

From lab to patient

How statistics shapes decisions in medicine

Nicola Rennie

Royal Statistical Society William Guy Lecturer 2024 – 2025
Lancaster Medical School, Lancaster University | Office for National Statistics

About Me

At school:

- Maths
- English
- Biology
- Chemistry
- Physics
- Art & Design
- Music

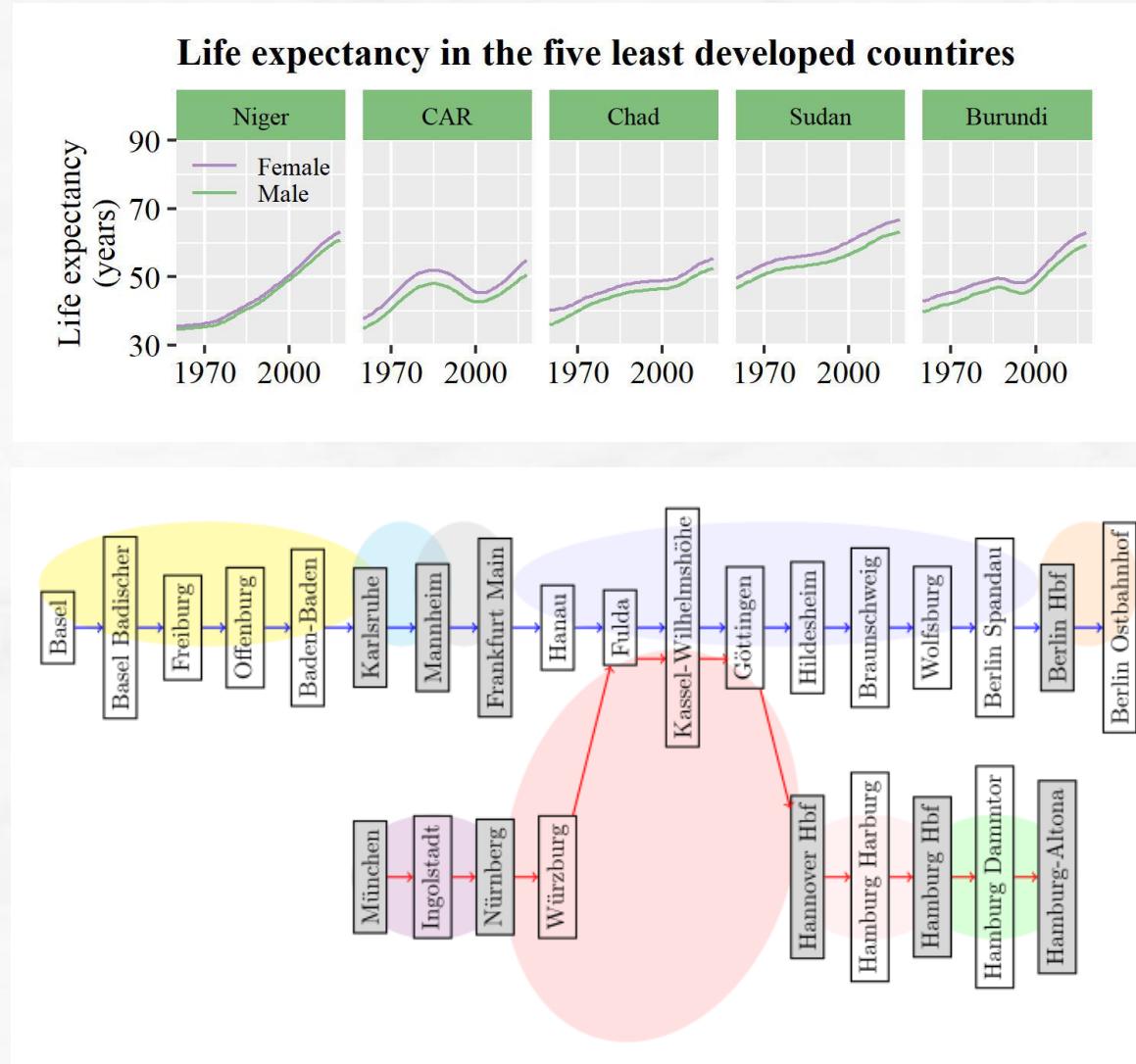


About Me

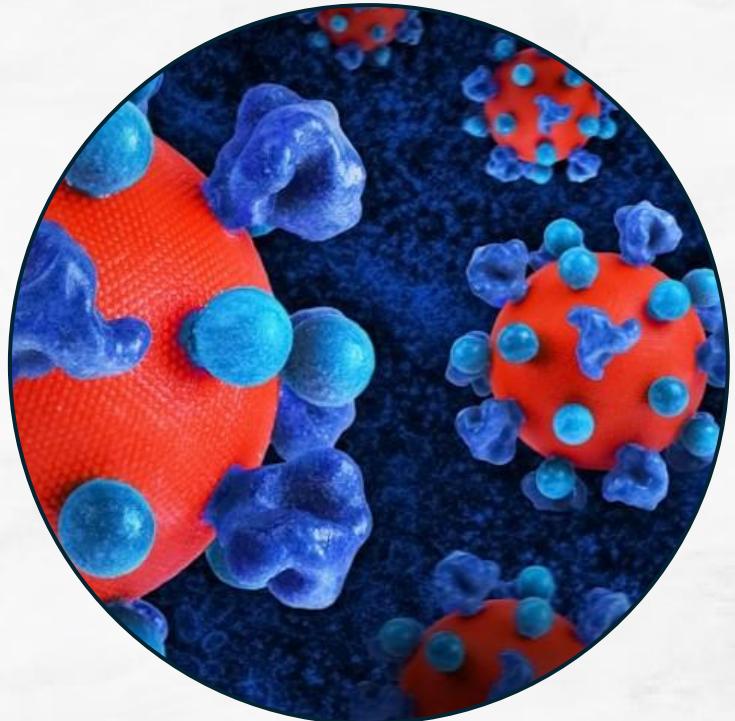
- Studied Maths at the University of St. Andrews
- Did a Masters and PhD in Statistics at Lancaster University
- Worked as a Data Scientist then a Lecturer in Health Data Science
- Data visualisation specialist at Office for National Statistics



Some of the work I've done



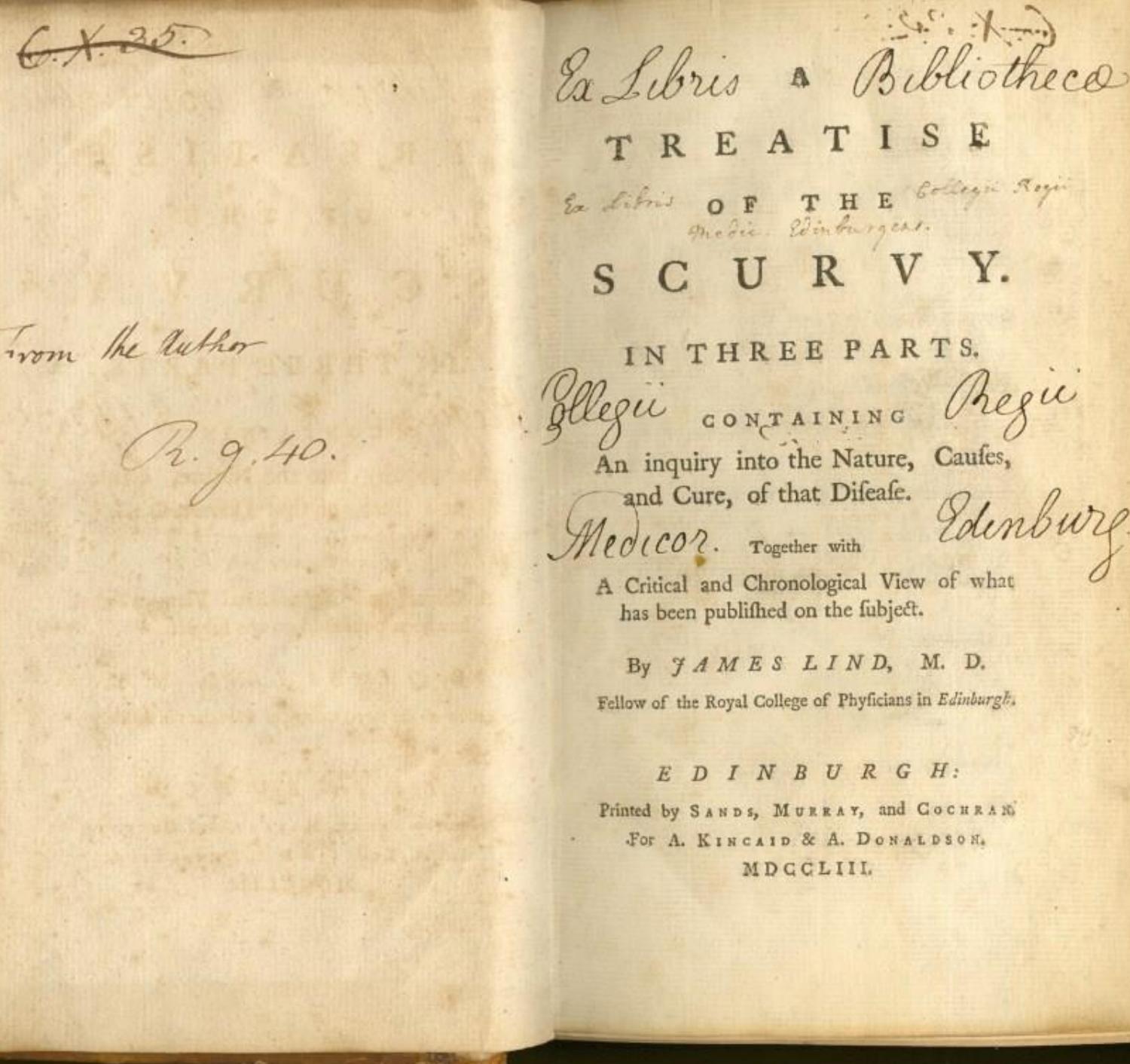
Statistics in medicine



An experiment...

- Let's say you develop a brand new treatment for the common cold.
- You give your new treatment to 50 people who have a cold.
- After a week, 49 people are fully recovered.
- Does the treatment work?





One of the first clinical trials happened in 1747.

A disease called scurvy was a huge problem for sailors.

12 patients with scurvy on a ship and gave them each one of 6 possible treatments.

Sailors whose daily diet included citrus fruits recovered, but the others still had symptoms.

Citrus fruits (containing vitamin C) could cure scurvy.

- How do we know that a medicine will work?
- How do we know how much of that medicine to give patients?
- How do we know it is safe to give patients?
- What are the side effects of the medicine?
- Does it work equally well for all patients?

NEWS

[Home](#) | [Election 2024](#) | [InDepth](#) | [Israel-Gaza war](#) | [Cost of Living](#) | [War in Ukraine](#) | [Climate](#) | [UK](#) | [World](#) | [Business](#)

Health

How do we know Covid vaccines are safe?

15 February 2022

 [Coronavirus](#)



By Michelle Roberts

Health editor, BBC News online



Blood pressure is measured using a blood pressure monitor.

High blood pressure can increase risk of other, more serious, health conditions.

**How do we
know if a
treatment
works?**

What do we measure?

