Data visualization in healthcare

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April 4, 2024

Learning objectives

History of data visualization in healthcare

Review data visualization benefits and tools in healthcare

A case study on Purdue Pharma misleading stakeholders through manipulated visualizations

Understand the impact data visualization has on healthcare decisions

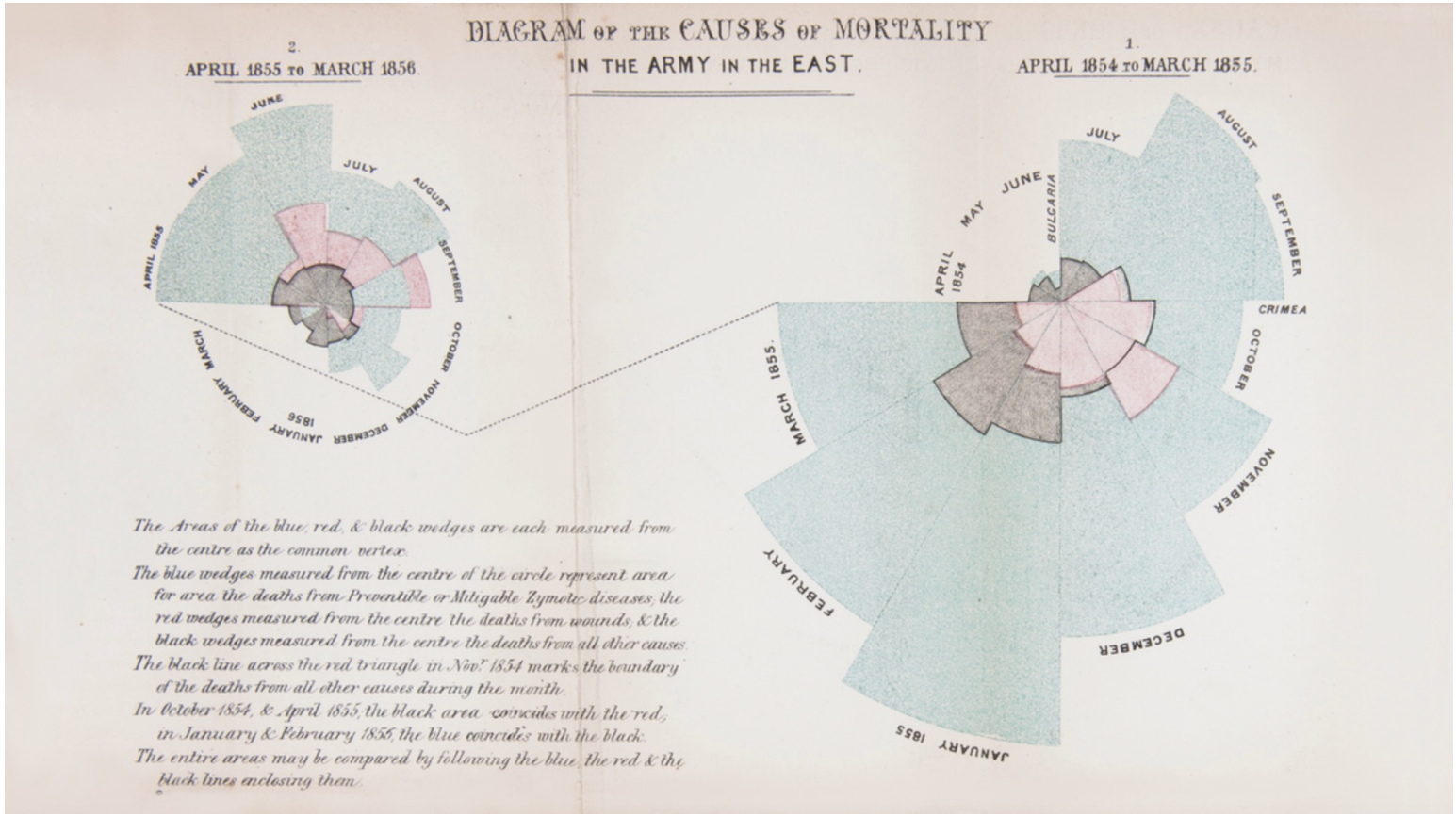
Section 1: History of data visualization

The history of data visualization in healthcare

- Early Visualizations
  - 19th Century: Florence Nightingale utilized graphical representations to illustrate the significance of sanitation in preventing mortality during the Crimean War (‘The Florence Effect’).
  - 20th Century: Charts and graphs were commonly used to present healthcare data, often in primary forms.

Abudiyab & Alanazi, 2022

History: Florence Nightingale's groundbreaking healthcare visualization



The history of data visualization in healthcare (cont'd)

- Digital Revolution
  - 1980s-1990s: The advent of computers and software allowed for more sophisticated data visualization techniques.
  - 1990s-Present: With the rise of electronic health records (EHRs) and big data analytics, healthcare visualization became more widespread and impactful.
- Modern Innovations
  - Interactive Dashboards: Real-time data visualization tools enable healthcare professionals to monitor patient outcomes and trends instantly.

Abudiyab & Alanazi, 2022

Section 2: Data visualization benefits in healthcare

The benefits of data visualization in healthcare

Improved decision-making and patient outcomes

- Enables quick and efficient analysis of vast datasets, enhancing decision-making processes.

Enhanced operational efficiency and resource allocation

- They facilitate real-time sharing of information and response to performance issues.

Identifying population health trends

- Data visualization tools help monitor population health trends.
- E.g., forecasting disease outbreaks, identifying chronic disease risk factors, and pre-empting patient-specific health crises.

Chornyy, 2023

The benefits of data visualization in healthcare (cont'd)

Enhancing patient education and empowerment

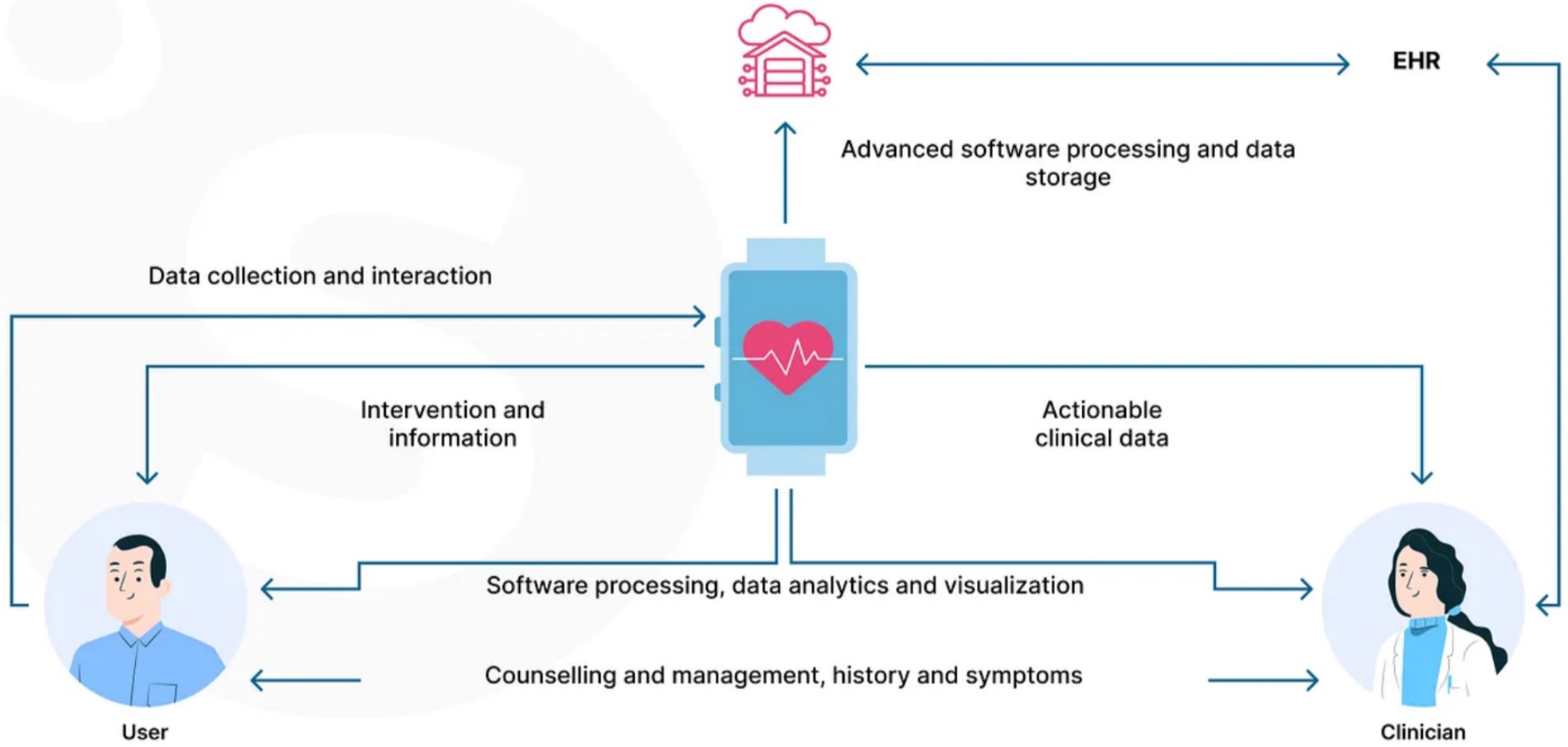
- Visualization techniques in health apps and software improve patient understanding of complex data and empower them to manage their health effectively.

Detecting fraud and ensuring transparency

- Data visualization helps map financial transactions, patient billing, and insurance claims, highlighting inconsistencies and potential fraud.

