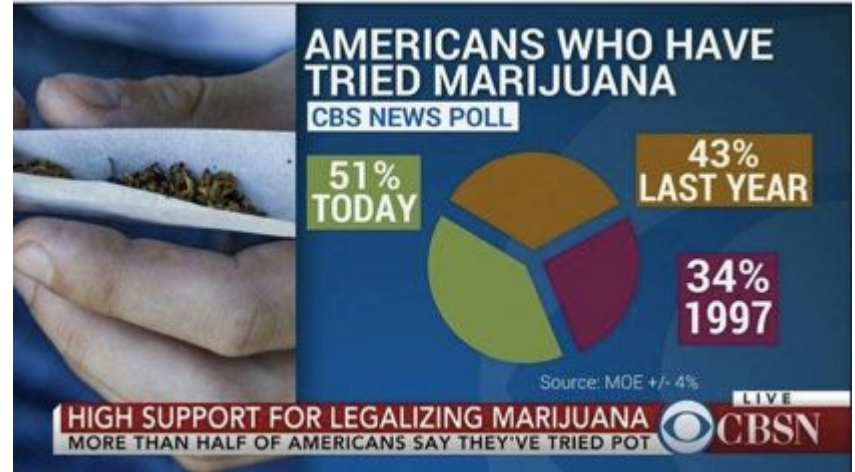Data visualization

They're everywhere

Pell Grant Maximum Awards
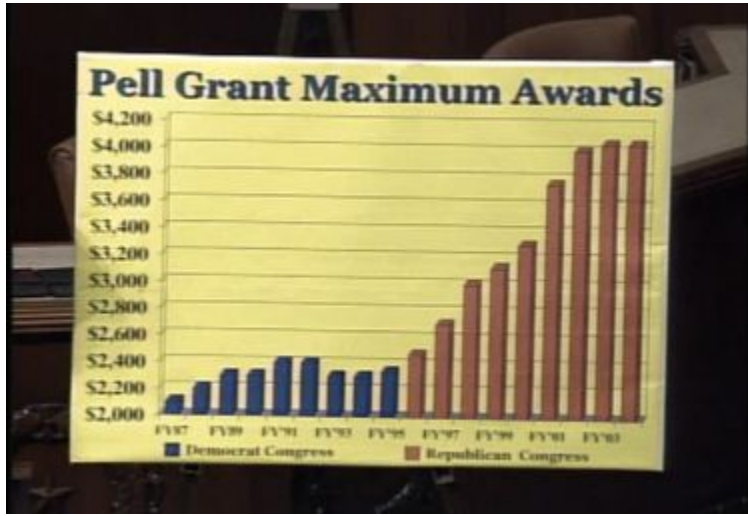
Source: Congress
Audience: Congress people & general public
Issue: Pell grant awards (D vs R congress)
Source: ?
Persuasion: Probably (brought to the floor to be discussed re: legislation)
Problem: Y-axis not start at 0

AMERICANS WHO HAVE TRIED MARIJUANA
CBS NEWS POLL

Source: News
Audience: general public
Issue: Support for legalizing marijuana (but graph about use—is that ok?)
Source: MOE (?)
Persuasion: Maybe?
Problem: Does not add up to 100%

Visualizations, like sats, can be used to mislead

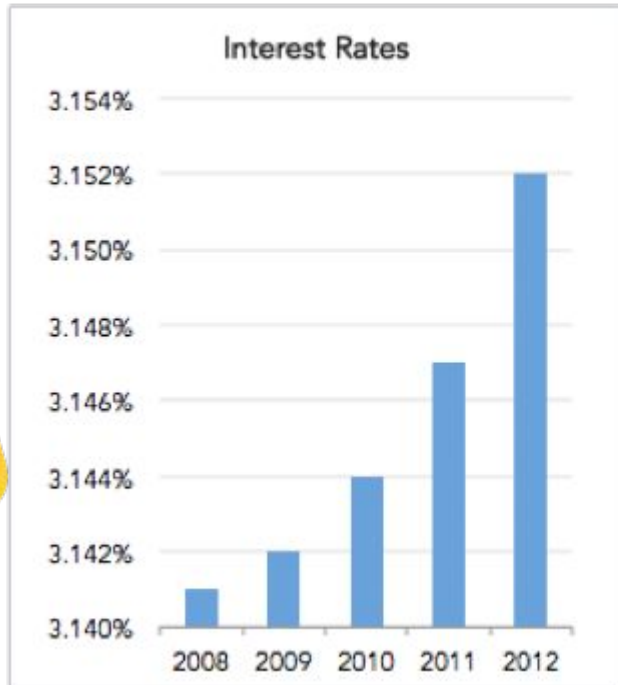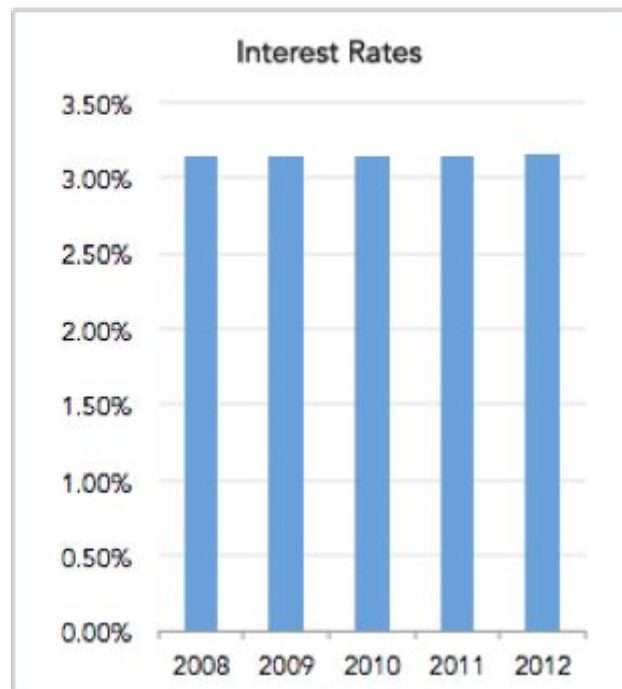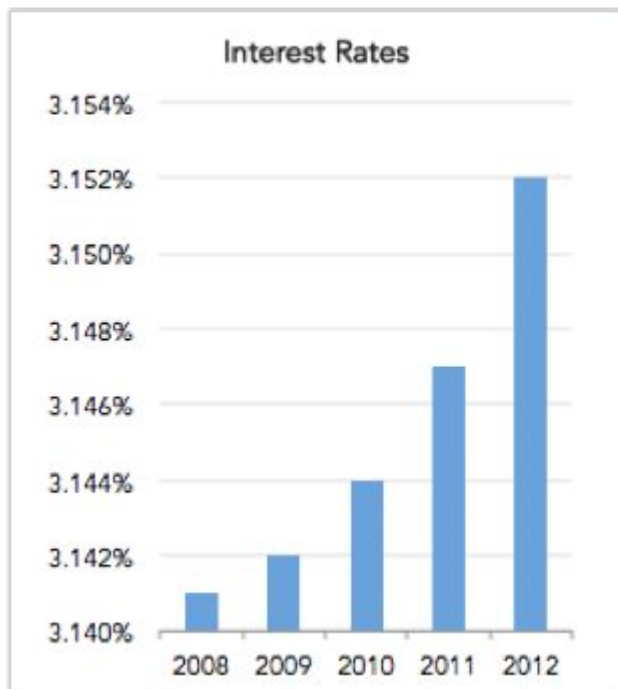**Same Data, Different Y-Axis**
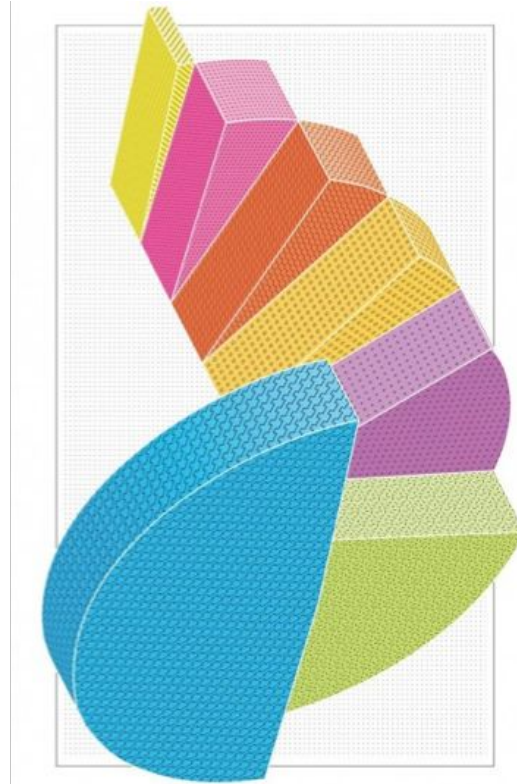
Interest Rates