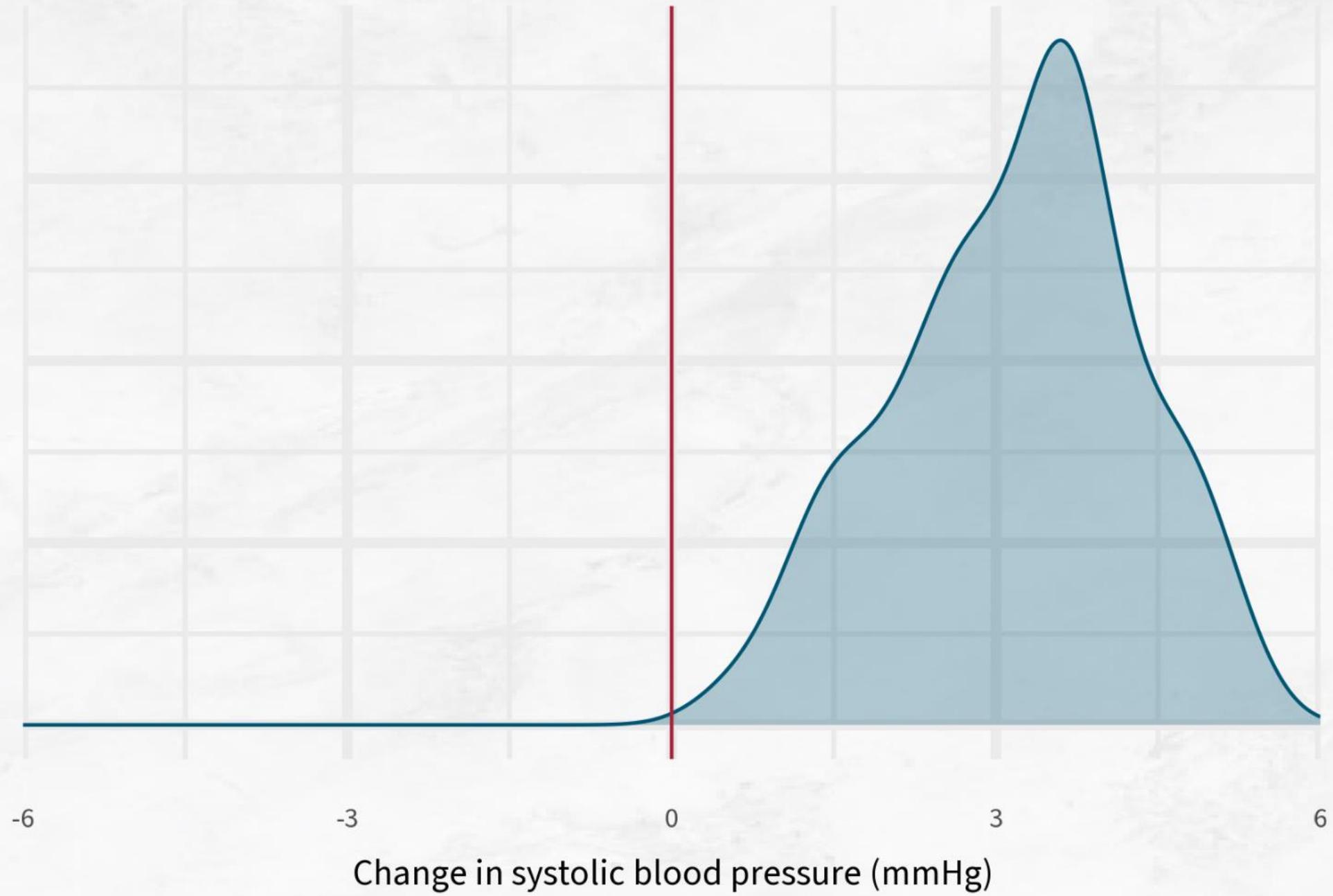


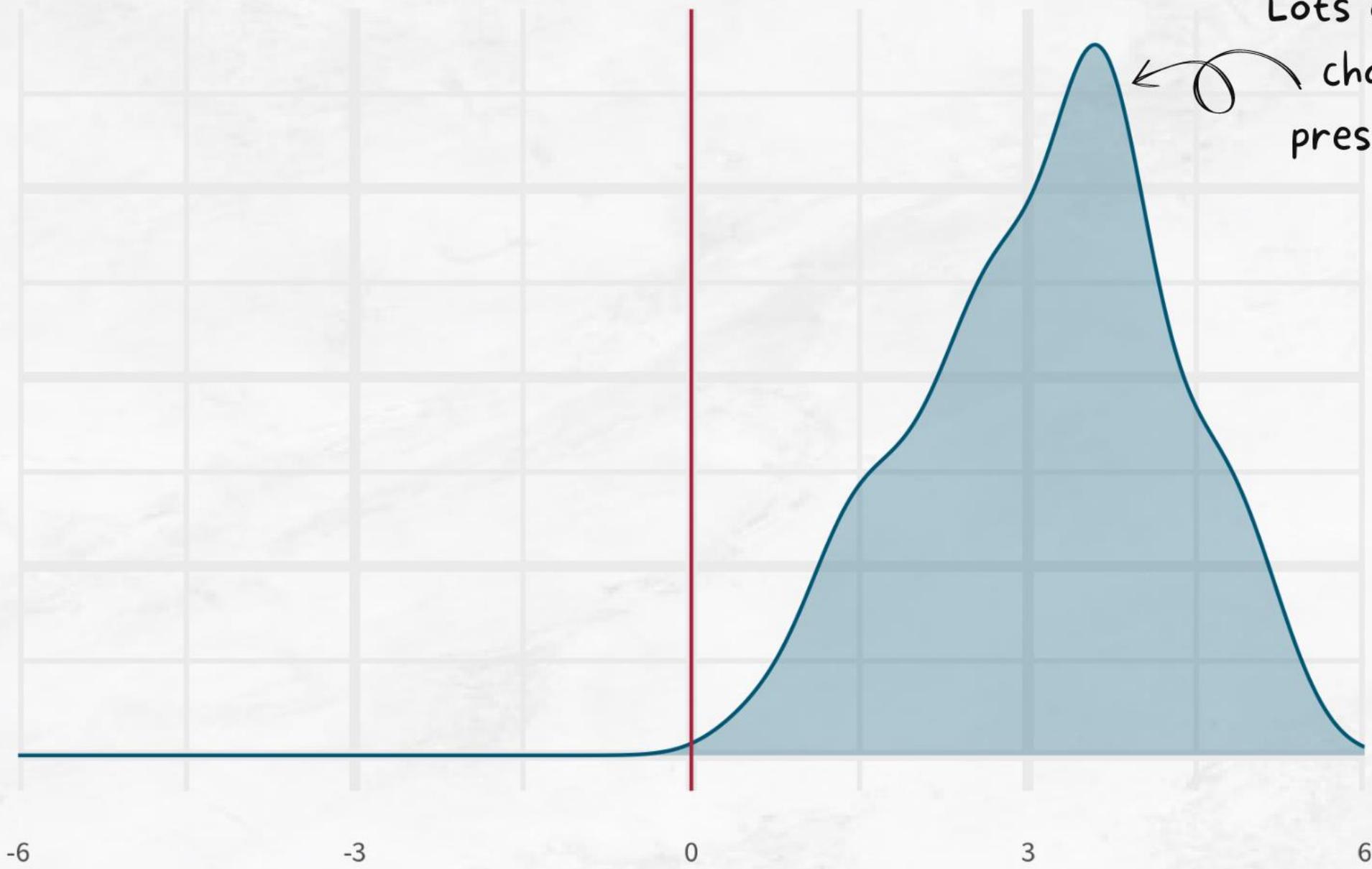
Blood pressure **before**
treatment



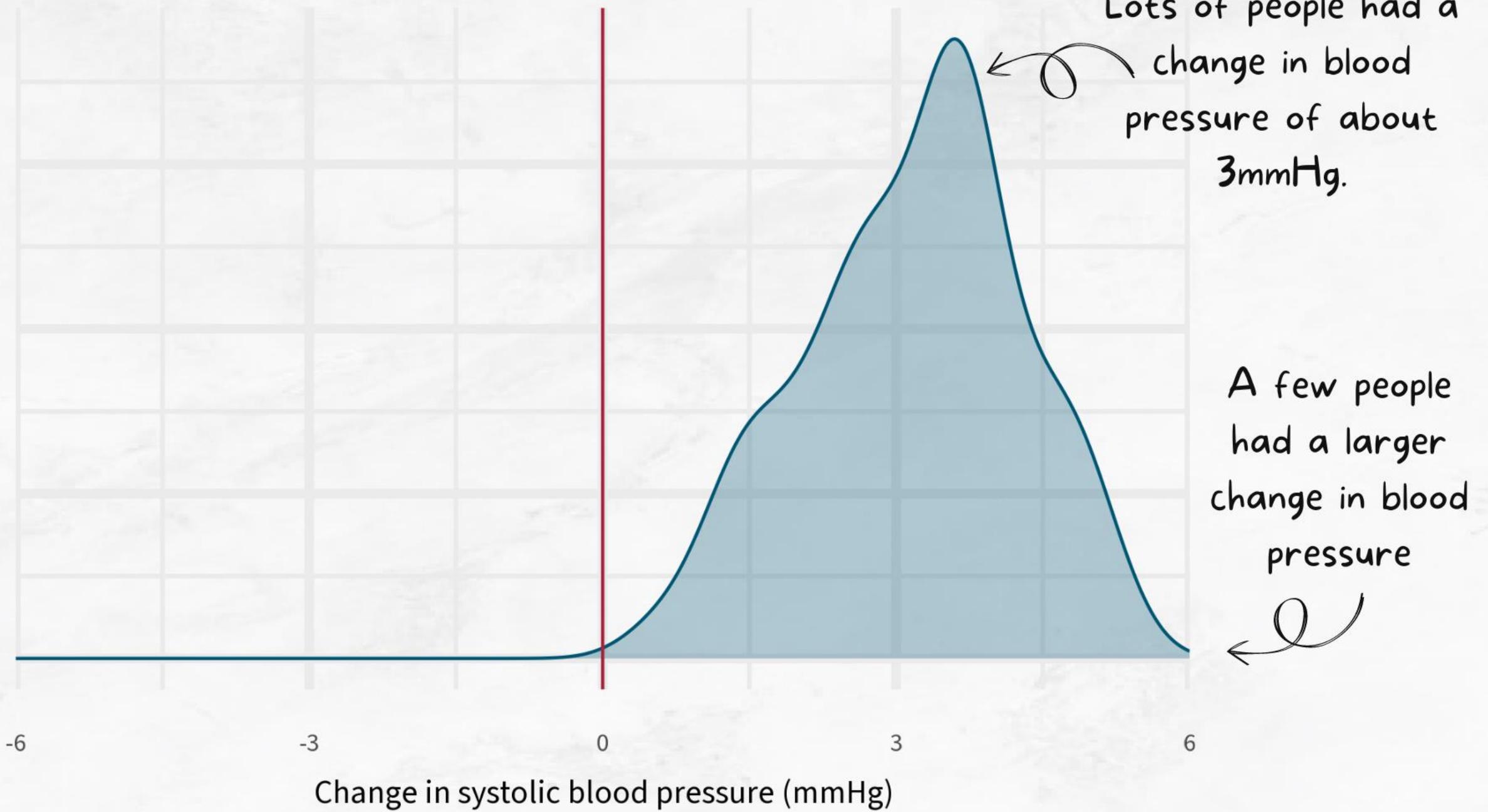
Blood pressure **after**
treatment

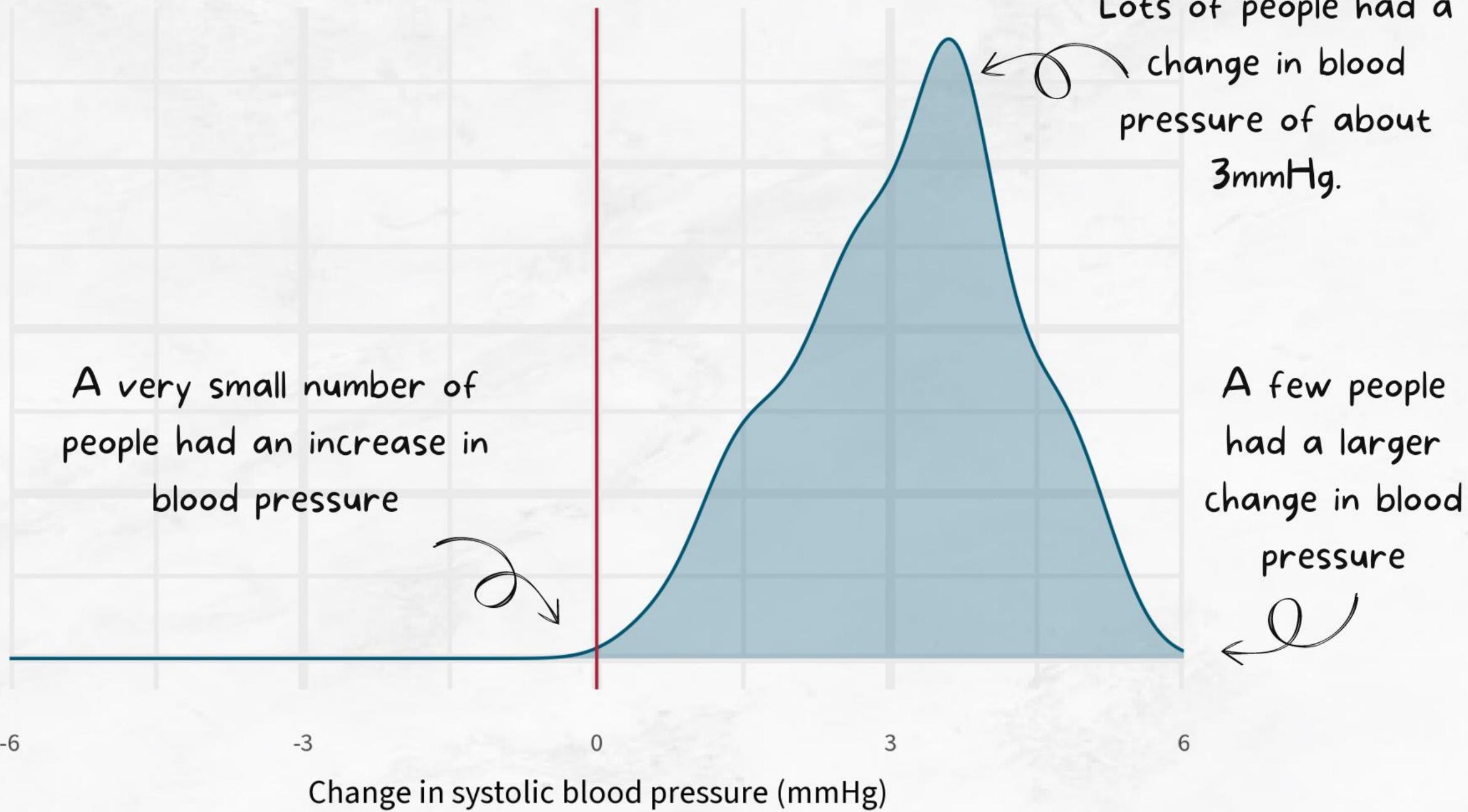