Chornyy, 2023

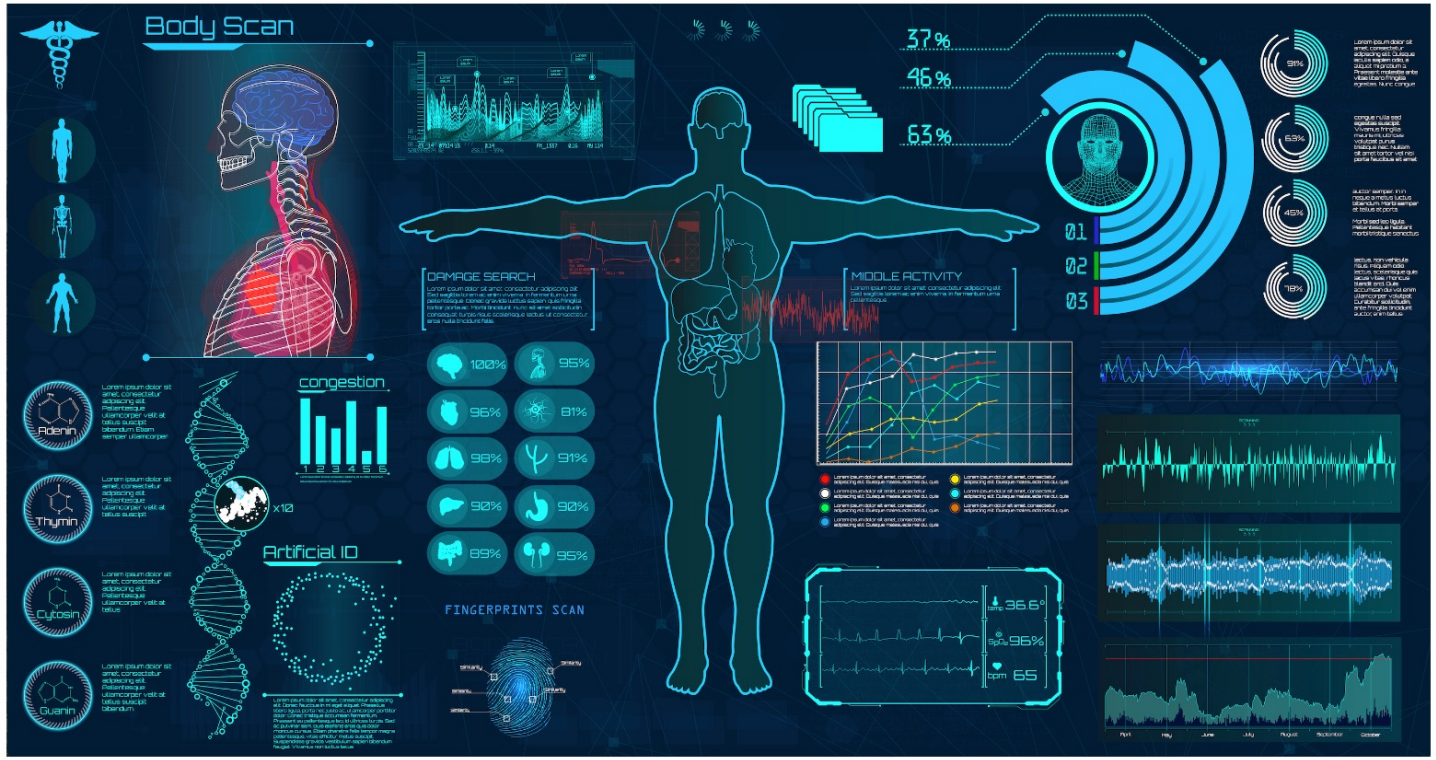
The process of developing data visualizations in healthcare settings



Vaniukov, 2024

Enhancing patient care through visualization

Enhancing patient care through visualization?

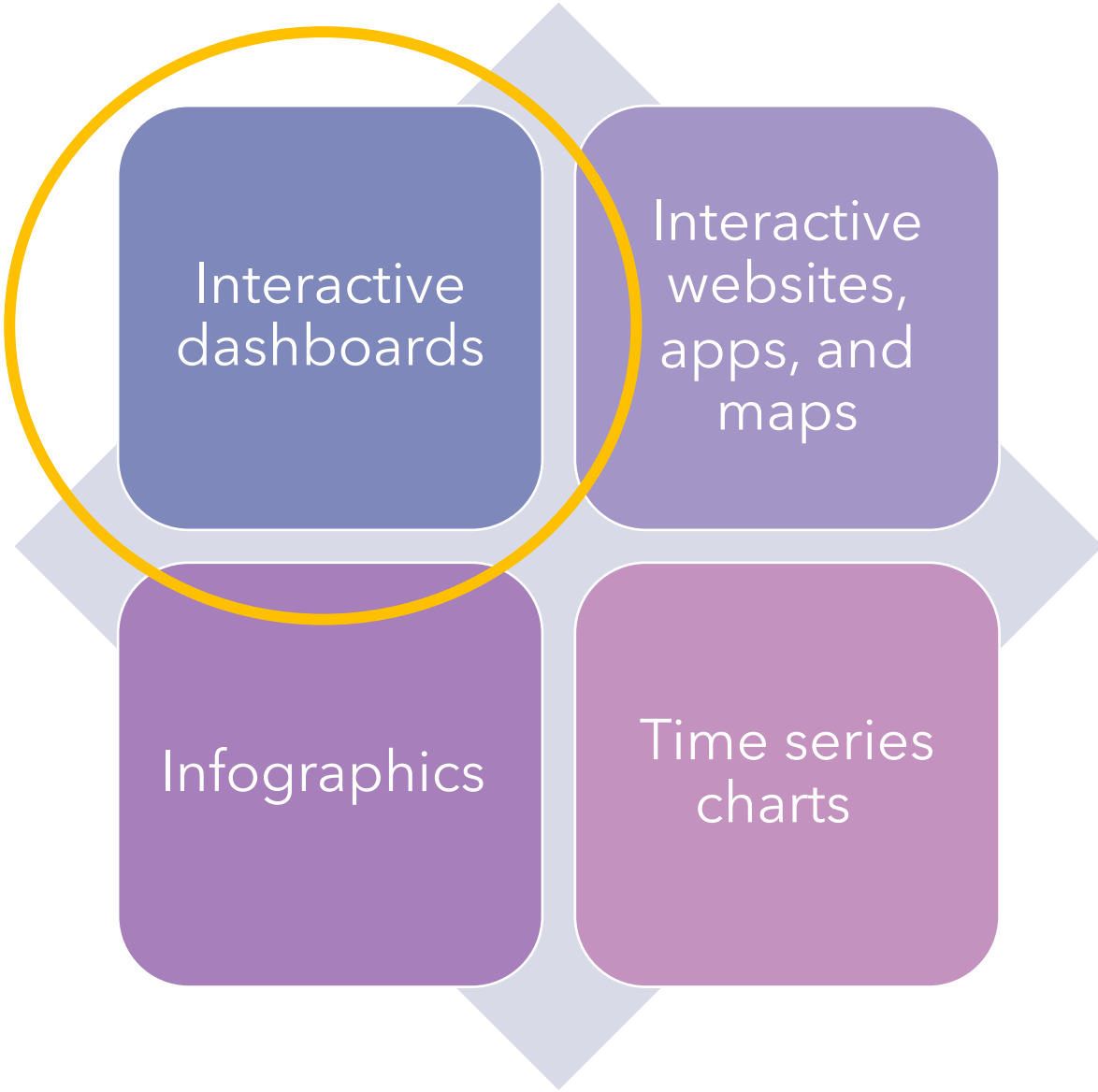


Common healthcare visualization types

- Charts and Graphs
- Diagrams and Flowcharts
- Tables
- Maps
- Infographics
- Dashboards

Section 3: Data visualization tools in healthcare settings

How is data visualization used in healthcare?



Patient Health Summary

Patient ID
PATIENT_1

80.56 bph
Heart Rate

119.43 mmHg
Blood Pressure

▼ -71%
Step Counter

3,220	11,000
Steps Walked	Target Steps

▼ -46.37%
Hours of Sleep

5.90 hr	11 hr
Sleeping Hrs	Maximum Hrs

16 bpm
Respiration Rate

170 mg/dL
Blood Glucose

31.60 °C
Body Temperature

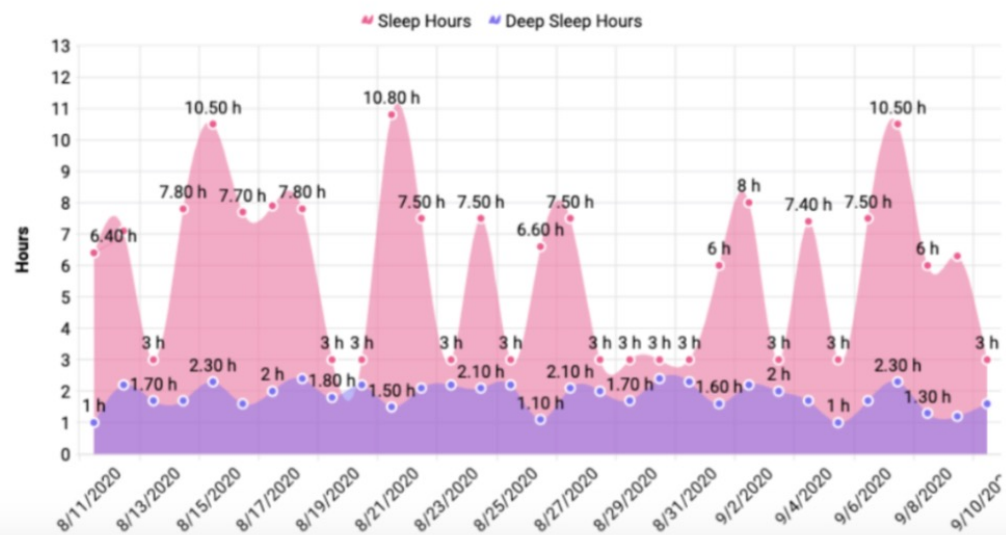
210 mg/dL
Blood Cholesterol

Patient Health Summary

Patient ID	Name	Gender	Age	Blood Type	Weight	Body Mass...	BMI Weigh...
PATIENT_1	Rita Moos	Male	48	A+	70 kg	22 kg...	Normal
PATIENT_2	Simon Roult	Female	49	B+	64 kg	21 kg...	Normal
PATIENT_3	Matti More...	Male	57	O+	70 kg	23 kg...	Normal
PATIENT_4	Pirkko Nina	Female	53	AB+	55 kg	23 kg...	Normal
PATIENT_5	Fran Tonini	Male	48	O+	49 kg	34 kg...	Obese