What do you see in this chart?

Visualizations, like sats, can be used to mislead

Same Data, Different Y-Axis

...or to look pretty

Which slices are the exact same size?

...or to look pretty

Anatomy of a Winning TED Talk

1%

Sophisticated Visual Aids

We're not sure who puts the D in TED—most of the best presentations favor tepid PowerPoint slide shows (sorry, Brené Brown), Pictionary-quality drawings (really, Simon Sinek?), or no props at all.

5%

Opening Joke

Remember the one about the shoe salesmen who went to Africa in the 1900s? That's how Benjamin Zander opened his talk—which turned out to be about classical music.

5%

Spontaneous Moment

Don't overprepare. Tease the guy in the front row ("You could light up a village with this guy's eyes"). Commend the stagehand who handles the human brain you brought.

5%

Statement of Utter Certainty

People come for answers—give 'em what they want, as Shawn Achor did: "By training your brain ... we can reverse the formula for happiness and success."

12%

Snappy Refrain

The TED equivalent of "I have a dream." Example: "People don't buy what you do; they buy why you do it." Repeat 7x.

23%

Personal Failure

Be relatable. We want to know about that nervous breakdown. Or at least the time you didn't fit in at summer camp.

49%

Contrarian Thesis

Wait a sec—we should be playing more videogames? The more choices we have, the worse off we are? TED is where conventional wisdom goes to die.
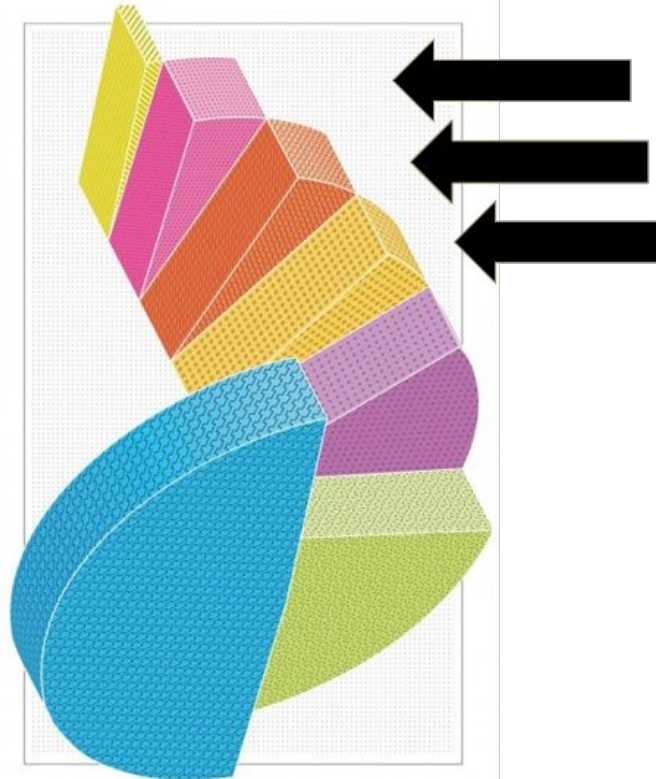
Gun deaths in Florida