Difference = before - after





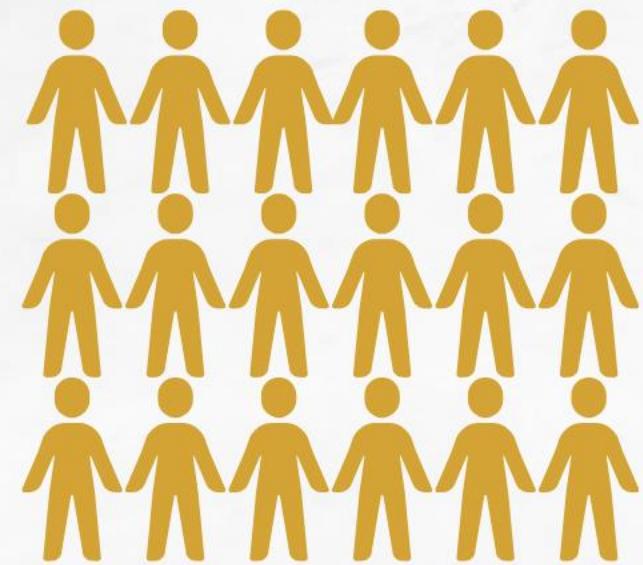
Lots of people had a
change in blood
pressure of about
3mmHg.

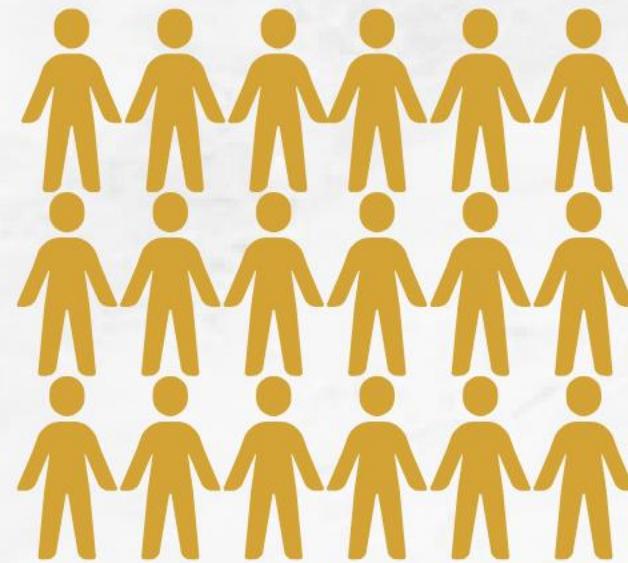




**How many
times do we
test a
medicine?**

How many people do we need?