Sleep Hours vs. Deep Sleep Hours Summary - PATIENT_1

Last 30 Days



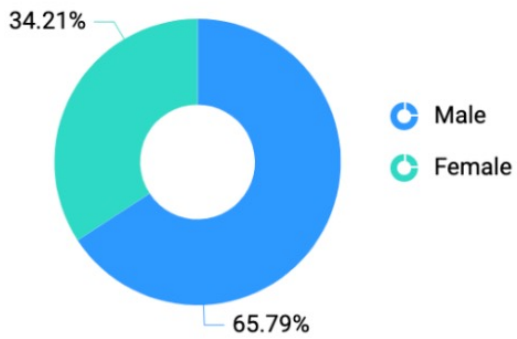
Patient Experience Analysis Dashboard

Day of Week
All

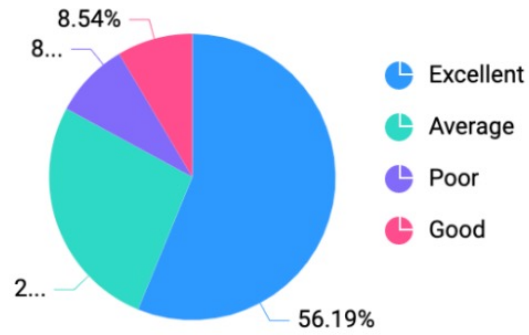
Department
All

Date
10/28/2020 - 7/13/2021

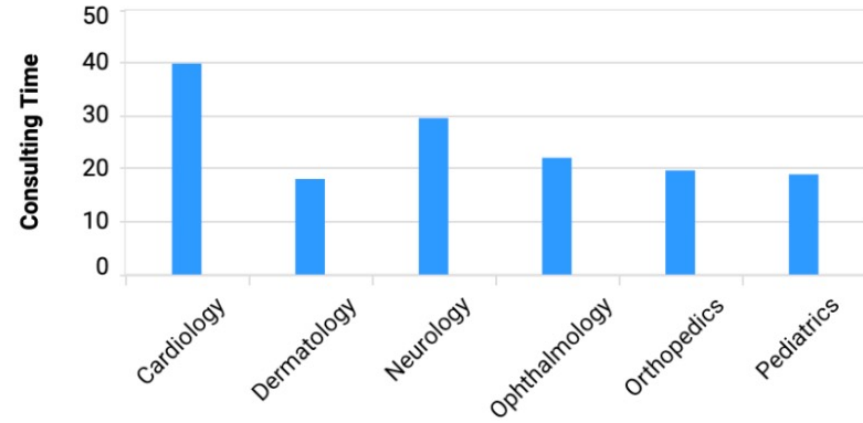
Patients Feedback b...



Patient Satisfaction



Average Visit Length by Department



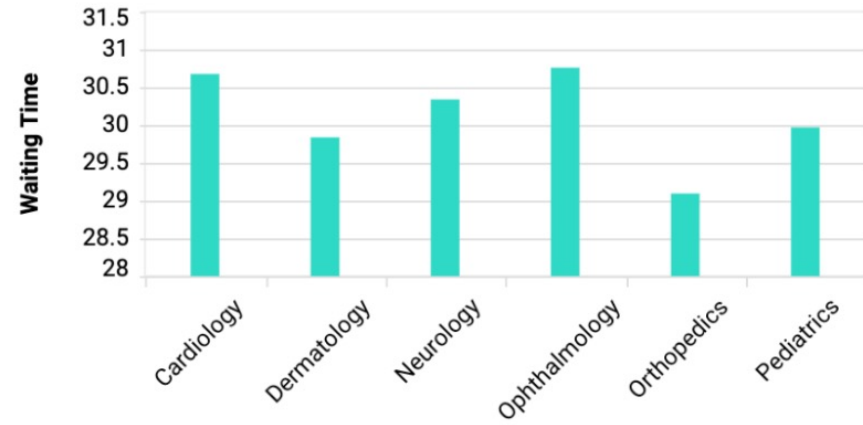
Patient Count by Depar...