Number of murders committed using firearms

2005
Florida enacted
its 'Stand Your
Ground' law

873

721

1990s   2000s   2010s

Source: Florida Department of Law Enforcement

C. Chan 16/02/2014   REUTERS
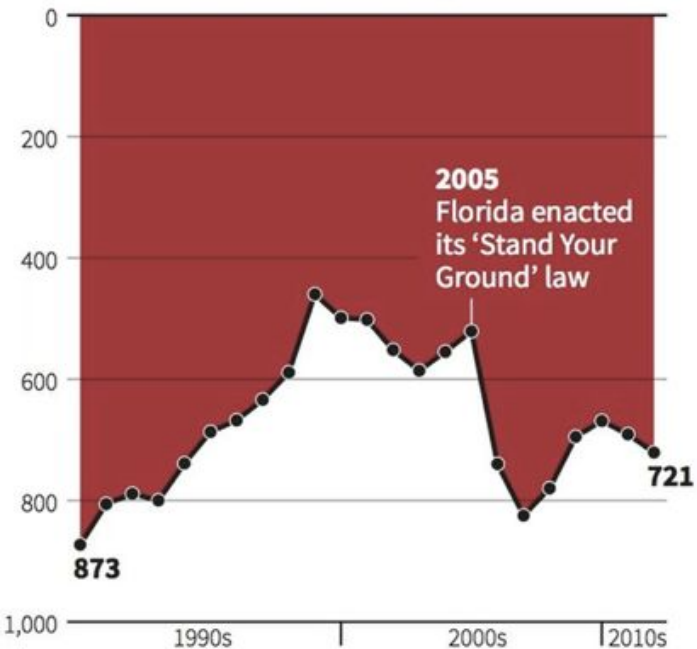
What do you think about
this graph?

Do you think the creator
had an agenda?

What design decisions
were made the creator
to make this graph?

Gun deaths in Florida
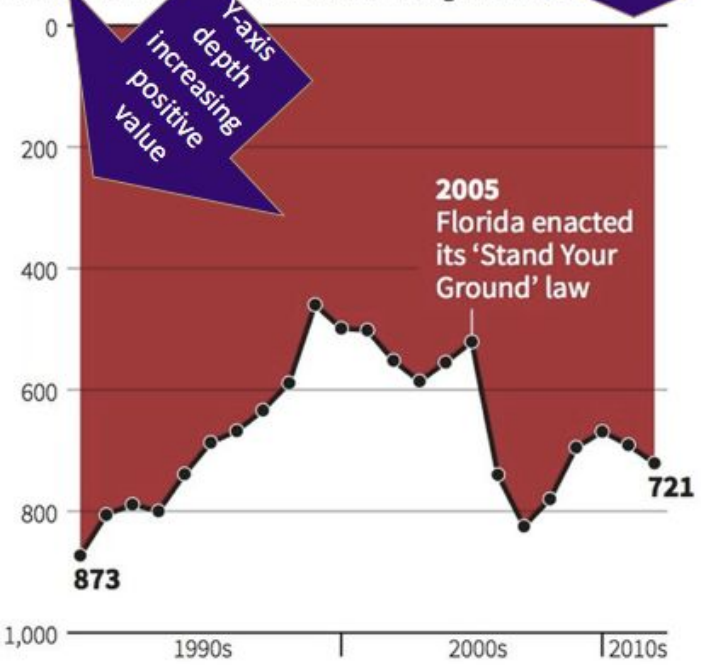
Number of murders committed using firearms

X-axis at the top

Y-axis depth increasing positive value

Value	
0	
200	
400	
600	
800	
1,000	

2005
Florida enacted its 'Stand Your Ground' law

873

721

1990s   2000s   2010s

Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

REUTERS

Gun deaths in Florida

Number of murders committed using firearms

2005 Florida enacted its 'Stand Your Ground' law

873

721

Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

REUTERS

Annotations on left chart:
- X-axis at the top
- Y-axis depth increasing positive value