More certain → More people

Bigger variation → More people

Smaller change → More people

**How do we
decide who
gets which
treatment?**

Everybody gets new
treatment



Half of people get
new treatment



Half of people
get no treatment

Half of people get
new treatment



Half of people
get current
treatment

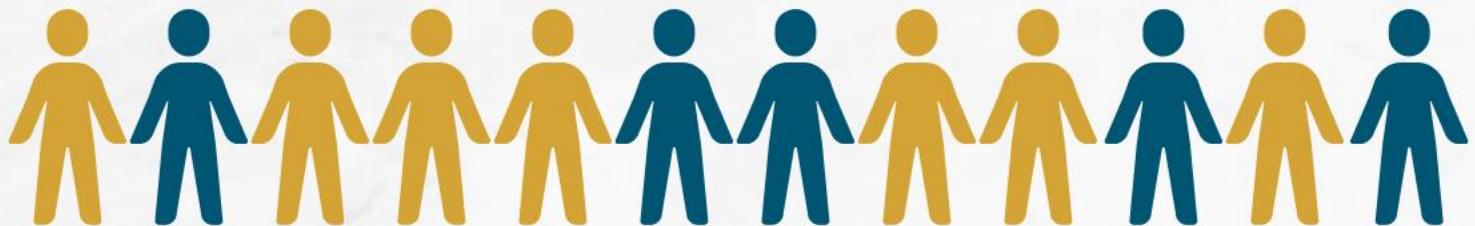
"Coin flip" |



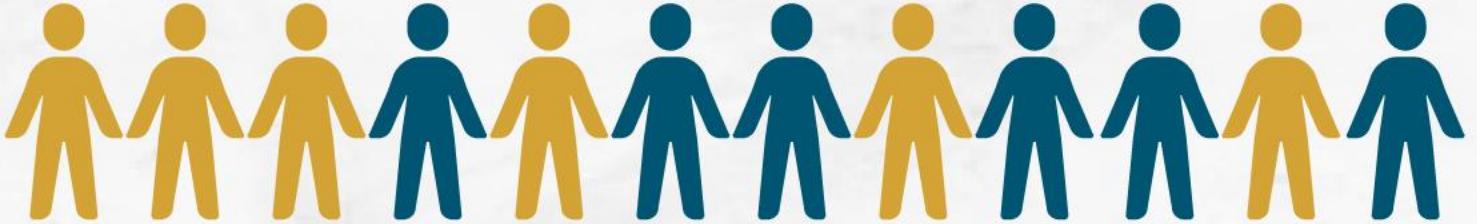
"Coin flip" 1



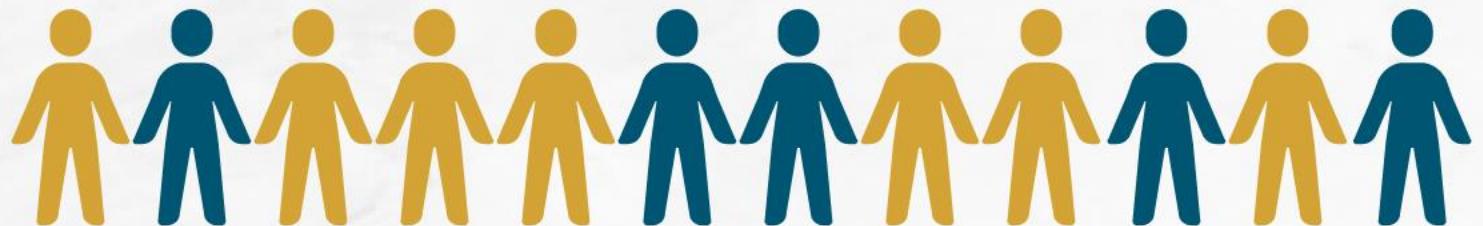
"Coin flip" 2



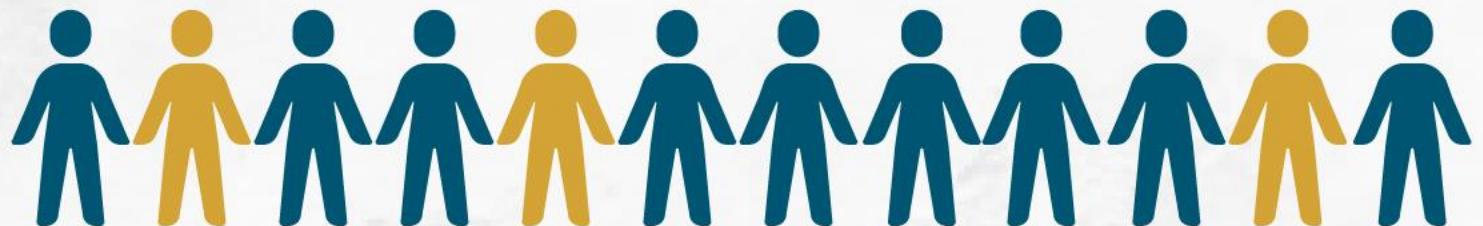
"Coin flip" 1



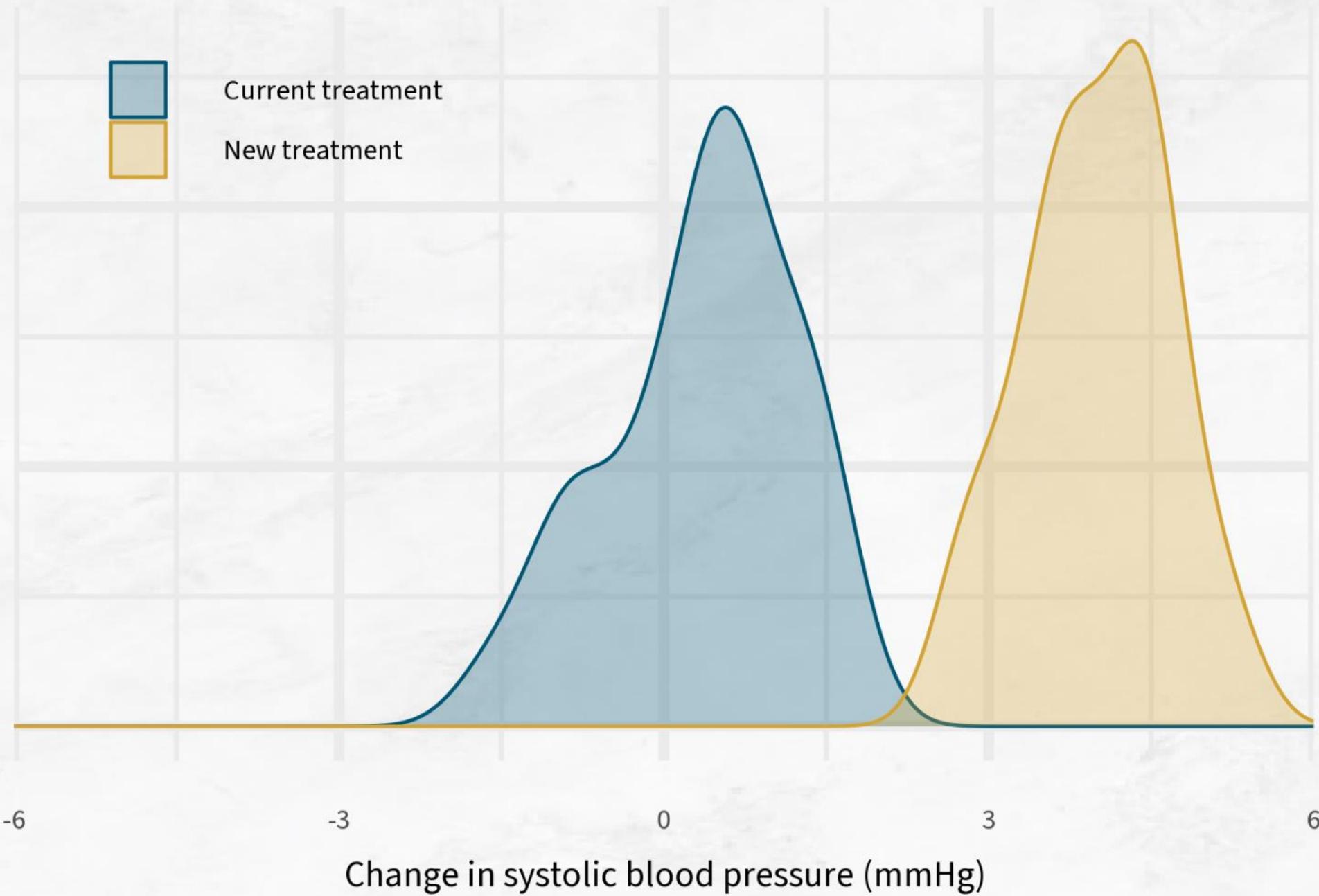
"Coin flip" 2