Department	Patients Count
Cardiology	2,344
Dermatology	2,321

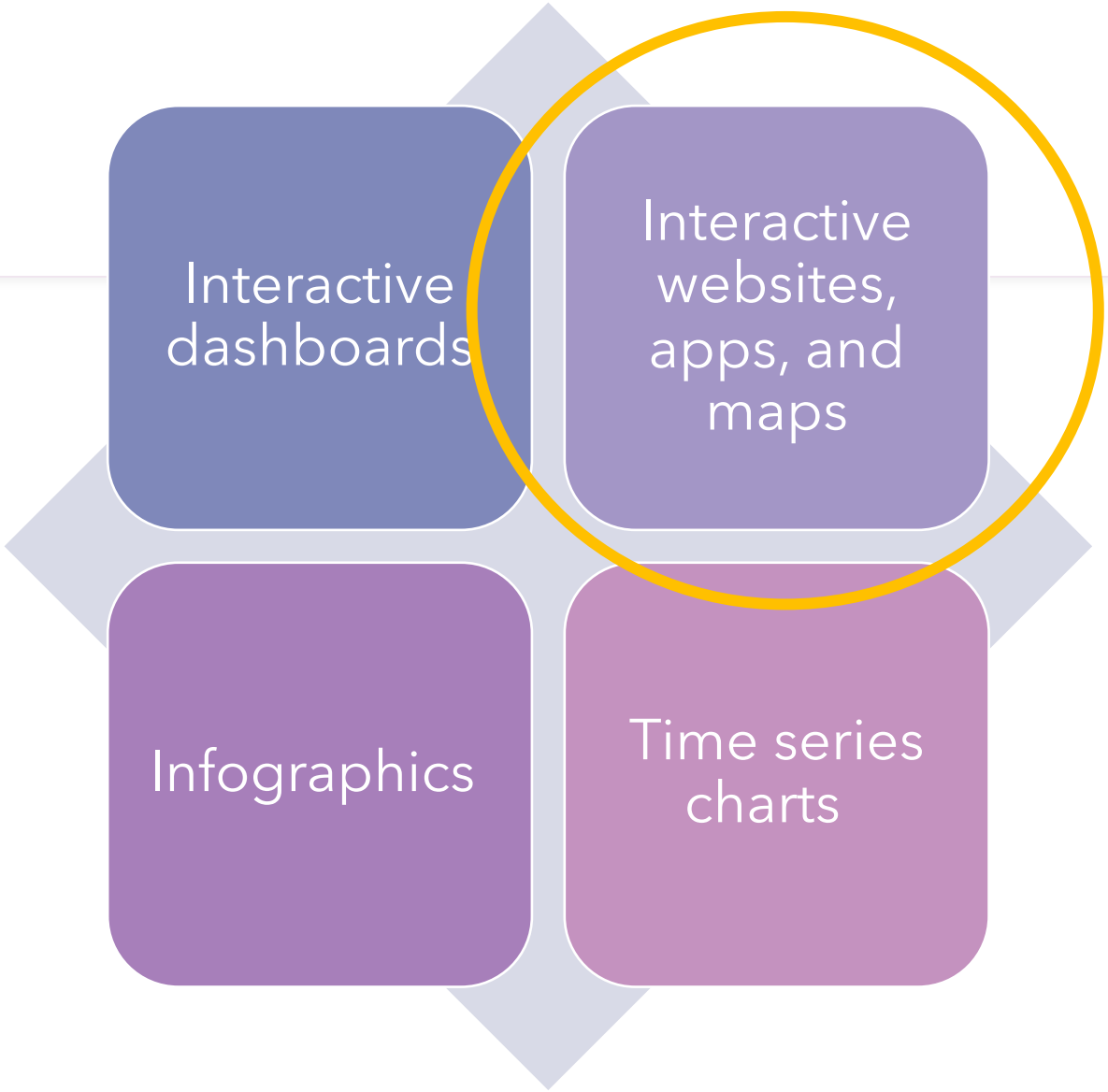
Patient Feedback Details

Name	Department	Feedback
Alen	Cardiology	Excellent
Alen	Dermatology	Excellent

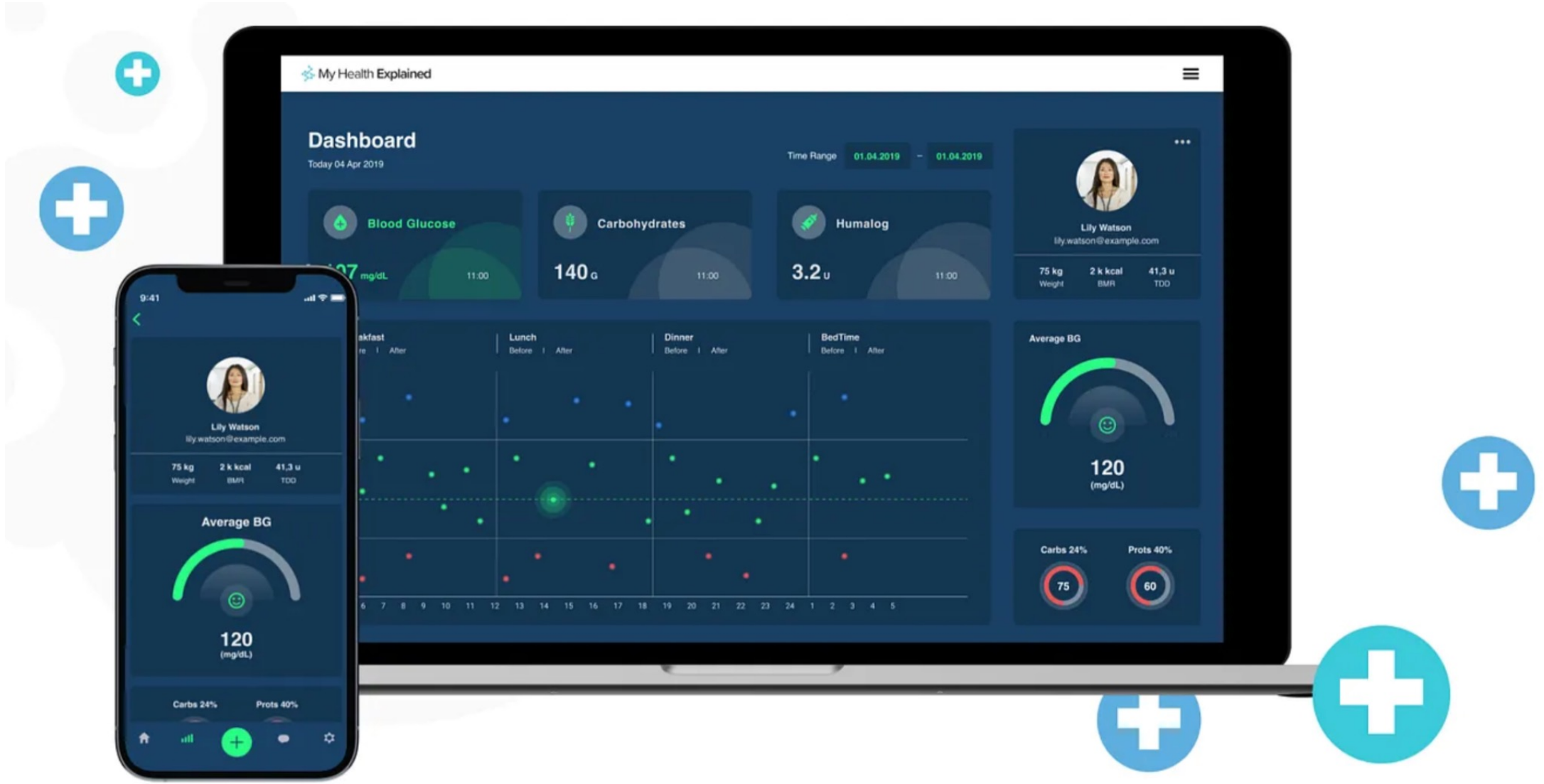
Average Wait Time by Department



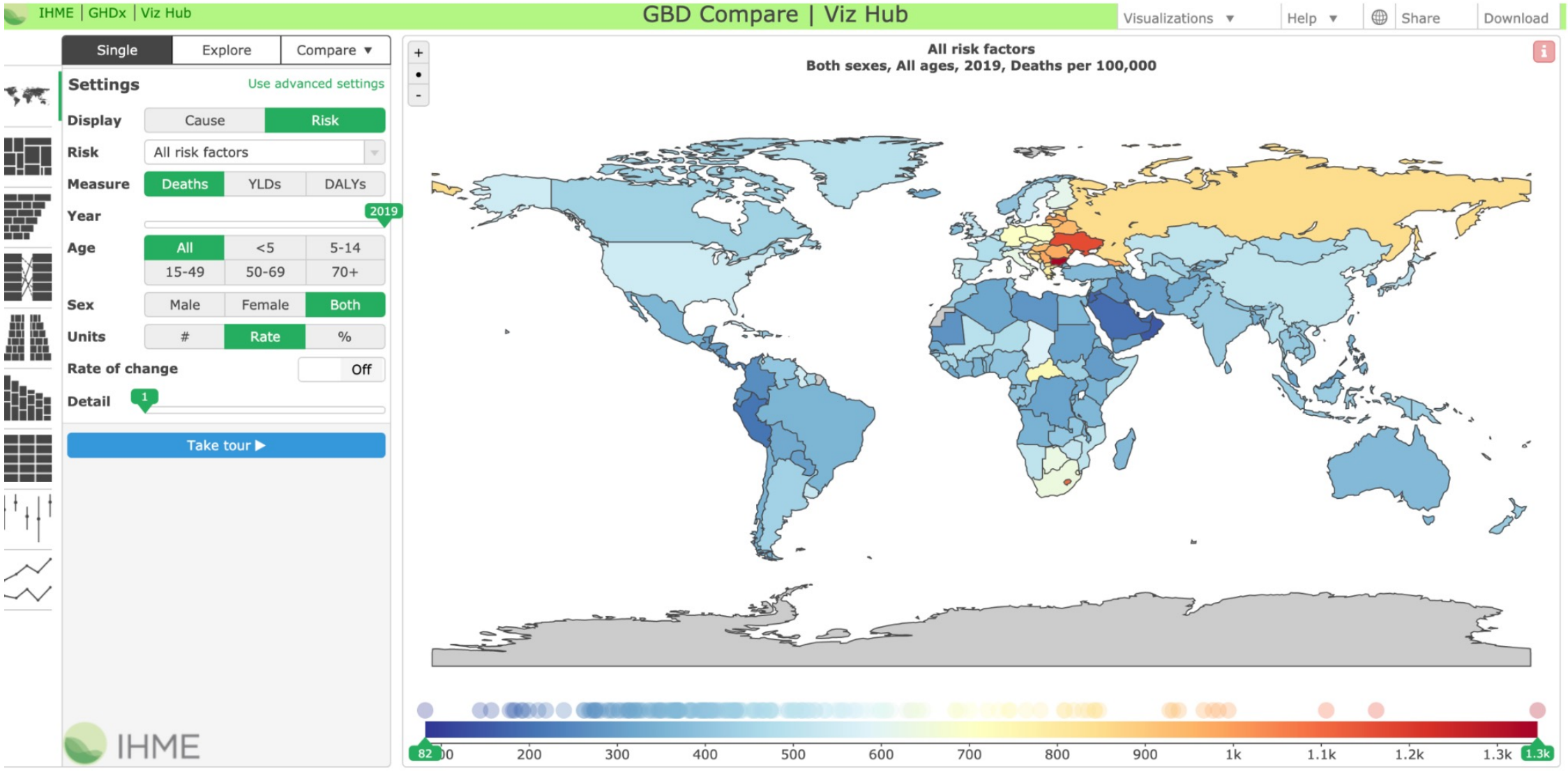
How is data visualization used in healthcare?



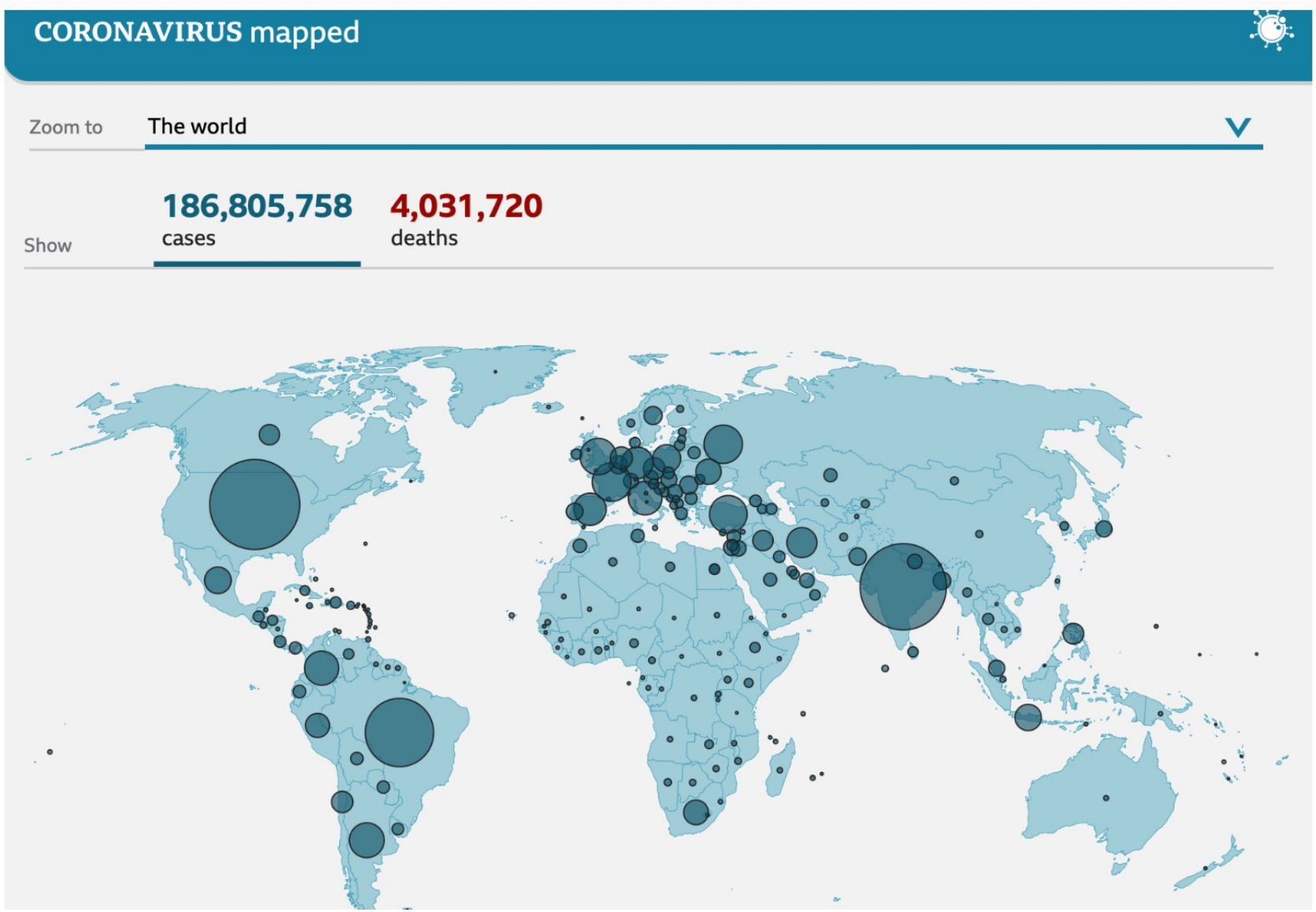
Interactive website example: My Health Explained