0
200
400
600
800
1,000

1990s
2000s
2010s

Right chart (inverted):
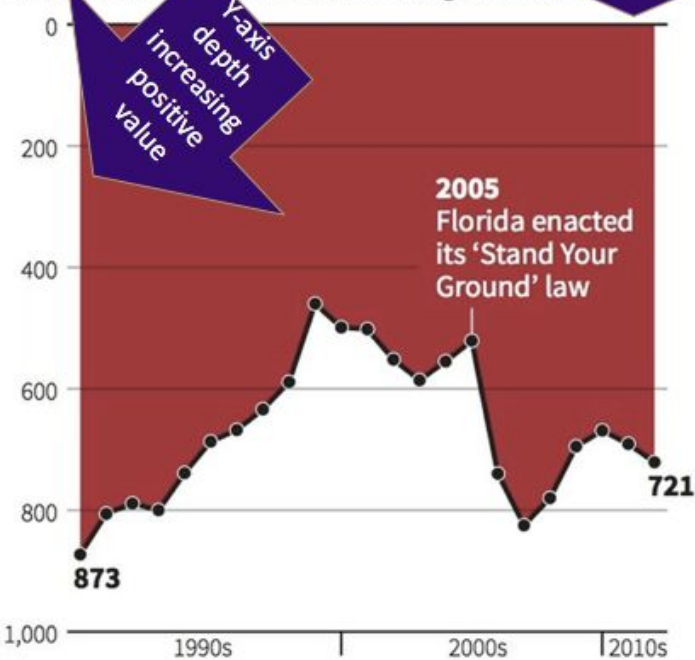
REUTERS

Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

1,000
1990s
2000s
2010s

873

800

600

400

200

0

2005 Florida enacted its 'Stand Your Ground' law

721

Number of murders committed

Gun deaths
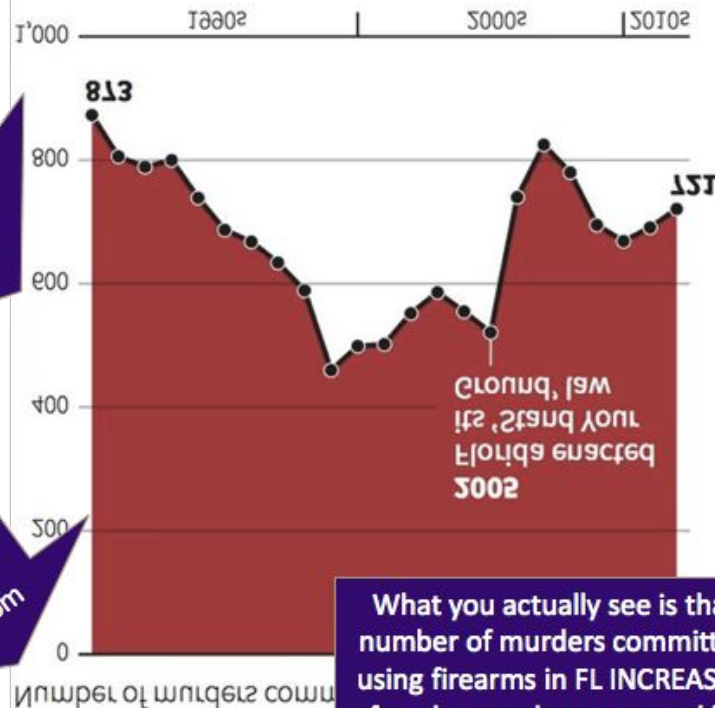
Annotations on right chart:
- Y-axis height increasing positive value
- X-axis at the bottom
- What you actually see is that number of murders committed using firearms in FL INCREASED after the stand your ground law was enacted

With visualizing data comes great responsibility

Even if a program makes a viz for you, it doesn't mean that viz makes sense

The program can make a viz it will but it won't tell you *if* that viz should be made

Programs rely on *you* to make the decision about what should be made into a viz

Your scientists were so preoccupied with whether or not they could, they didn't stop to think if they should.
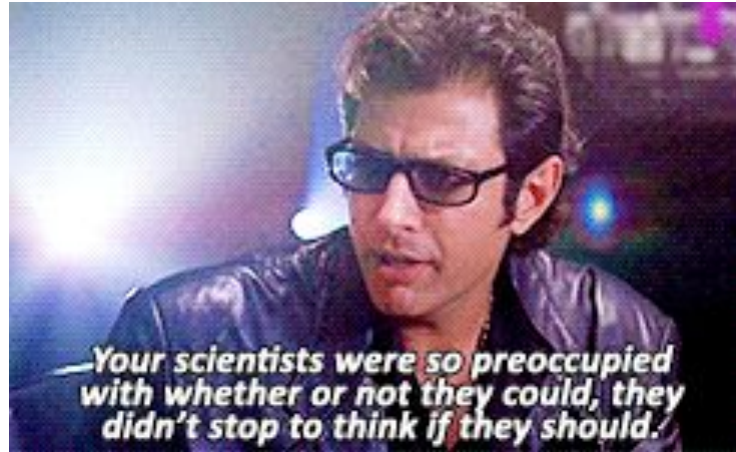
Example:
Not paying attention to data types

Categorical → Race

NOT APPROPRIATE!

Can only make scatter plots with 2 quantitative variables

Can lead to erroneous interpretations!

Scatterplot of race and gender

Categorical → Binary Gender Identity

Example:
Not paying attention to data types

This is appropriate!