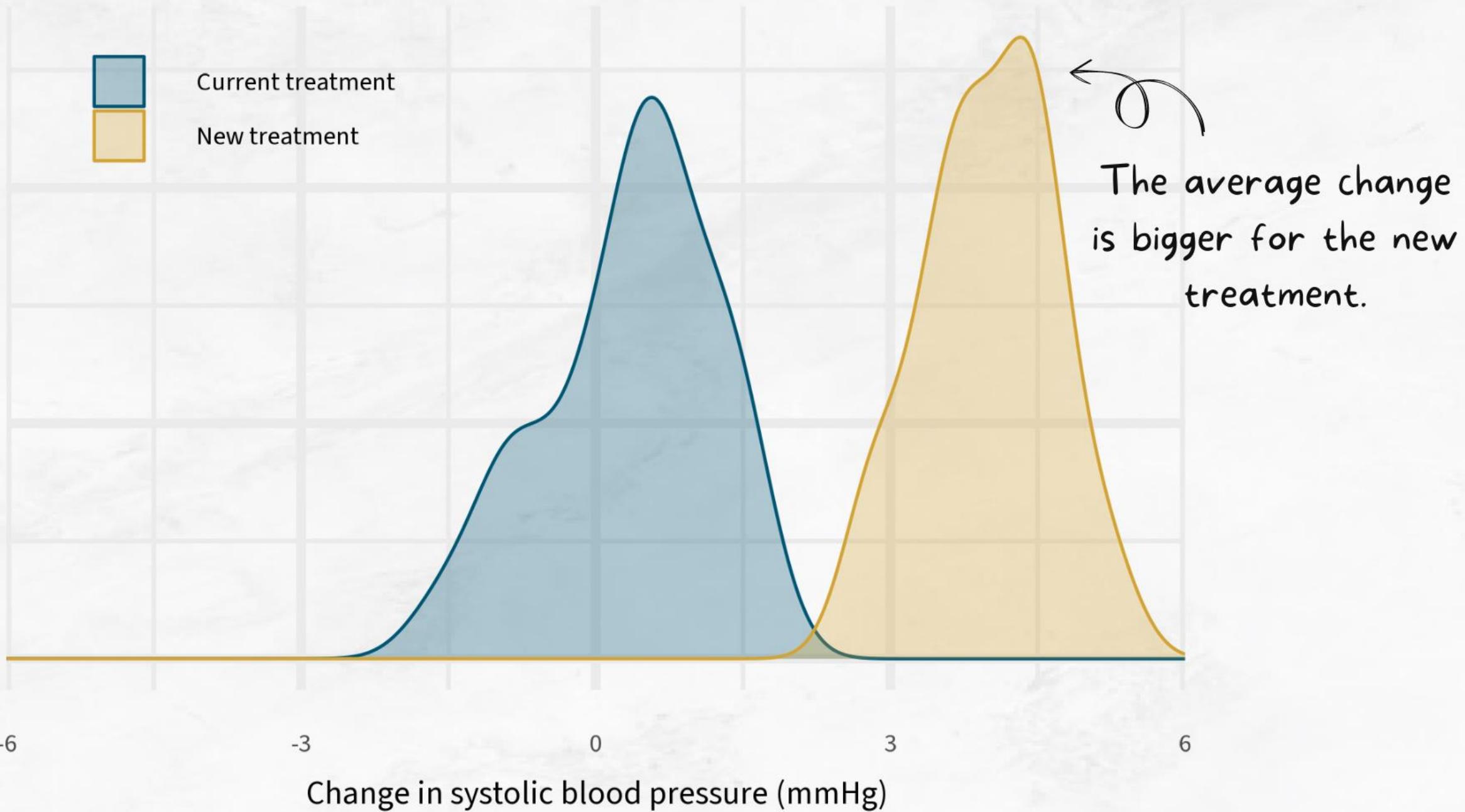


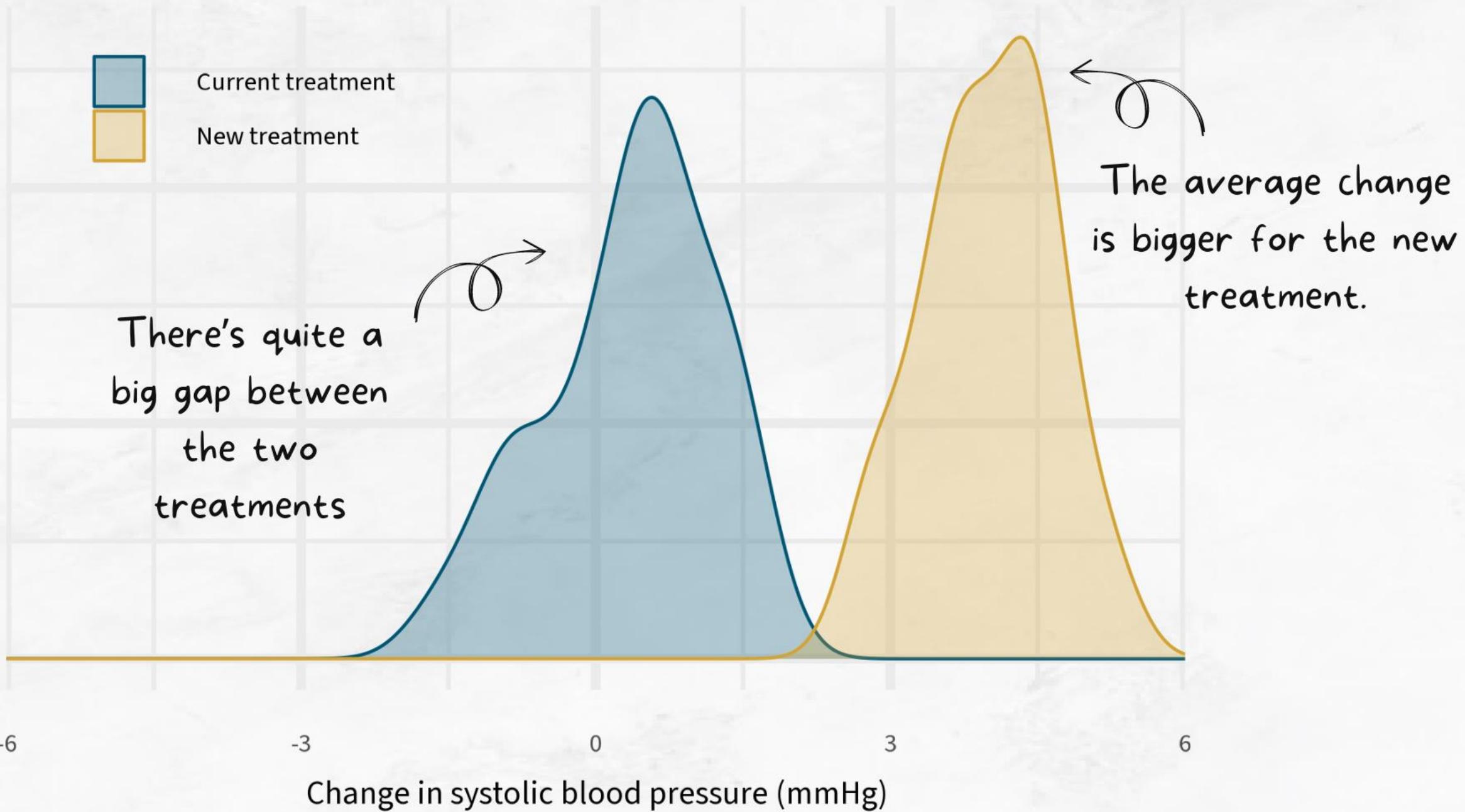
"Coin flip" 3

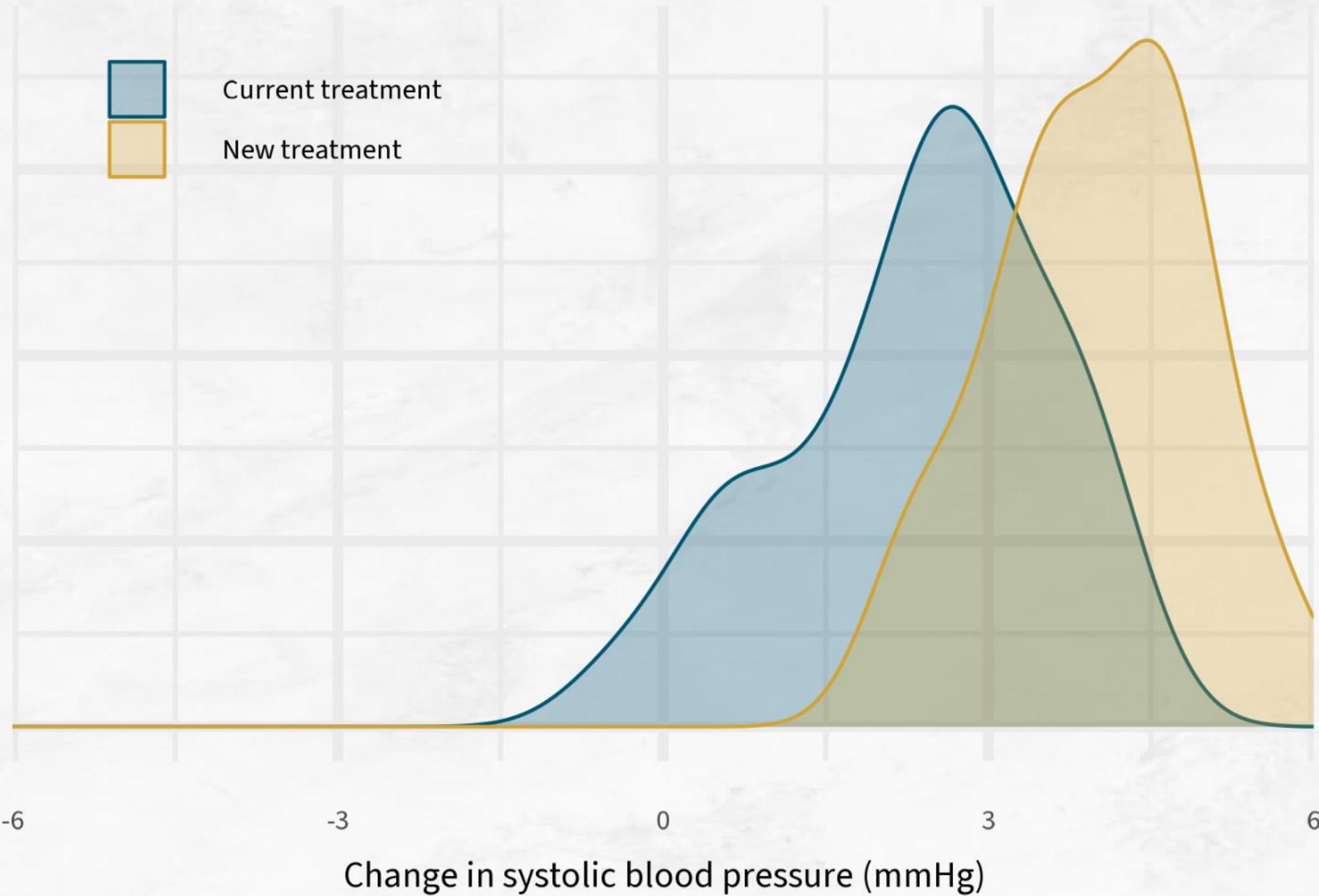


**How do we
compare two
treatments?**







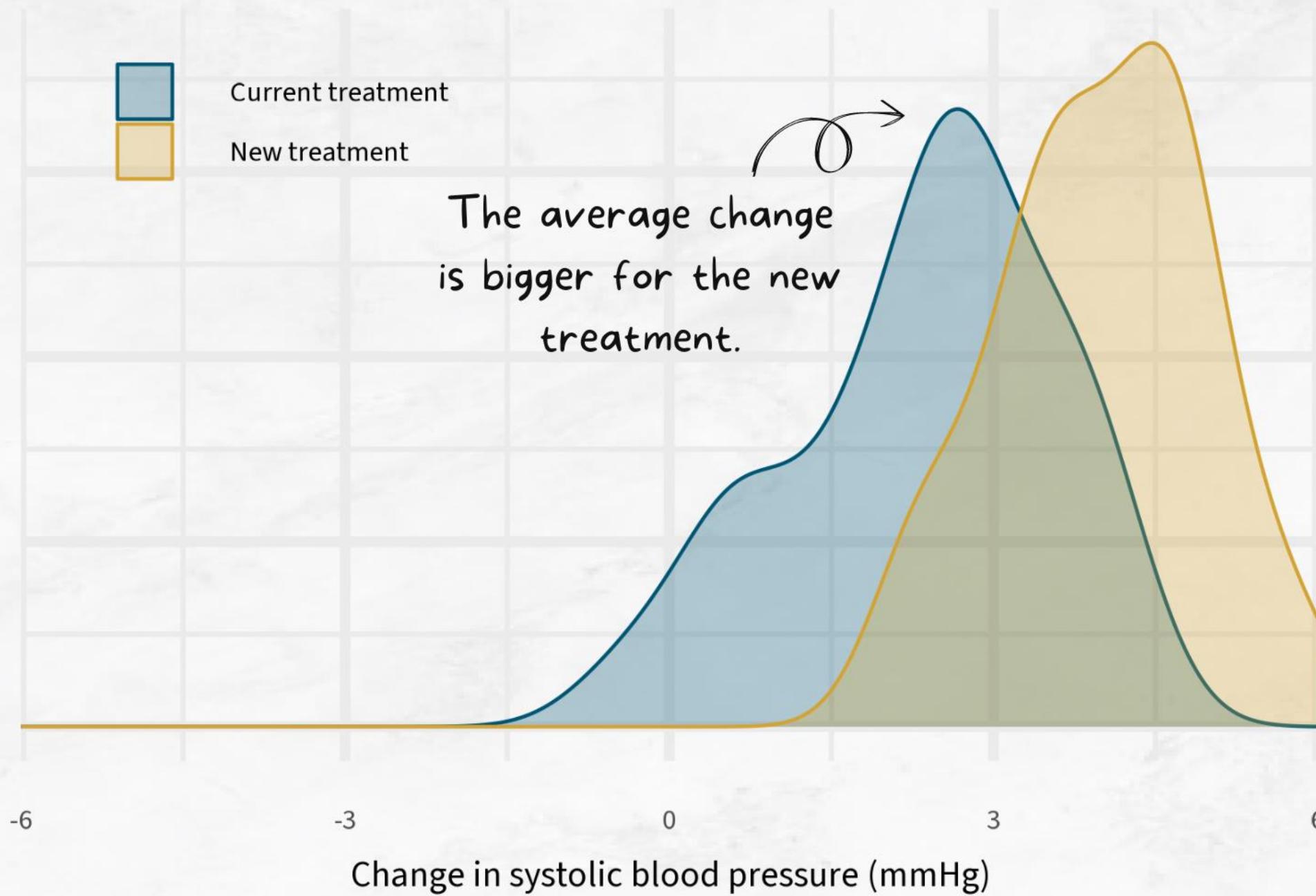


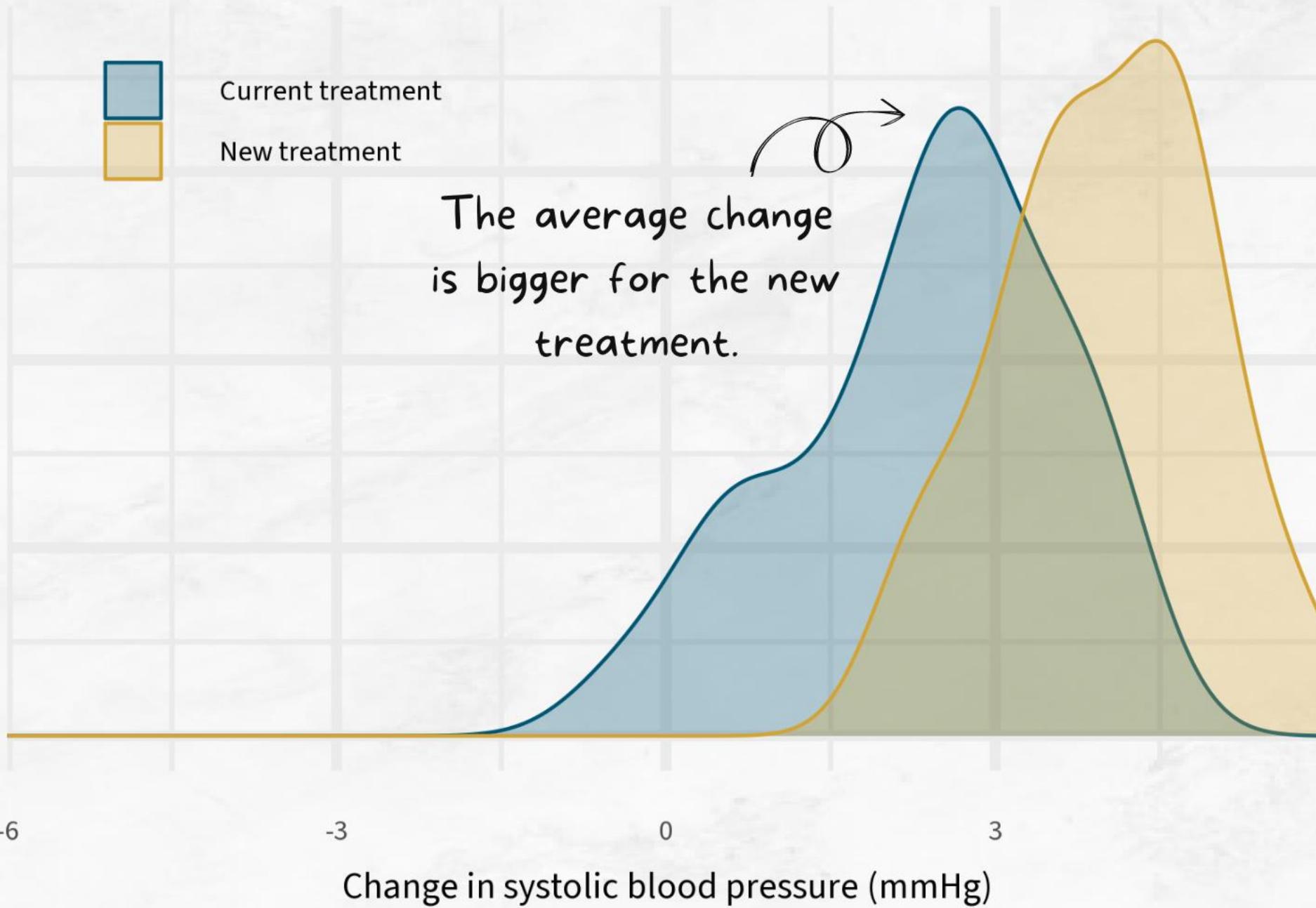


Current treatment

New treatment

The average change
is bigger for the new
treatment.





**What else can
you do with
data to help
people?**



Can you detect a heart murmur?

Using statistics to aid diagnosis

Heart murmurs



What are heart murmurs?

A heart murmur is an extra, unusual sound in your heartbeat.