Interactive map example: Institute of Health Metrics and Evaluation

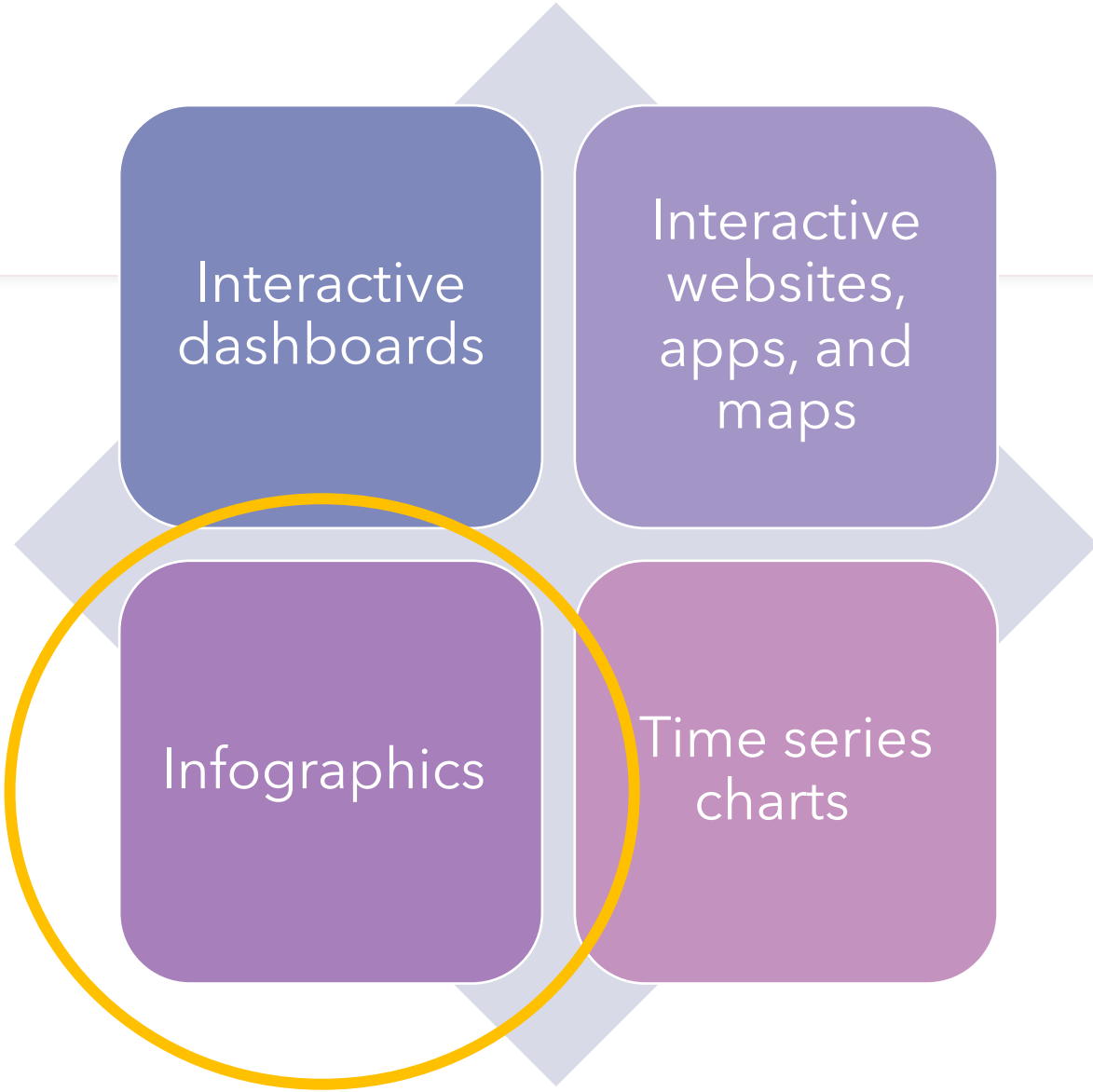


Interactive map example: COVID-19 cases



BBC, 2022

How is data visualization used in healthcare?



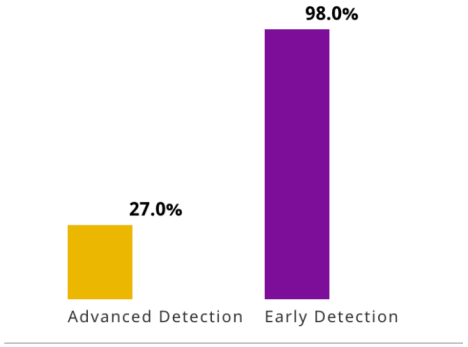
Infographic example: Breast cancer awareness

Lee, 2021

JOHNS HOPKINS
UNIVERSITY

SCREENING IS THE KEY TO PREVENTION

Begin having annual mammograms at age 40.



Survival rate by detection. Early detection leads to higher survival rates.

In 2020, there are more than

3,500,000

breast cancer survivors in the United States.