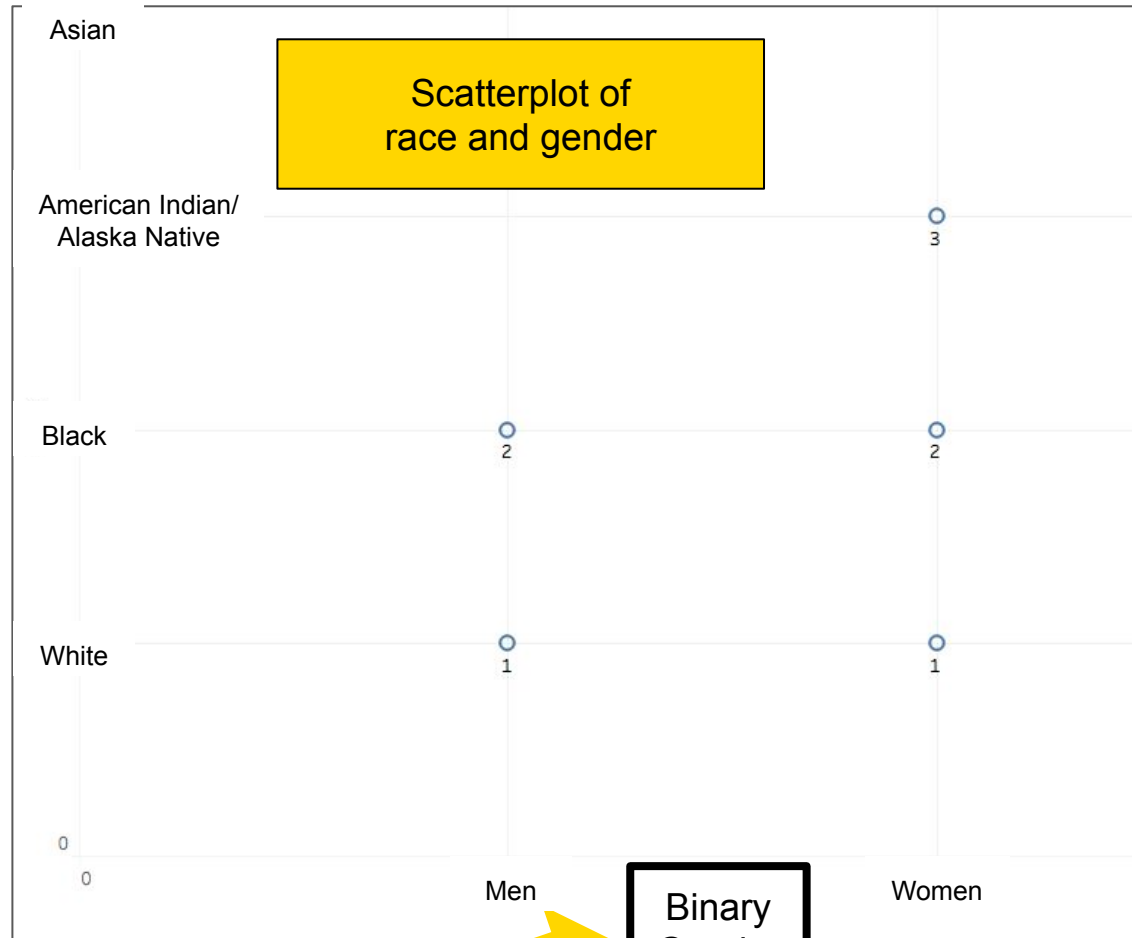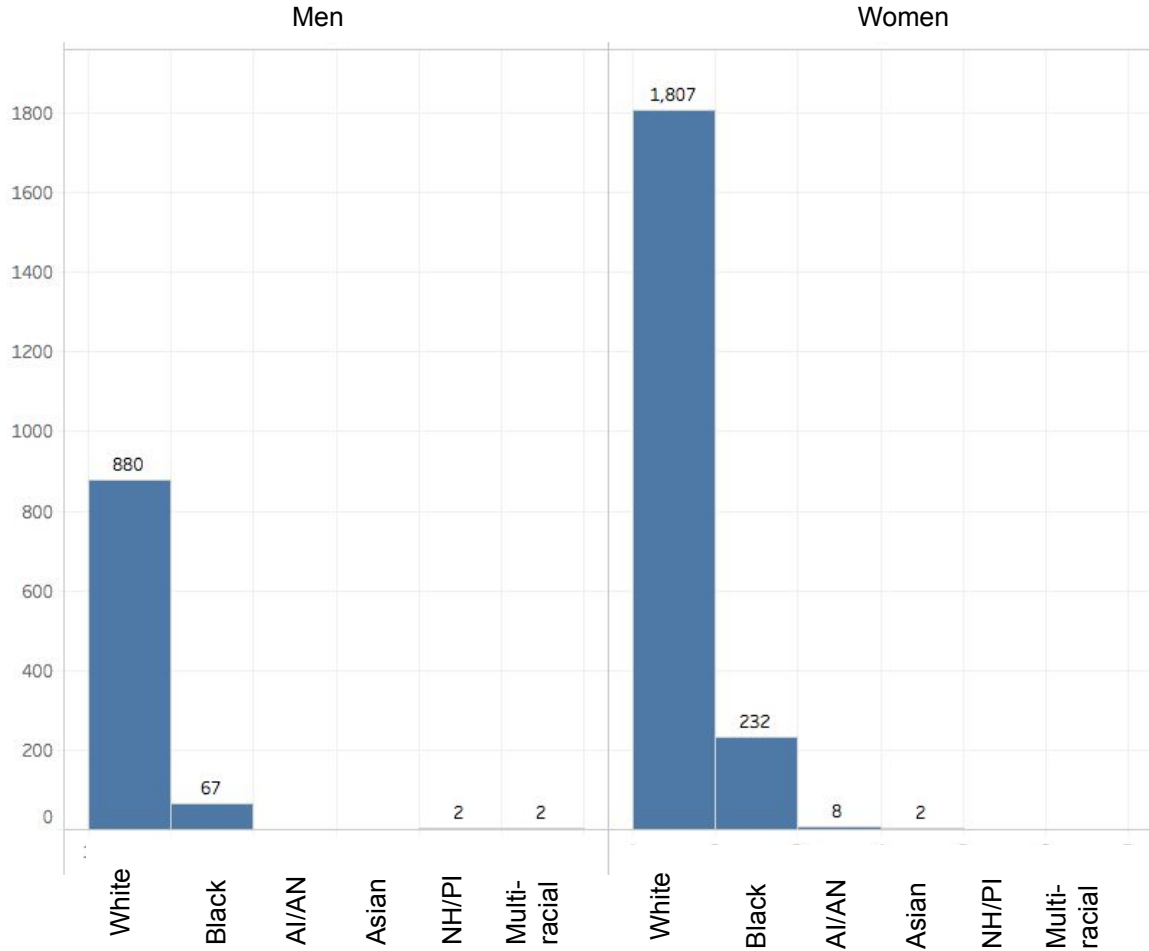Bar charts

Maps/Choropleths

Maps

Often used to show disease prevalence or incidence

Maps

Often used to show disease prevalence or incidence

Shading indicates ranges where light→dark shading proportional to steps in ranges

LIFE EXPECTANCY FOR WOMEN

Carnation

Bellevue

Seattle

Snoqualmie

Issaquah

Renton

Vashon Island

Federal Way

Auburn

AVERAGE 2014 LIFESPAN (IN YEARS)
- 68 - 71
- 72 - 75
- 76 - 79
- 80 - 83
- 84 and up

Source: Institute for Health Metrics and Evaluation
EMILY M. ENG / THE SEATTLE TIMES

Prevalence of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2016

Color indicates ranges where color order not necessarily in proportion to %

- <20%
- 20%-<25%
- 25%-<30%
- 30%-<35%
- ≥35%
- Insufficient data*
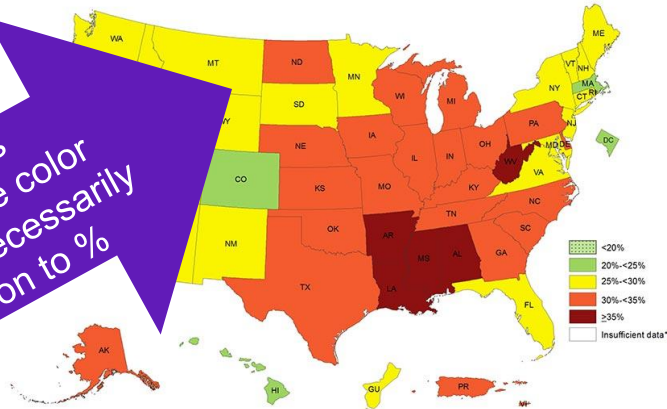
https://www.cdc.gov/obesity/images/data/brfss_2016_obesity-overall.jpg

Maps

Often used to show disease prevalence or incidence

Color indicate ranges

When used well:
- Data relates to geographic, built environment, and other space/context-related issues
  - E.g. relationship between asthma prevalence & pollution-causing factors like factories
- Allows investigators to see how geography impacts health

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What do you think about this use of a map? Is it used well?