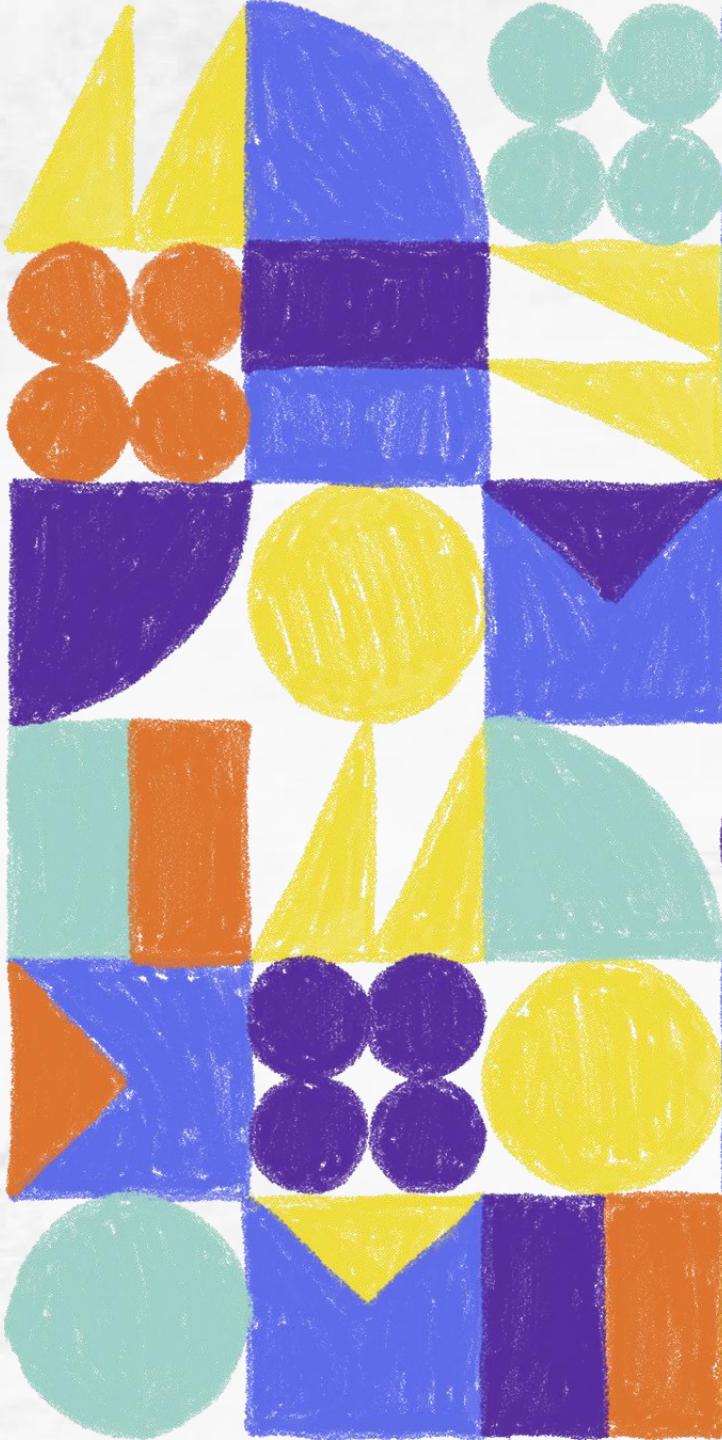
Are they dangerous?

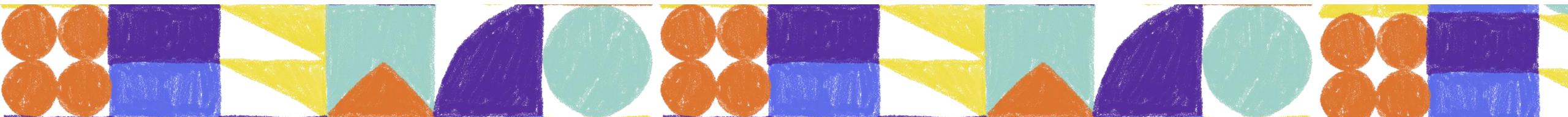
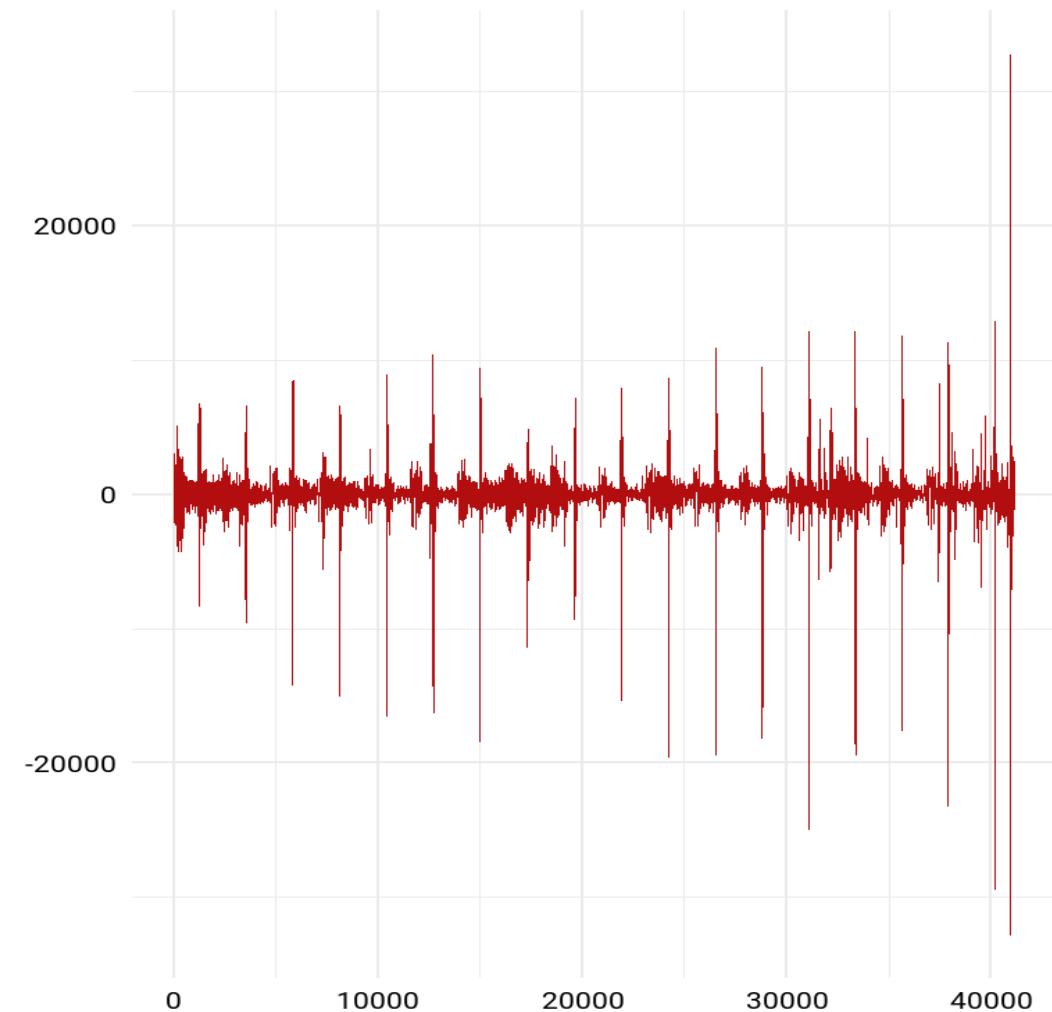
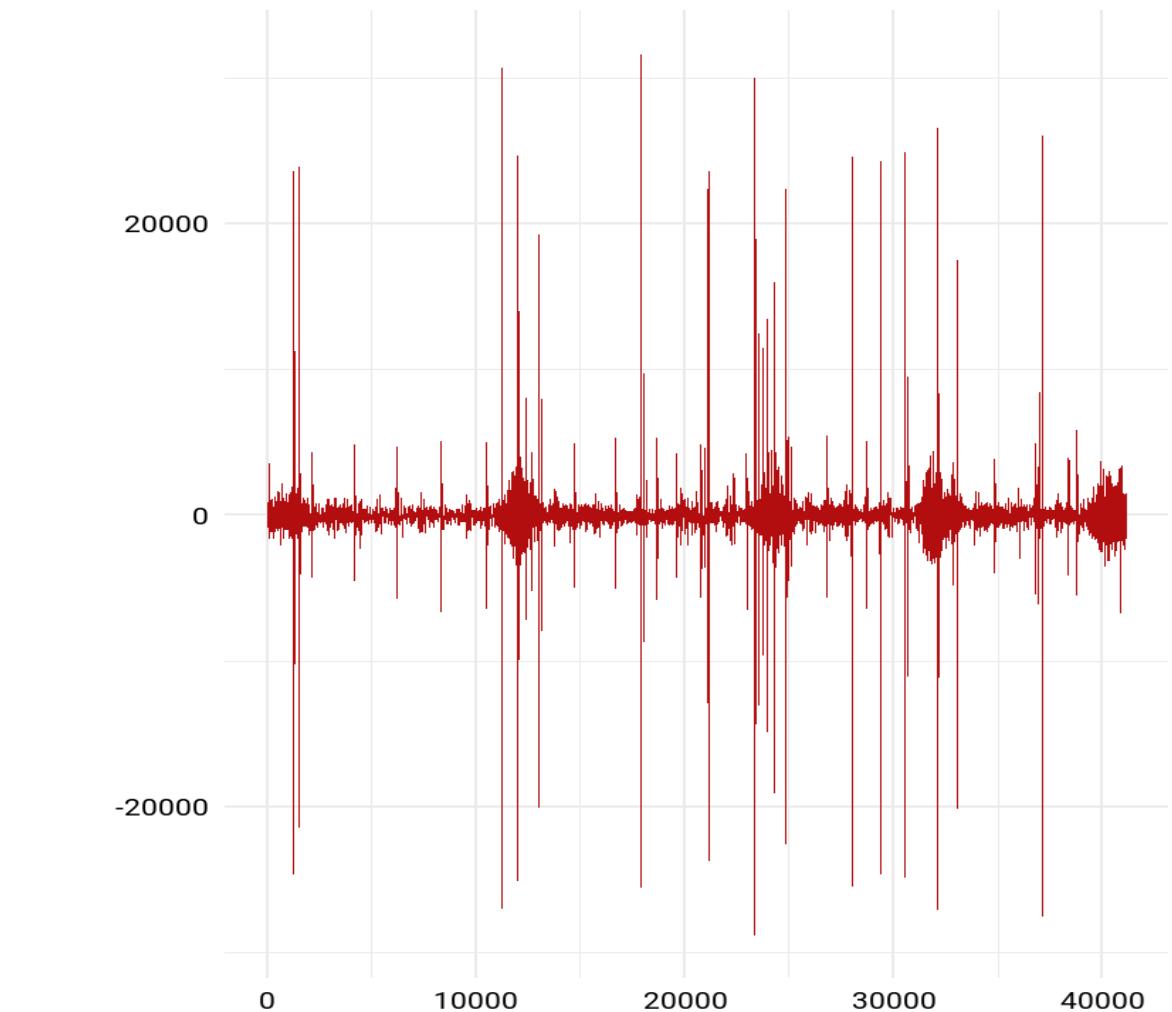
There are different types of heart murmurs. Some are more dangerous than others.