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Eat a healthy diet

Exercise regularly

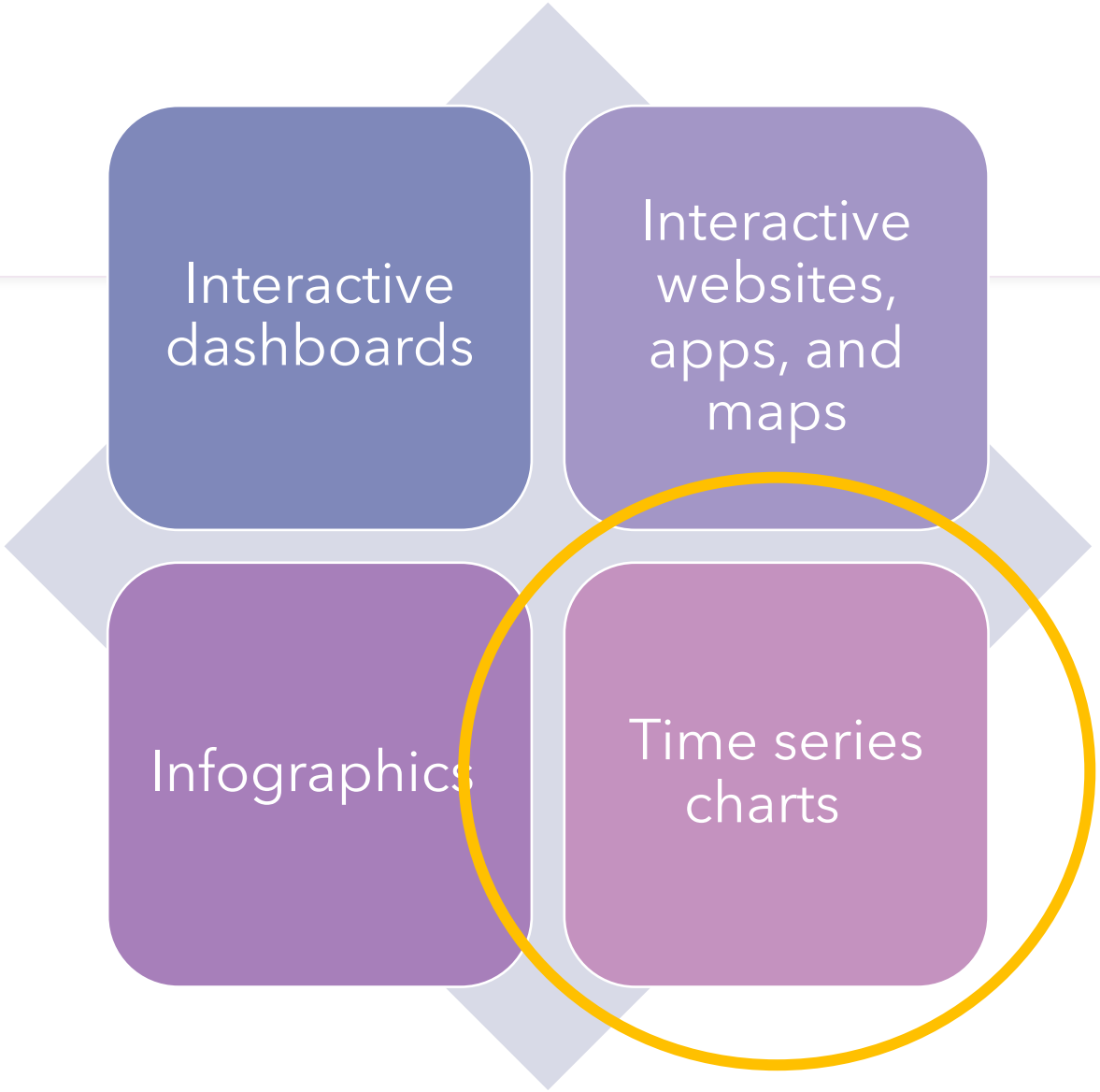
Maintain a healthy weight

Breastfeed

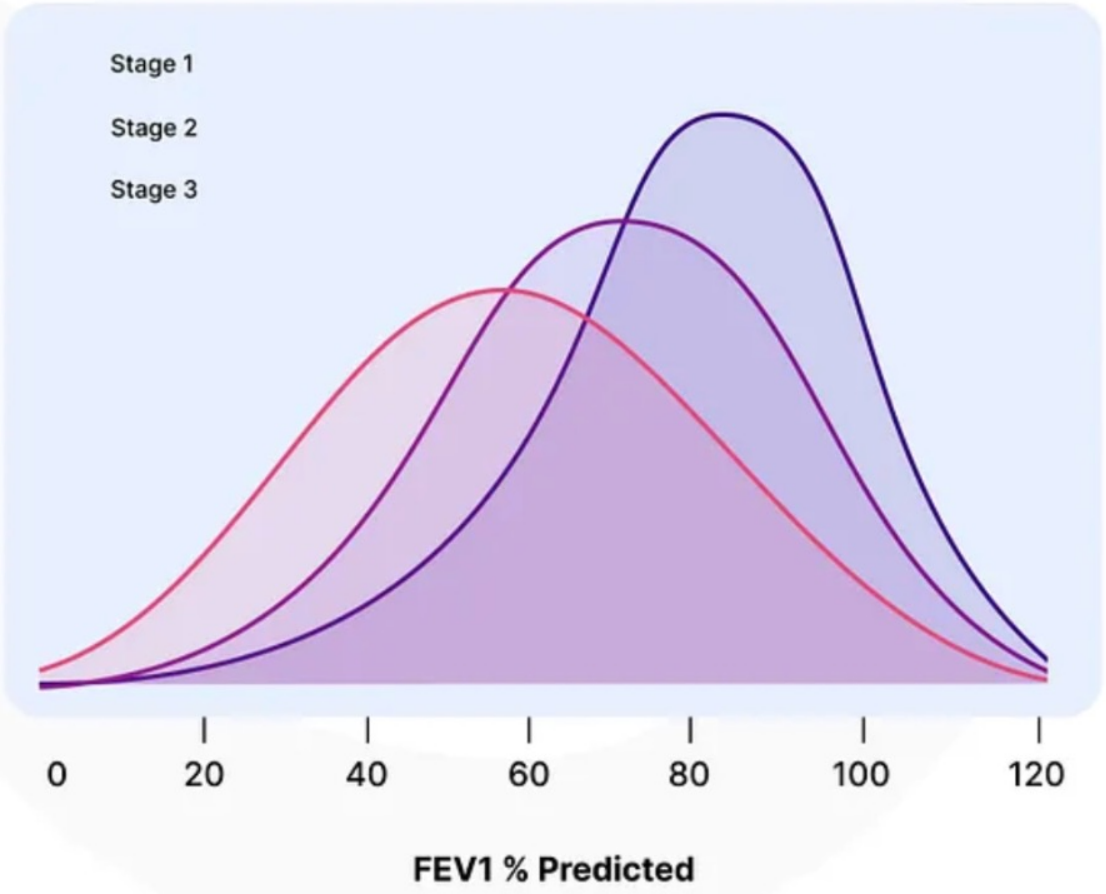
Avoid smoking

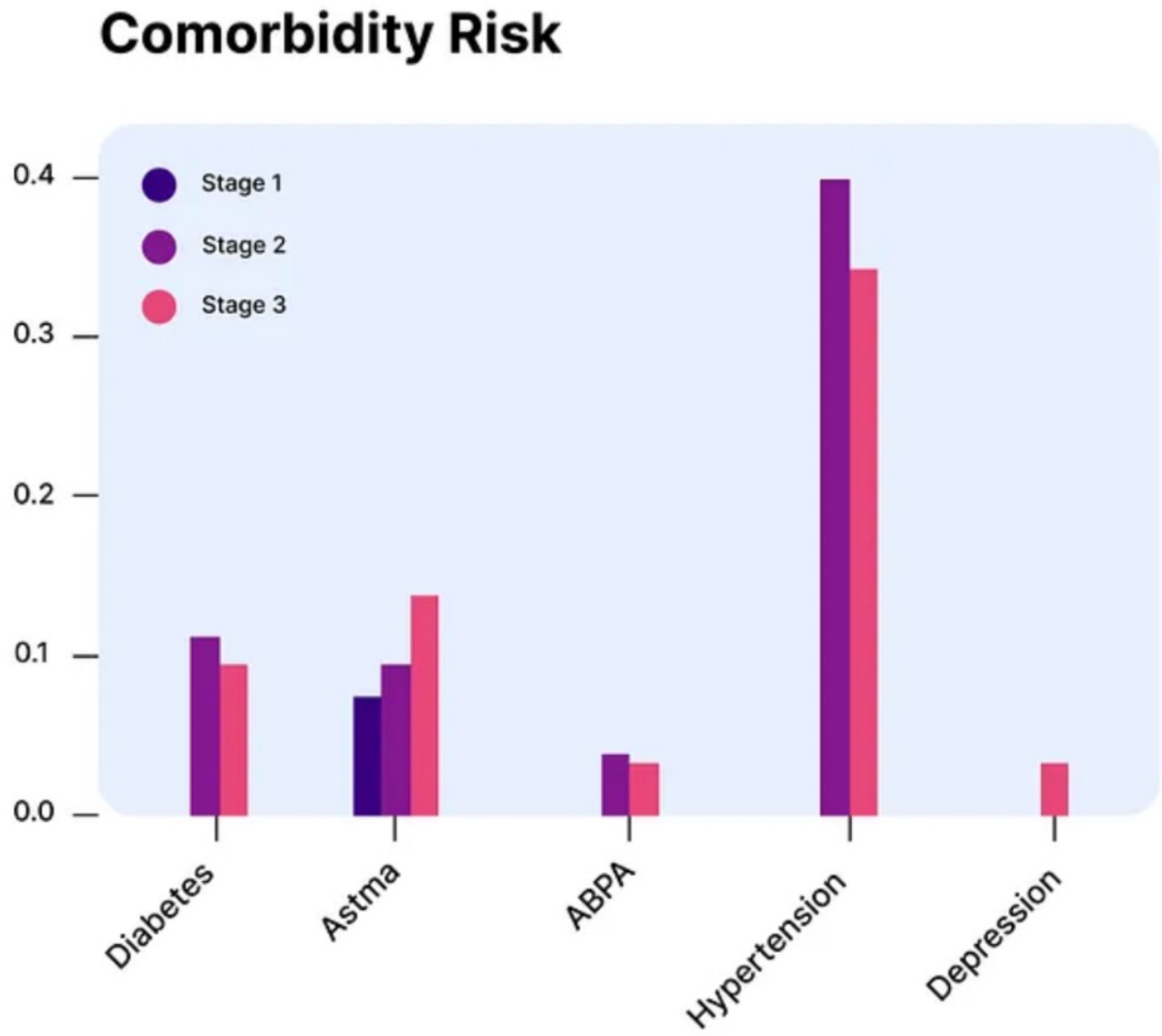
Limit alcohol consumption

How is data visualization used in healthcare?