Unclear how physical state boundaries relate to obesity

Map more of a visual indexing of 50 states worth of data rather than a way to see how geography relates to obesity
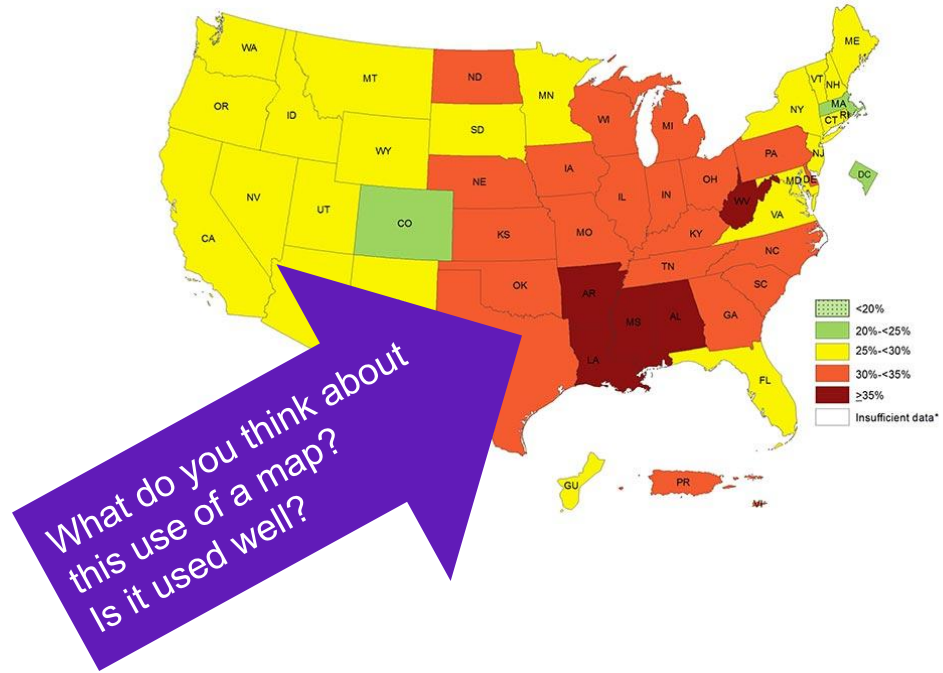
Maps

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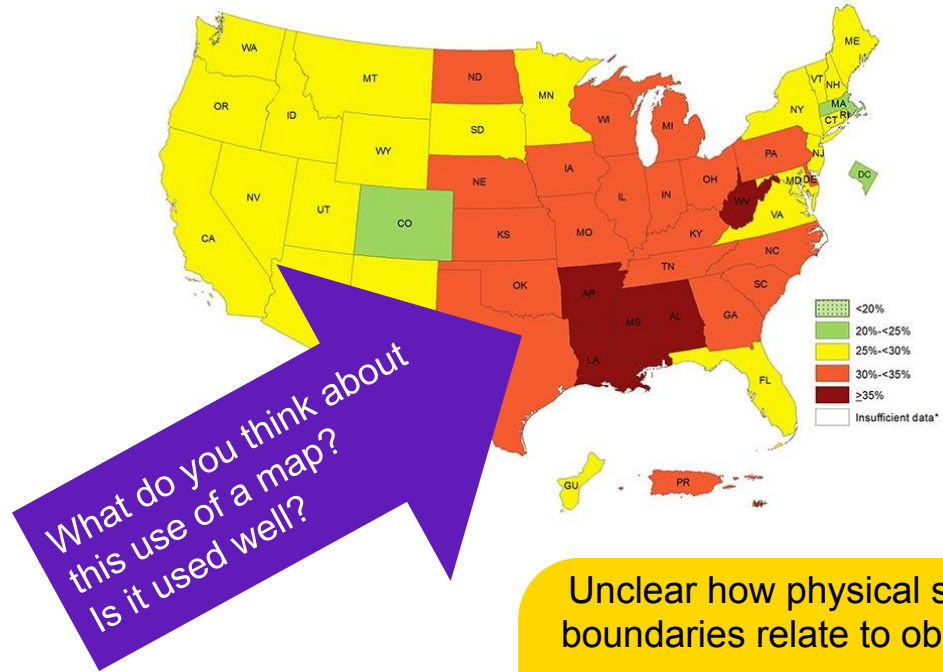- Allows investigators to see how geography impacts health

How else could this be visualized?

What do you think about this use of a map? Is it used well?

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Maps

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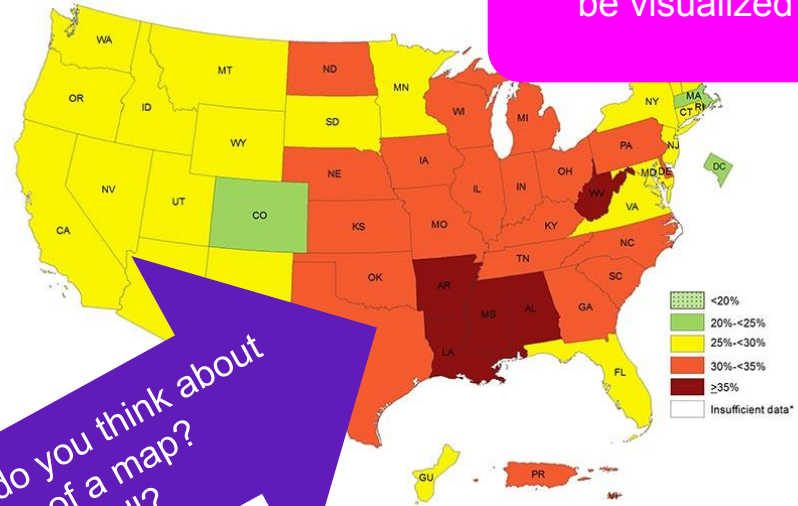LIFE EXPECTANCY FOR WOMEN

Carnation
Bellevue
Seattle
Issaquah
Snoqualmie
Renton
Vashon Island
Federal Way
Auburn

Source: Institute for He...
EMILY M. ENG...