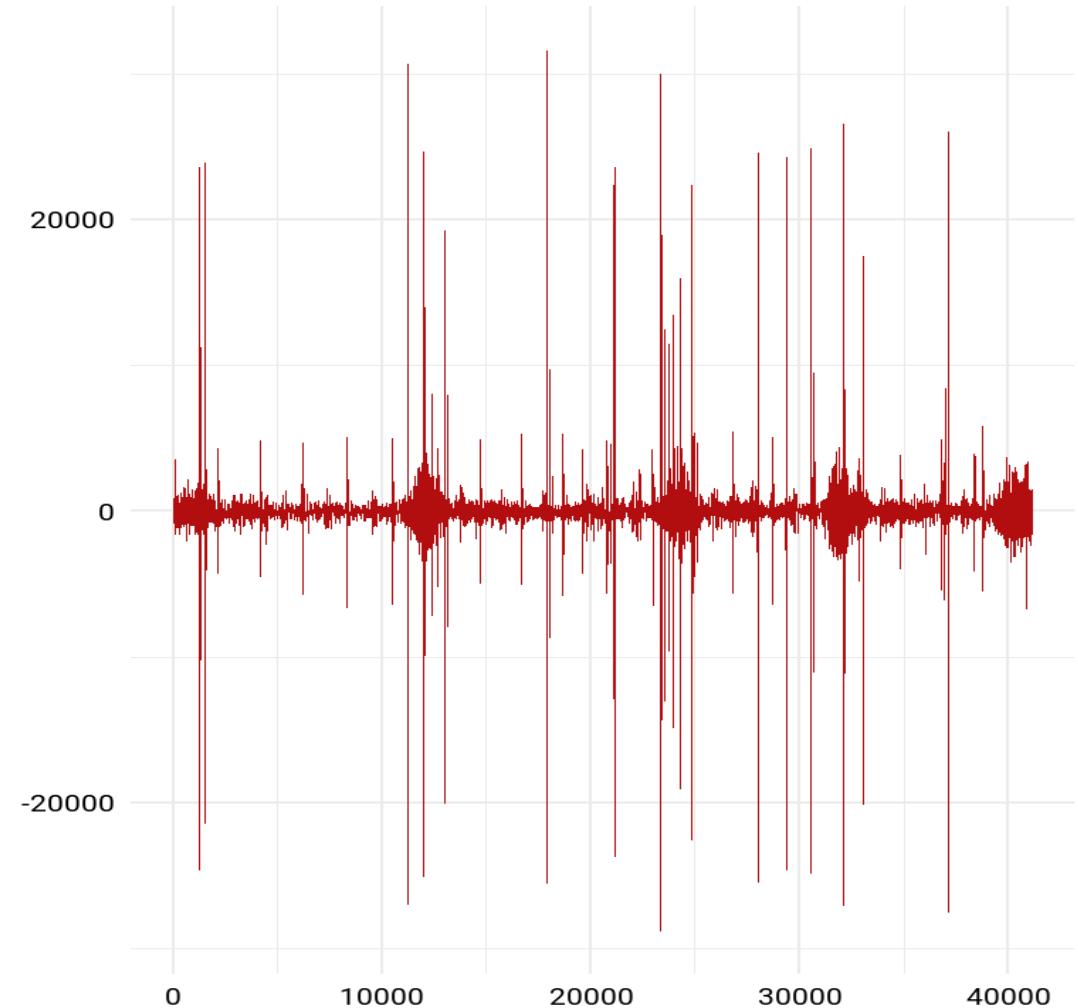
How are they diagnosed?

Heart murmurs can be diagnosed with a PCG (phonocardiogram).

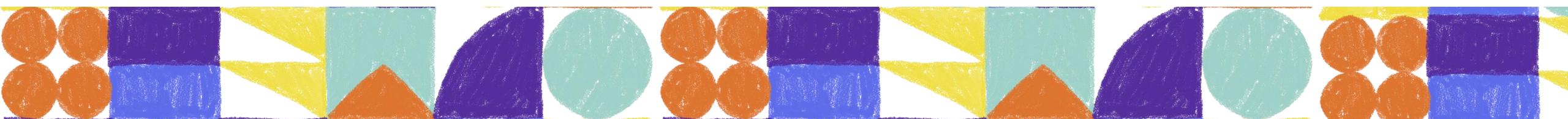
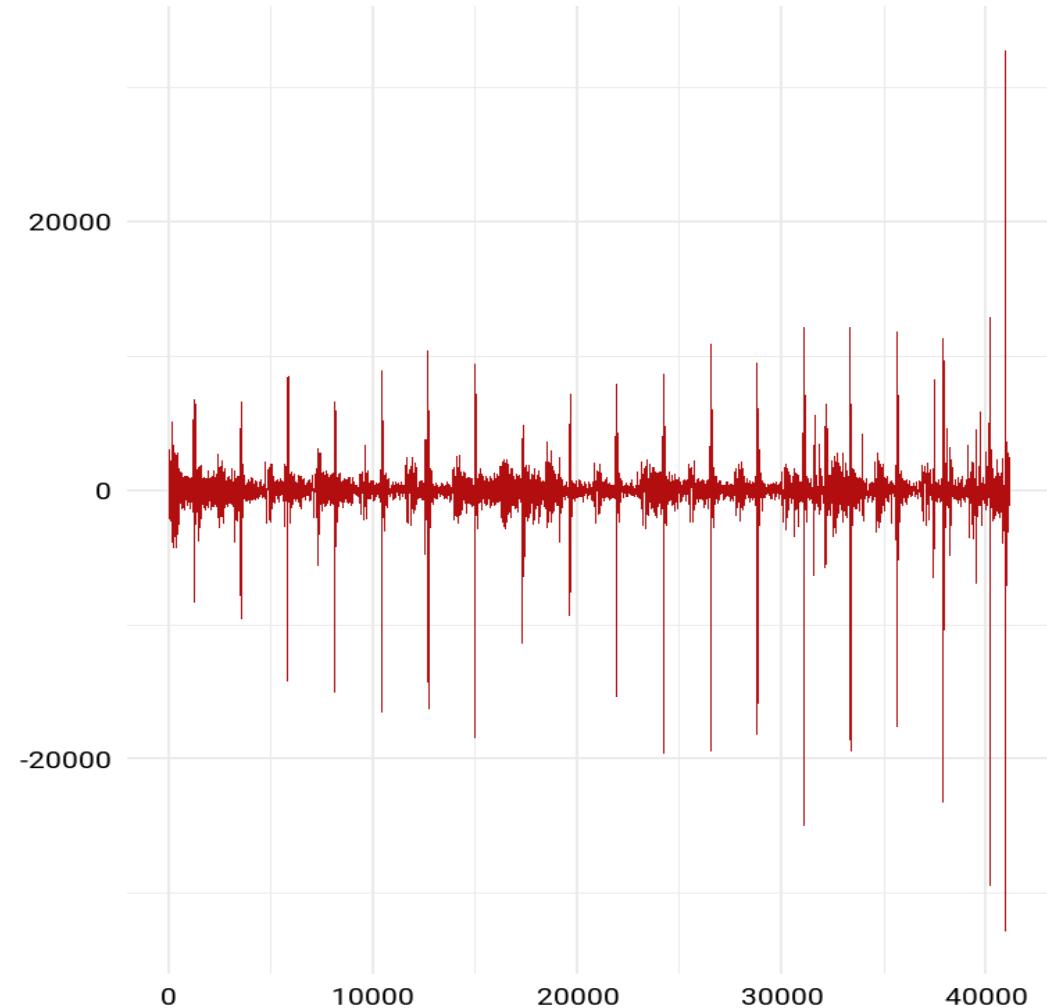




Subject: 23625 (Absent)



Subject: 13918 (Present)



Aim



Group phonocardiogram signals

Two groups: heart murmur and no heart murmur

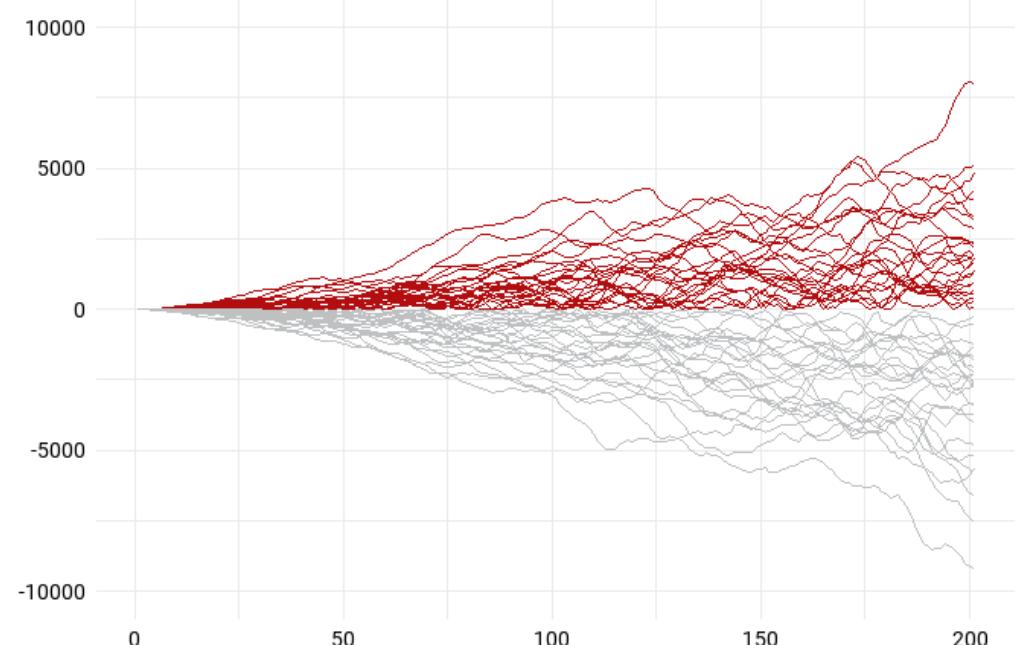
challenge



Data is very noisy

There are around 40,000 observations every 10 seconds.

If only classifying time series was this easy...



Method



Calculate features of the PCG signals

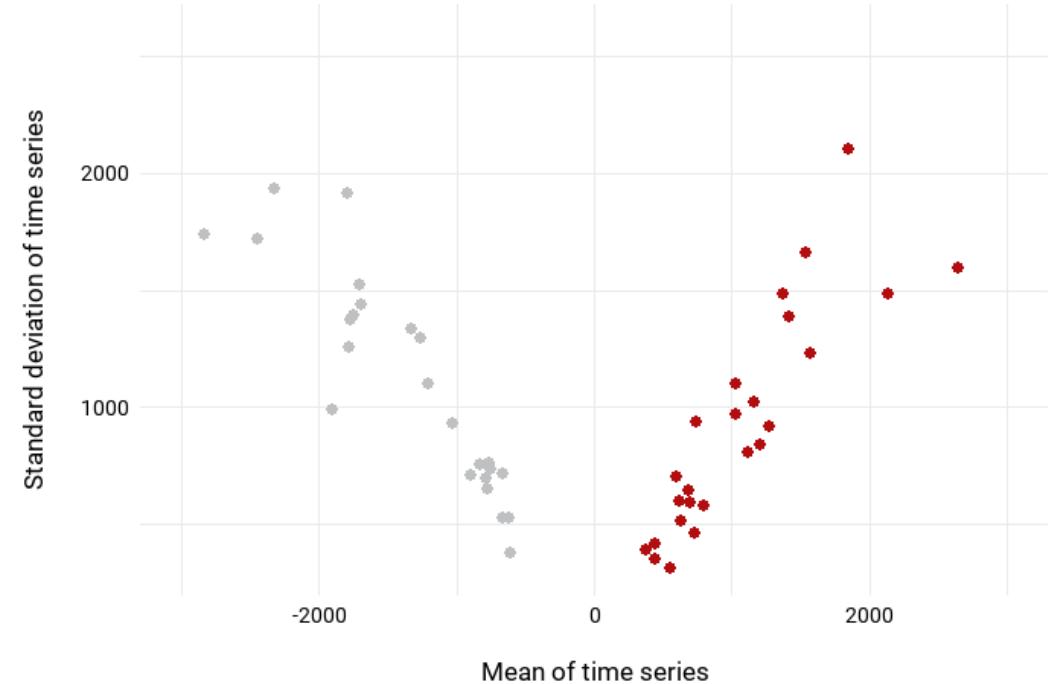
For example, measures of averages or variability.



Group new features instead

Two groups: heart murmur and no heart murmur.

This looks a little more familiar...



What else?