Time Scale Chart

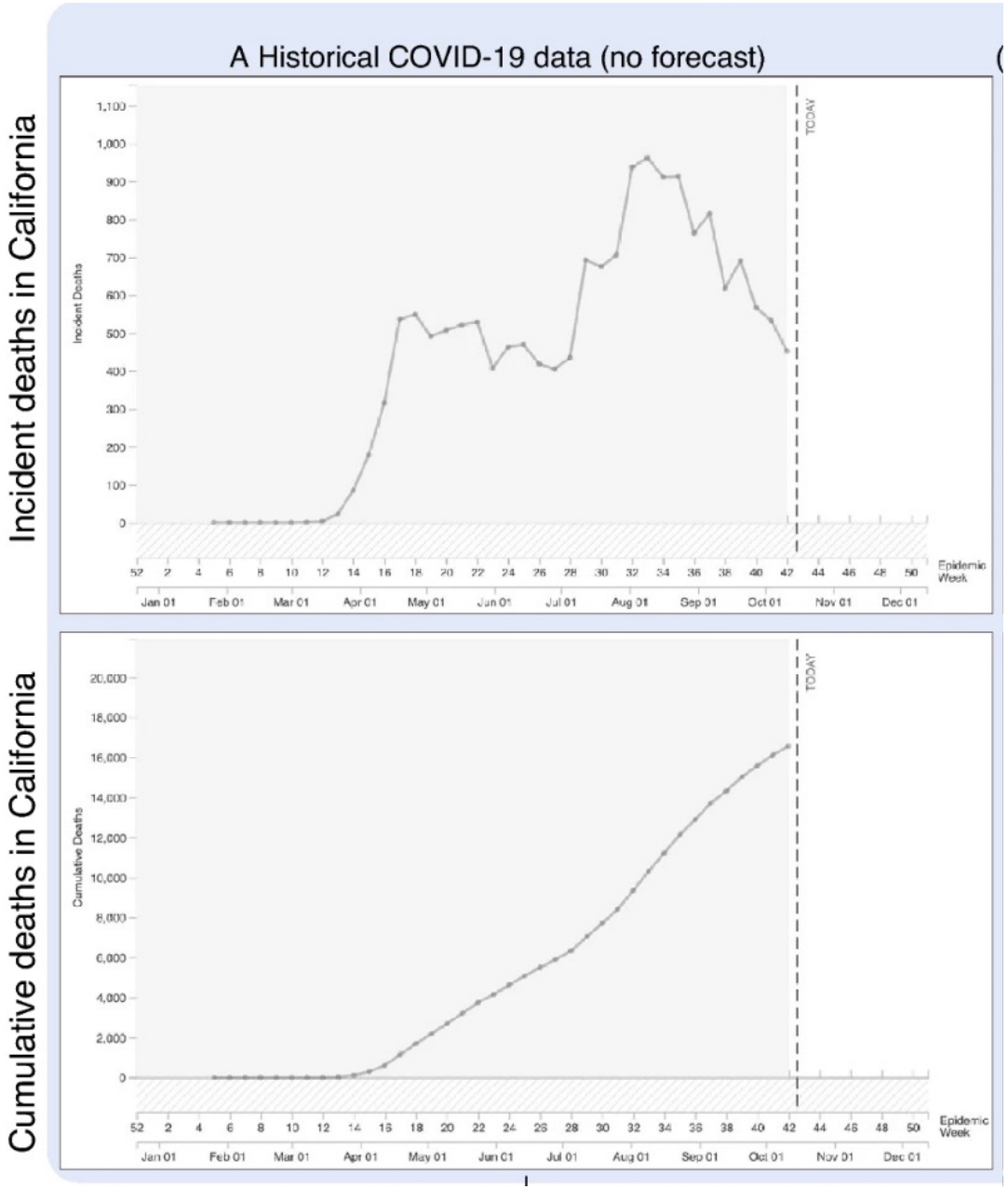




Vaniukov, 2024

Incident vs. cumulative rates of COVID-19

Padilla et al., 2022



Section 4: A case study on Purdue Pharma and the opioid crisis

Opioid crisis: Background

Bernard et al., 2018

1910's

Pain treatment focuses on pharmacological therapy

1940's

WWII disabled veterans
Need pain treatment

1960's

Debate on pain concept

1990's

Claims of low addiction risk associated with opioids

Pain is believed to be under-treated

2000's

Increased opioid prescribing

Opioid Crisis

How Purdue mislead stakeholders

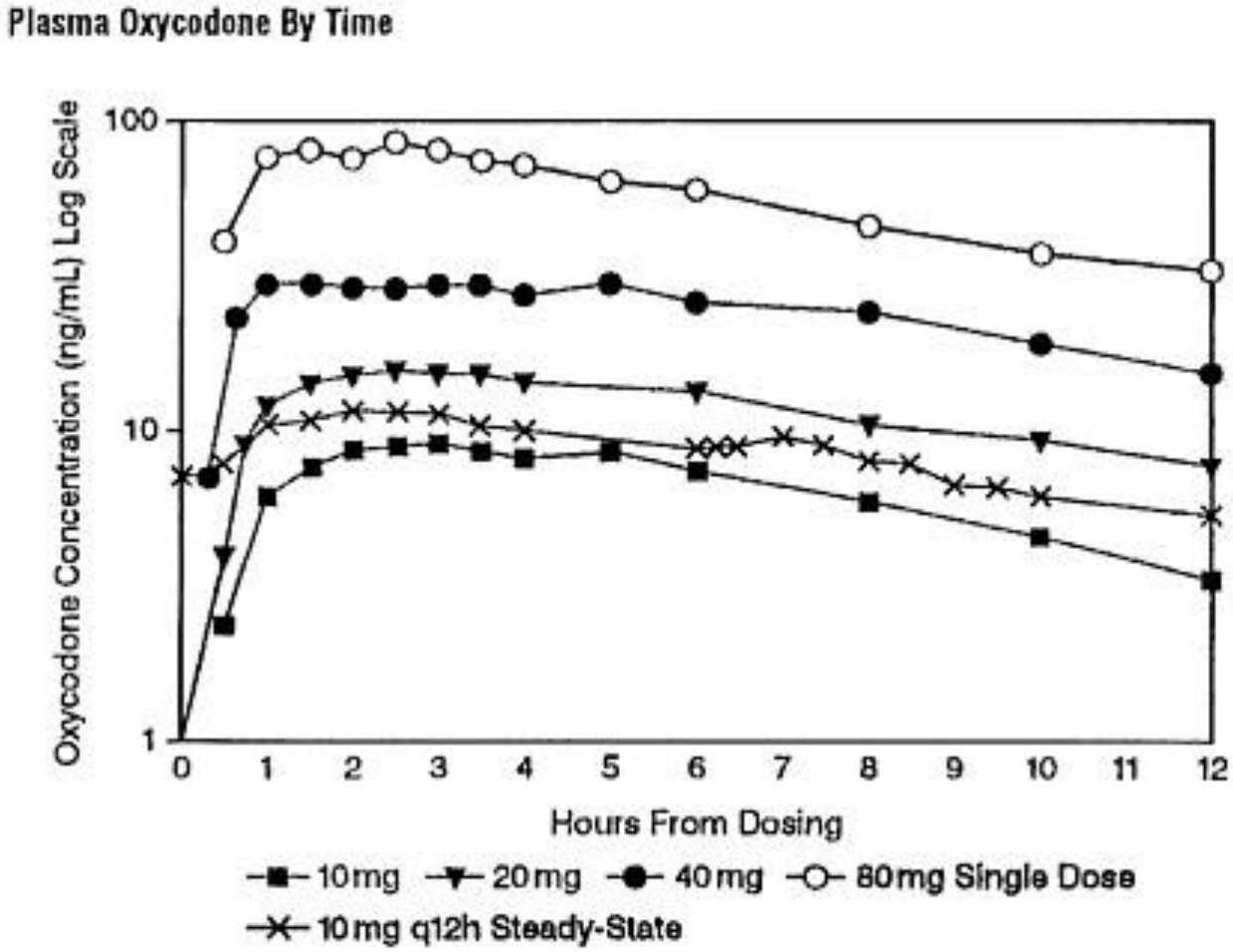
- Purdue Pharma gained FDA approval for OxyContin in 1995, marketing it as non-addictive.
- Representatives claimed low addiction rates, citing extensive studies.
- Congressional hearings exposed Purdue's dissemination of false addiction risk.
- OxyContin's misleading data visualization contributed to the opioid epidemic.

Groundbreaking study: Porter & Jick, 1980

- Purdue claimed that 1 in 10,000 patients can become addicted based on “research”
- “Recently, we examined our current files to determine the incidence of narcotic addiction …. We conclude that ***despite widespread use of narcotic drugs in hospitals, the development of addiction is rare in medical patients with no history of addiction.*** ”

The misleading Purdue visualization

Cabanski et al., 2018



Misleading log vs. linear scale

OxyContin PI Figure, Log y-axis

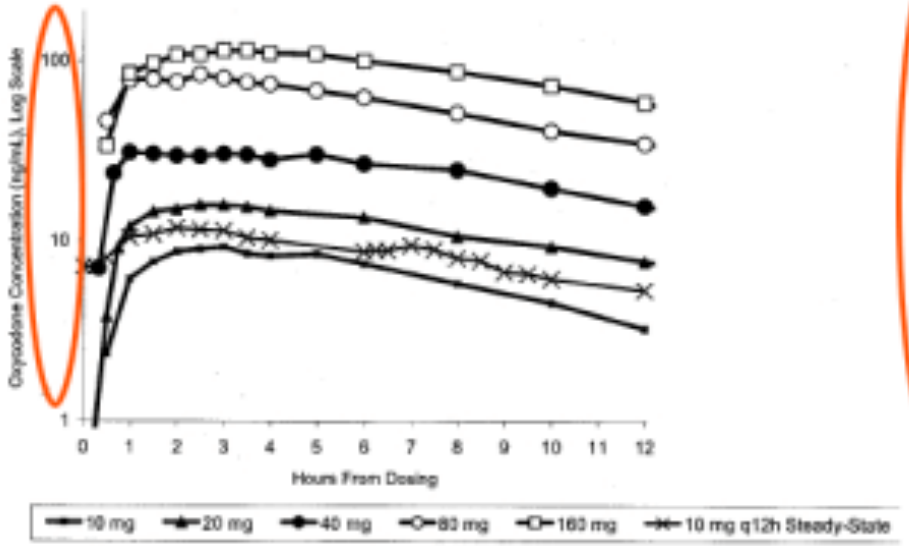


Figure 2

OxyContin PI Figure, Linear y-axis

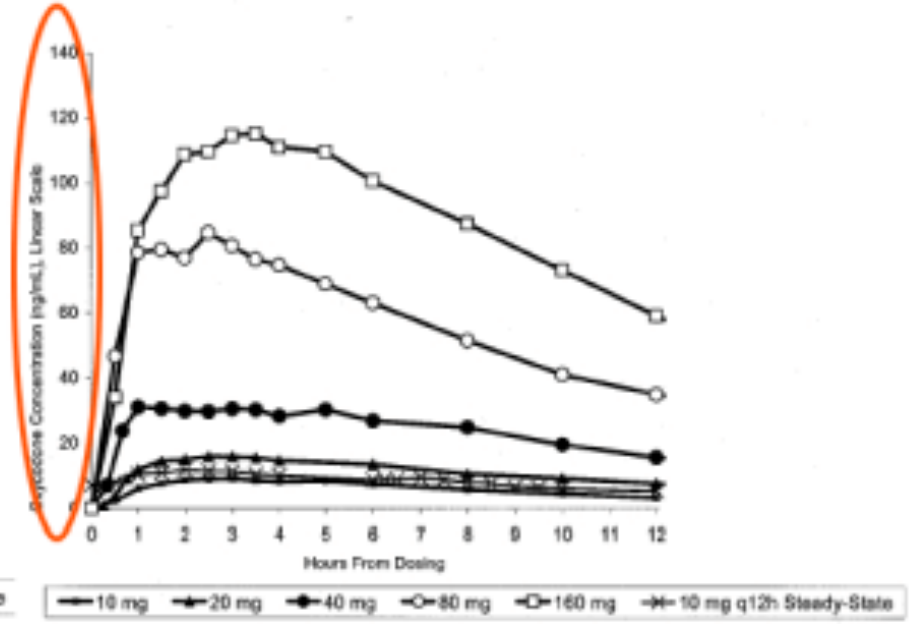


Figure 1

Cabanski et al., 2018

Interactive website examples

THE OPIOID EPIDEMIC BY THE NUMBERS

2016 and 2017 Data

130+
People died every day from opioid-related drug overdoses[3]
(estimated)