AVERAGE 2014 LIFESPAN (IN YEARS)
- 68 - 71
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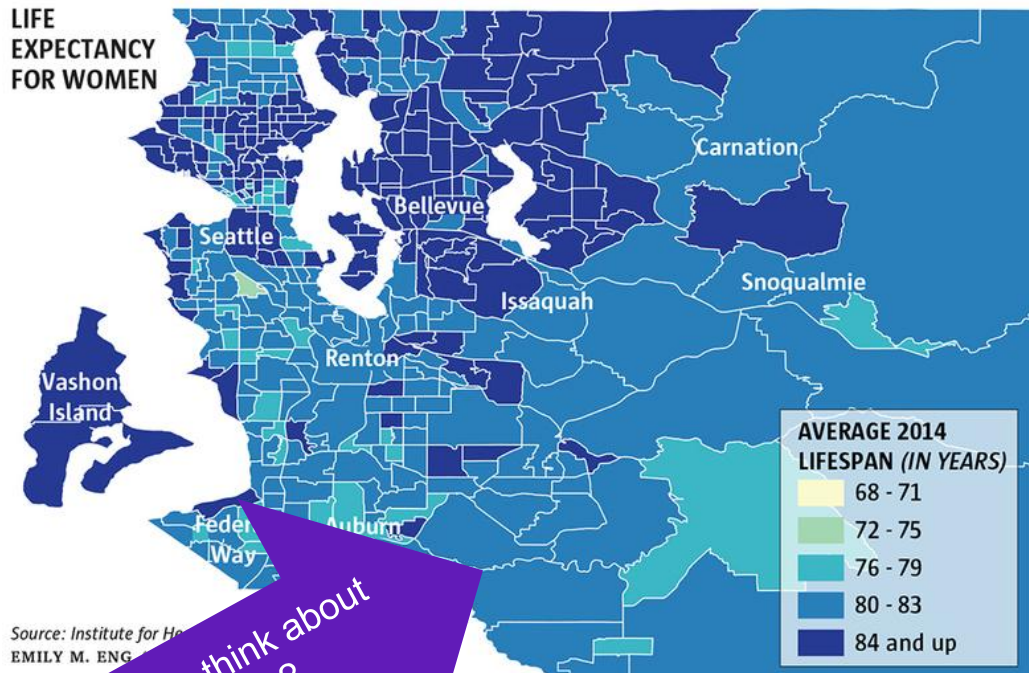What do you think about this use of a map? Is it used well?

Maps

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  - E.g. relationship between asthma prevalence & pollution-causing factors like factories
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What do you think about this use of a map? Is it used well?

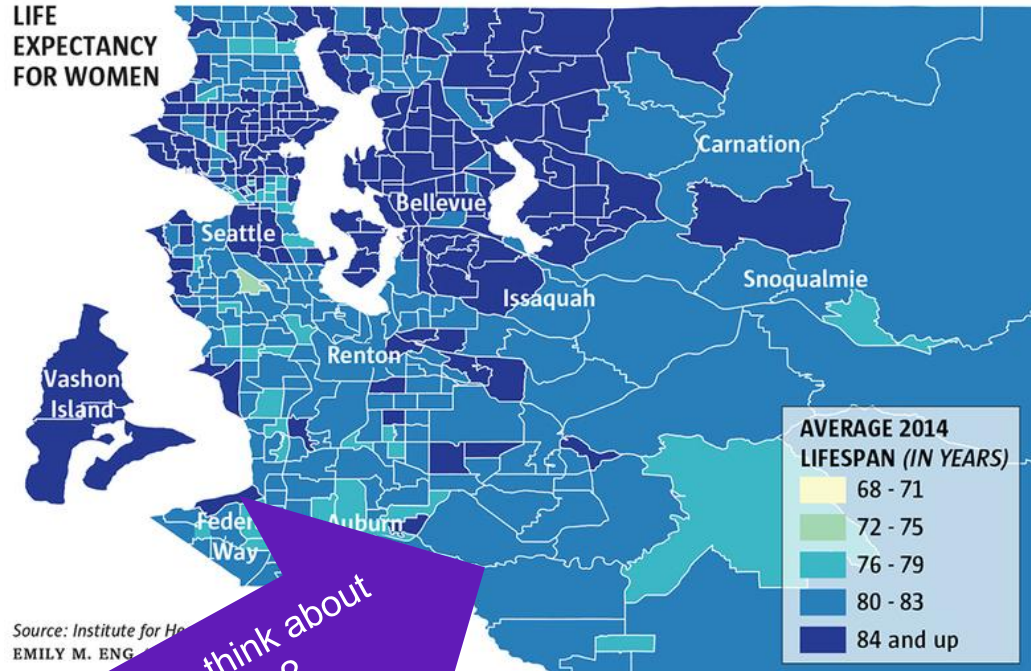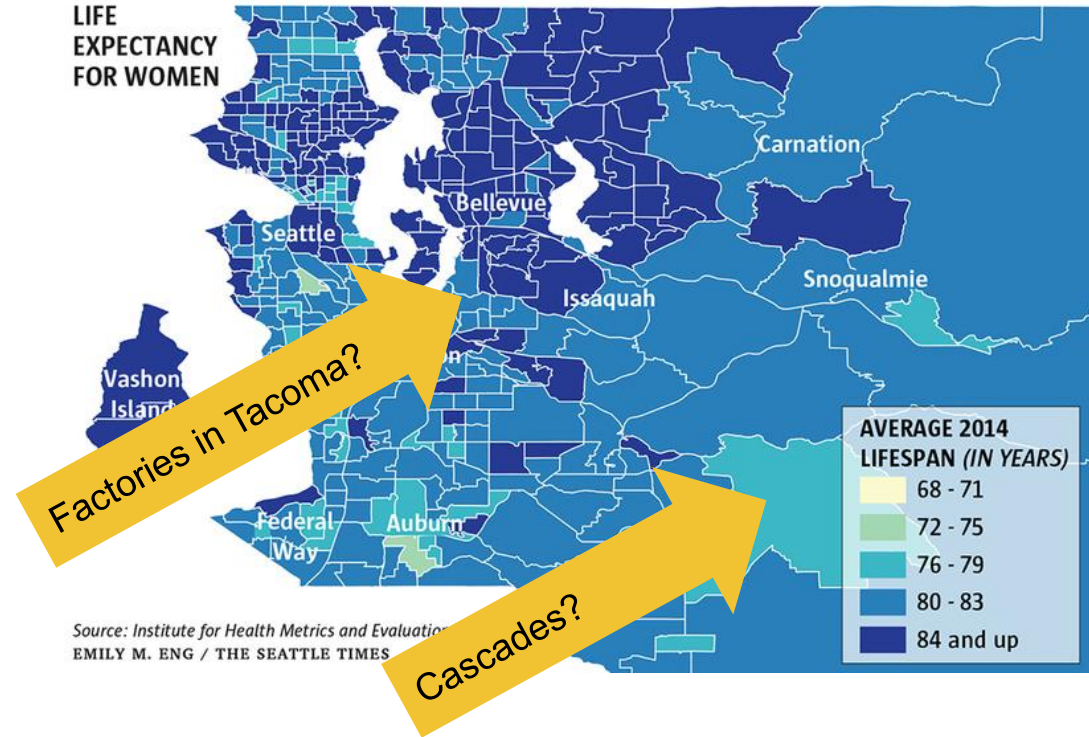Could be more appropriate if looking at regional-level segregation and physical access to resources that relate to social determinants of health which can impact life expectancy

Making maps

Determine if a map is the best way to represent your data:

- Do your data relate to geographic, built environment, and other space/context-related issues?
- What other geographic features would you need to add to give the context you need to make sense of the map?

LIFE EXPECTANCY FOR WOMEN

Carnation

Bellevue

Seattle

Issaquah

Snoqualmie

Vashon Island

Factories in Tacoma?

Federal Way

Auburn

Cascades?

AVERAGE 2014 LIFESPAN (IN YEARS)
- 68 - 71
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Source: Institute for Health Metrics and Evaluation
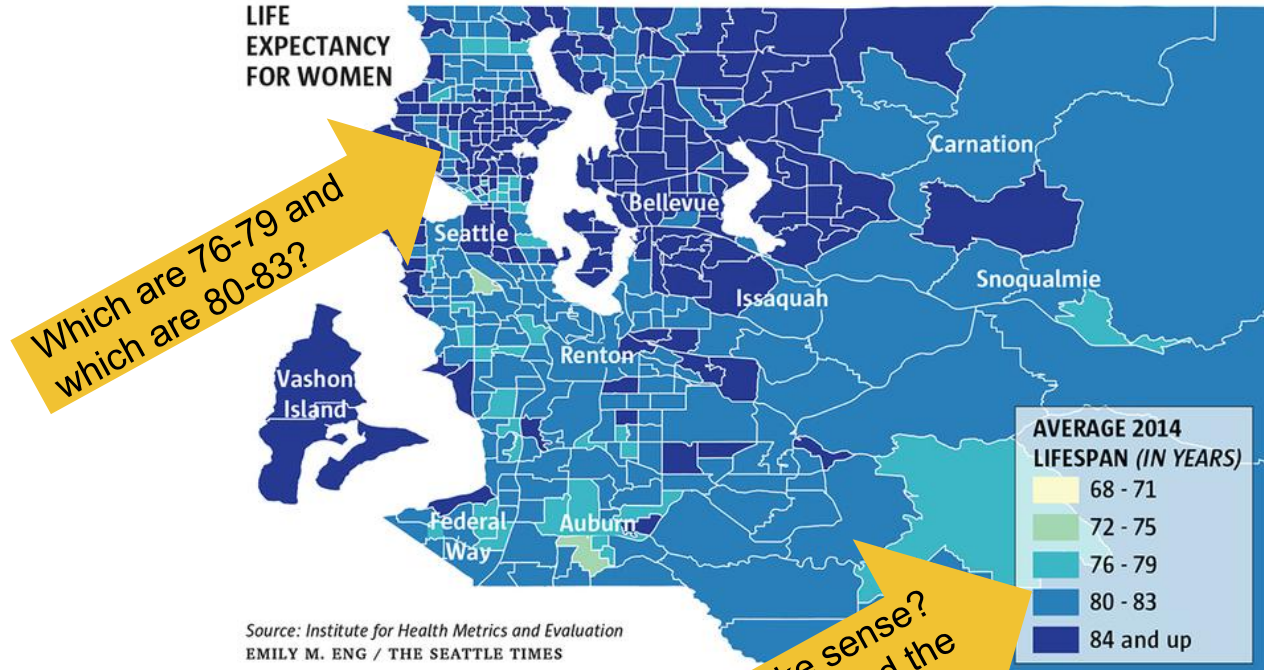EMILY M. ENG / THE SEATTLE TIMES

Making maps

Be careful when choosing your ranges & colors indicating ranges

- Use 1 color if possible
  - Blue often recommended
- Just change the saturation
  - e.g., light blue to dark blue
- Try to have as few bins (i.e., ranges) as possible
  - 2-4 ideal
  - Have the bins be purposeful
    - Equal distribution between groups
    - Groups based on accepted standards or norms

LIFE EXPECTANCY FOR WOMEN

Which are 76-79 and which are 80-83?

Do these groupings make sense? Can they help you understand the situation or make a decision?

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Source: Institute for Health Metrics and Evaluation
EMILY M. ENG / THE SEATTLE TIMES

Wrap-up

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- Understanding pain management and opioid abuse also requires looking outside the clinic to public health
- Data visualizations included in data dashboards can help support understanding and decision-making
  - There are more and more examples of PH dashboards with visualizations of data related to factors associated with pain and opioid addiction
- These visualizations should be carefully constructed using informed design decisions -- bad design can impact understanding of the data and lead to wrong/bad decisions

Wrap-up

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Any final thoughts, questions, reactions?

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Thanks!

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