11.4 m
People misused prescription opioids[1]

42,249
People died from overdosing on opioids[2]

2.1 million
People had an opioid use disorder[1]

886,000
People used heroin[1]

81,000
People used heroin for the first time[1]

2 million
People misused prescription opioids for the first time[1]

17,087
Deaths attributed to overdosing on commonly prescribed opioids[2]

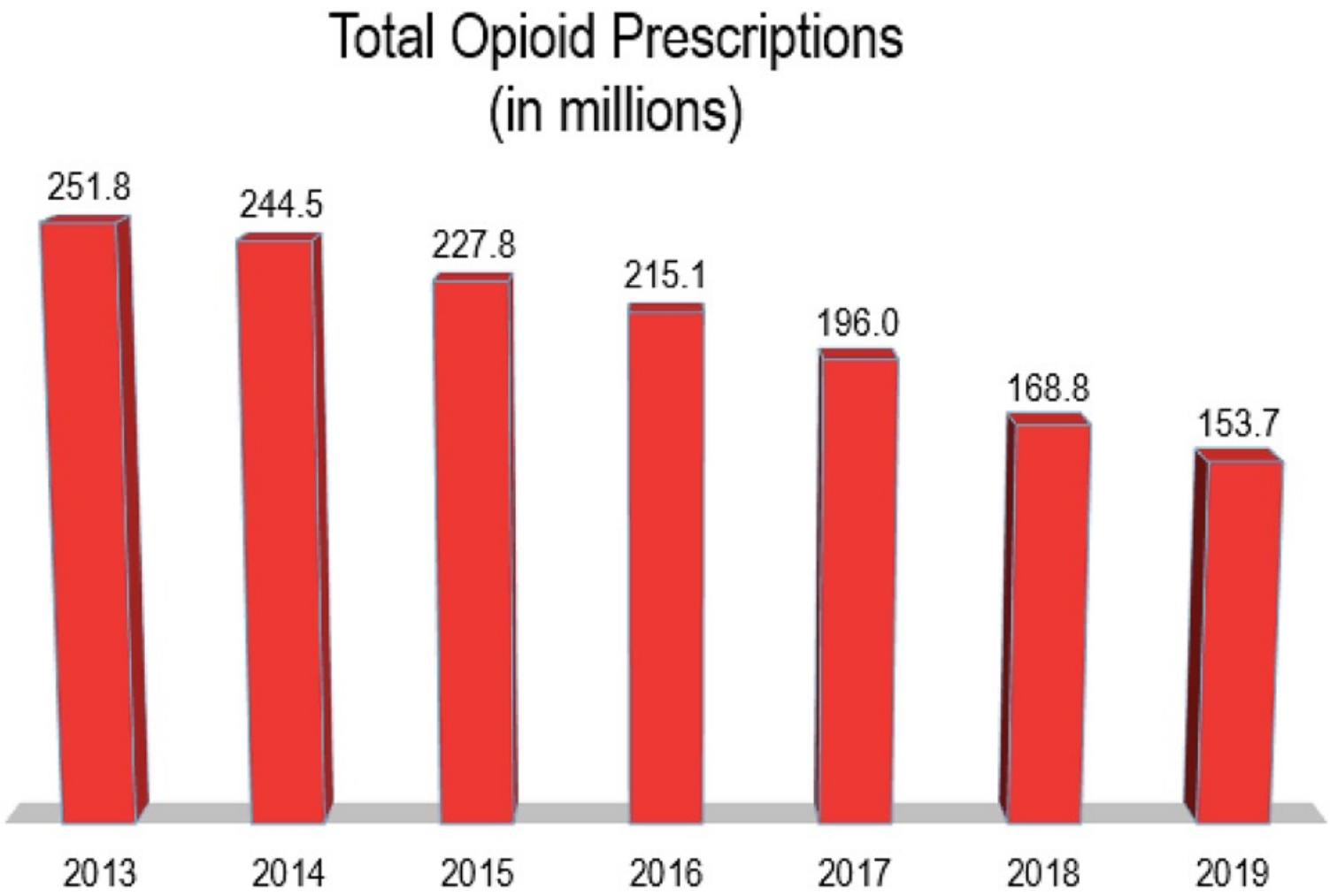
15,469
Deaths attributed to overdosing on heroin[2]

19,413
Deaths attributed to overdosing on synthetic opioids other than methadone[2]

SOURCES

1. 2017 National Survey on Drug Use and Health, Mortality in the United States, 2016
2. NCHS Data Brief No. 293, December 2017
3. NCHS, National Vital Statistics System. Estimates for 2017 and 2018 are based on provisional data.

HHS.GOV/OPIOIDS



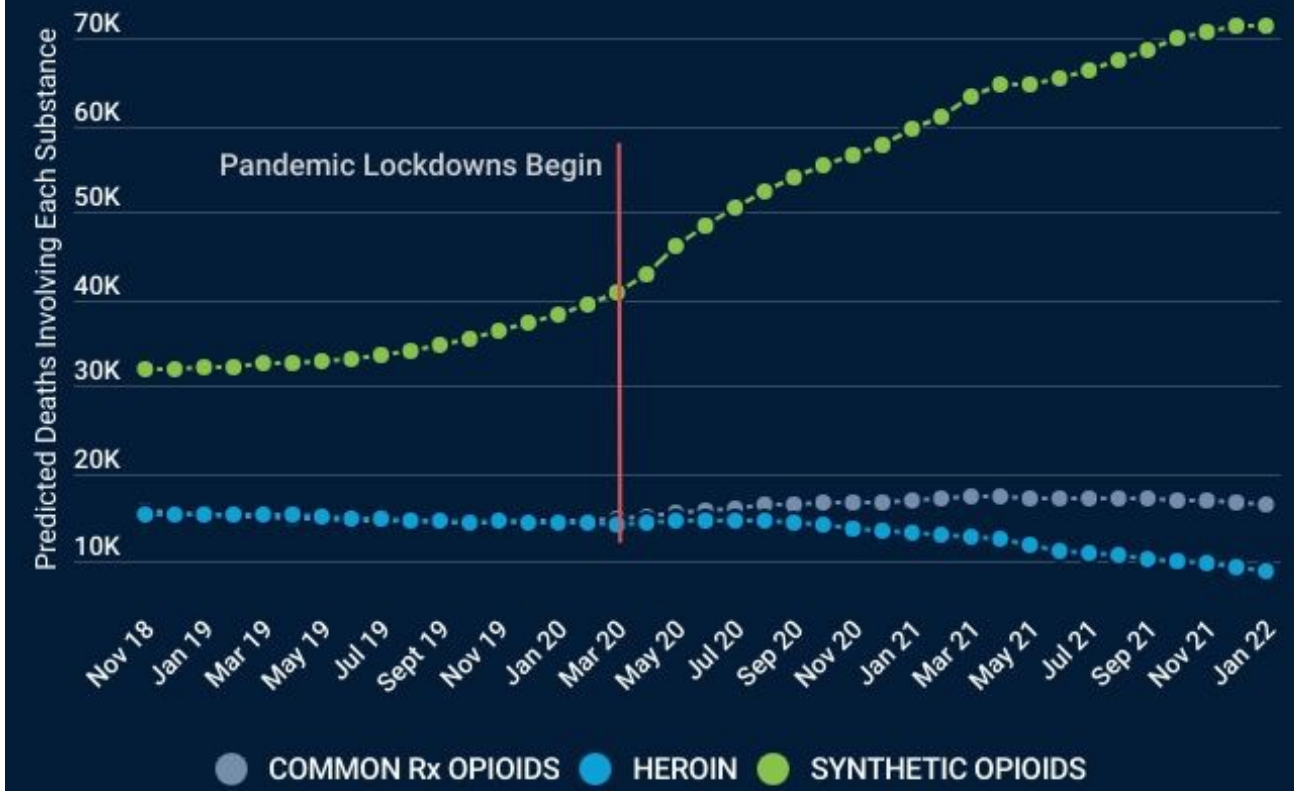
Manchikanti et al., 2021

Adverse impact for chronic pain care

- Doctors are pressured to restrict opioid prescriptions
- Patients are pressured to sign a treatment agreement to ensure that patients do not sell their opioids or go "doctor shopping."
- Reduction in prescriptions led to rationing pain medication and being unable to increase dosage at the onset of a pain crisis
- Reduction of opioid prescriptions is due to what is permissible by their doctor's health insurance company or their pharmacy stocking inadequate supplies of opioids
- Patient testimony:
    - "They just ask me what my pain is. You okay with just using morphine? And that's about it and they take my blood work. That's all the conversation I have. I've never had any real in-depth conversation concerning pain management."

Sinha et al., 2019

Provisional Data Point to Increase in Synthetic Opioid Deaths During the Pandemic



Categories not mutually exclusive; a single death may involve multiple substances.
Provisional data represent the number of deaths in the 12-month period ending in the month indicated. Numbers reported here are based on data as of June 16, 2022 and are predicted provisional deaths reflecting CDC adjustments for delayed reporting. Data are subject to change and are not comparable to final counts reported elsewhere.

NIHCM FOUNDATION

Takeaway messages

Data visualization in healthcare is a ***powerful*** tool

It can have a strong positive impact on:

- Patient care strategies
- Hospital policies
- Public health

It can have devastating effects, as seen in the ongoing opioid health crisis

Questions

Discussion questions

In what ways can data visualization be used to address disparities in healthcare access and outcomes among different population groups?

What responsibility do pharmaceutical companies have in ensuring the accuracy and transparency of data visualization used in marketing and educational materials?

How might healthcare providers critically evaluate data visualizations presented by pharmaceutical companies to ensure informed decision-making regarding treatment options and patient care

Considering the rapid advancements in technology and data analytics, what do you envision as the future of data visualization in healthcare, and what challenges might arise in its implementation?