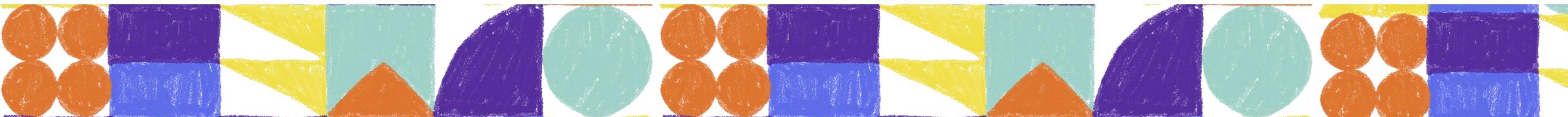
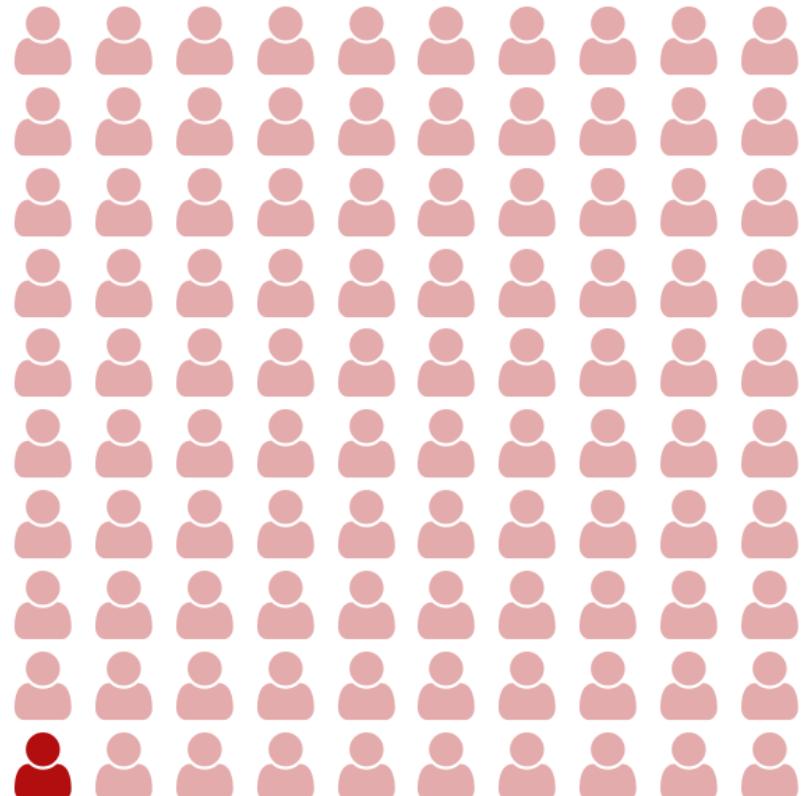
Improving predictions

Current methodology sometimes misses people who have heart murmurs.



Detect different types of heart murmur

Some heart murmurs are easier to detect than others. Some are more important to detect than others.





How do we communicate data?

Visualising data

Data visualisation



Turning Numbers into Pictures

Showing information in a way that's easier to understand.



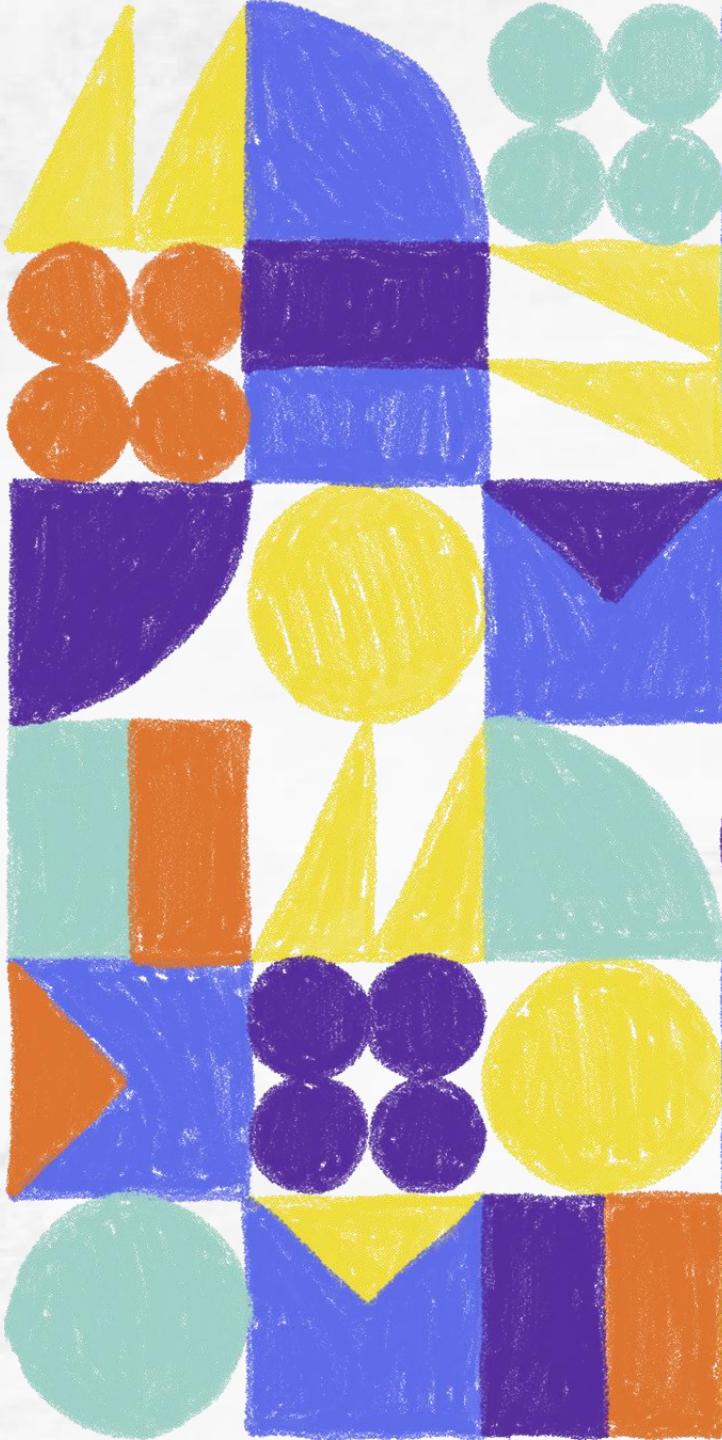
Identifying patterns

Telling stories and explaining how things change.

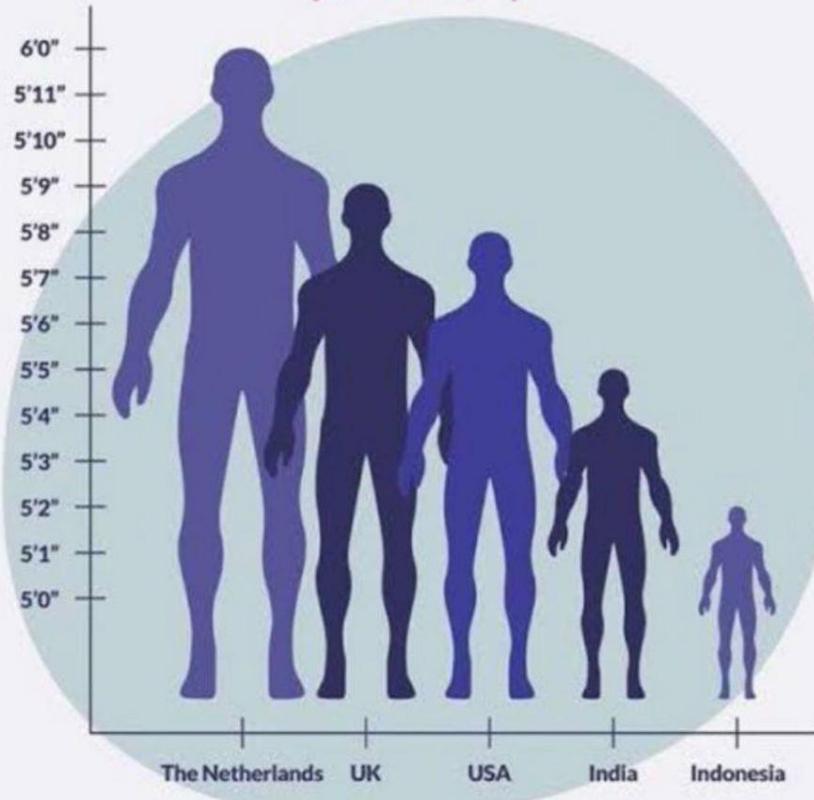


Make better decisions

Compare different categories more easily.

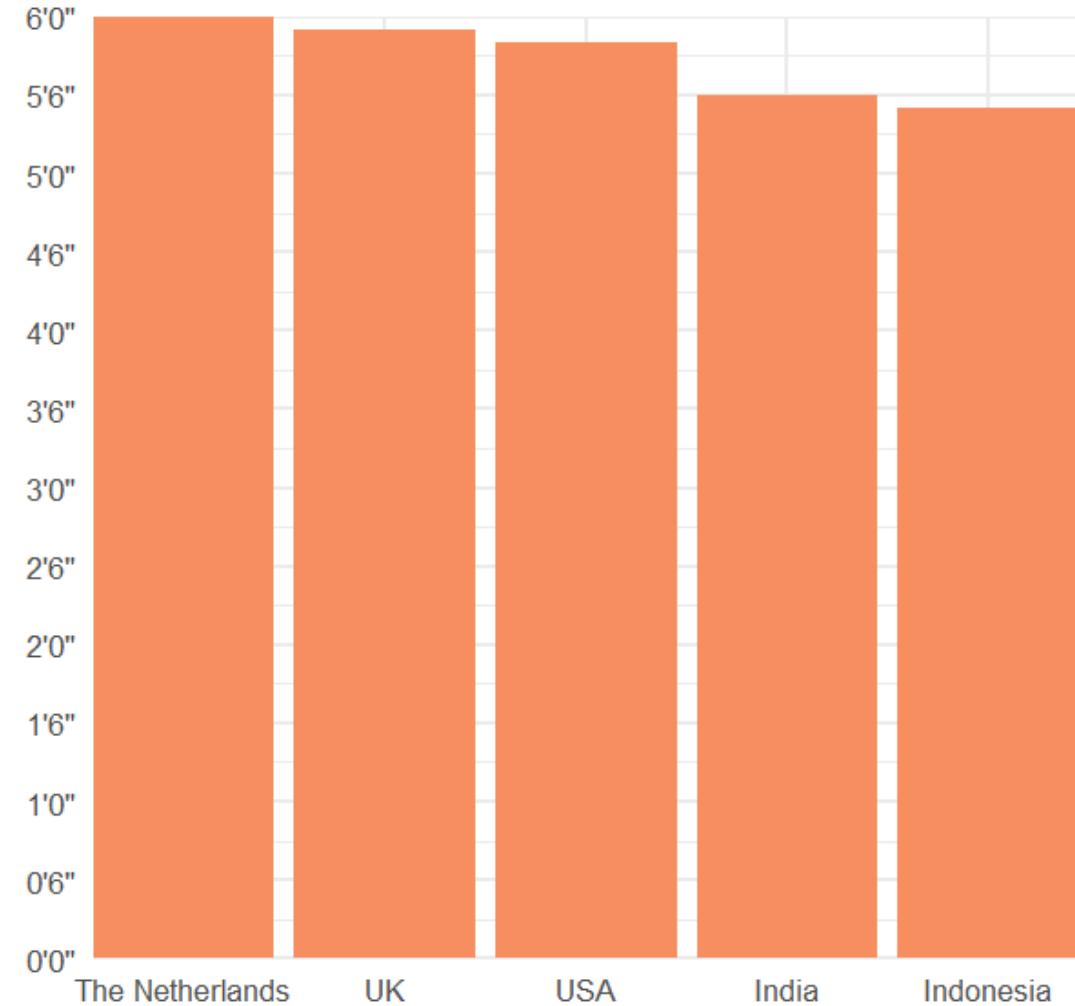


Average male height per country



Patient

Average male height per country

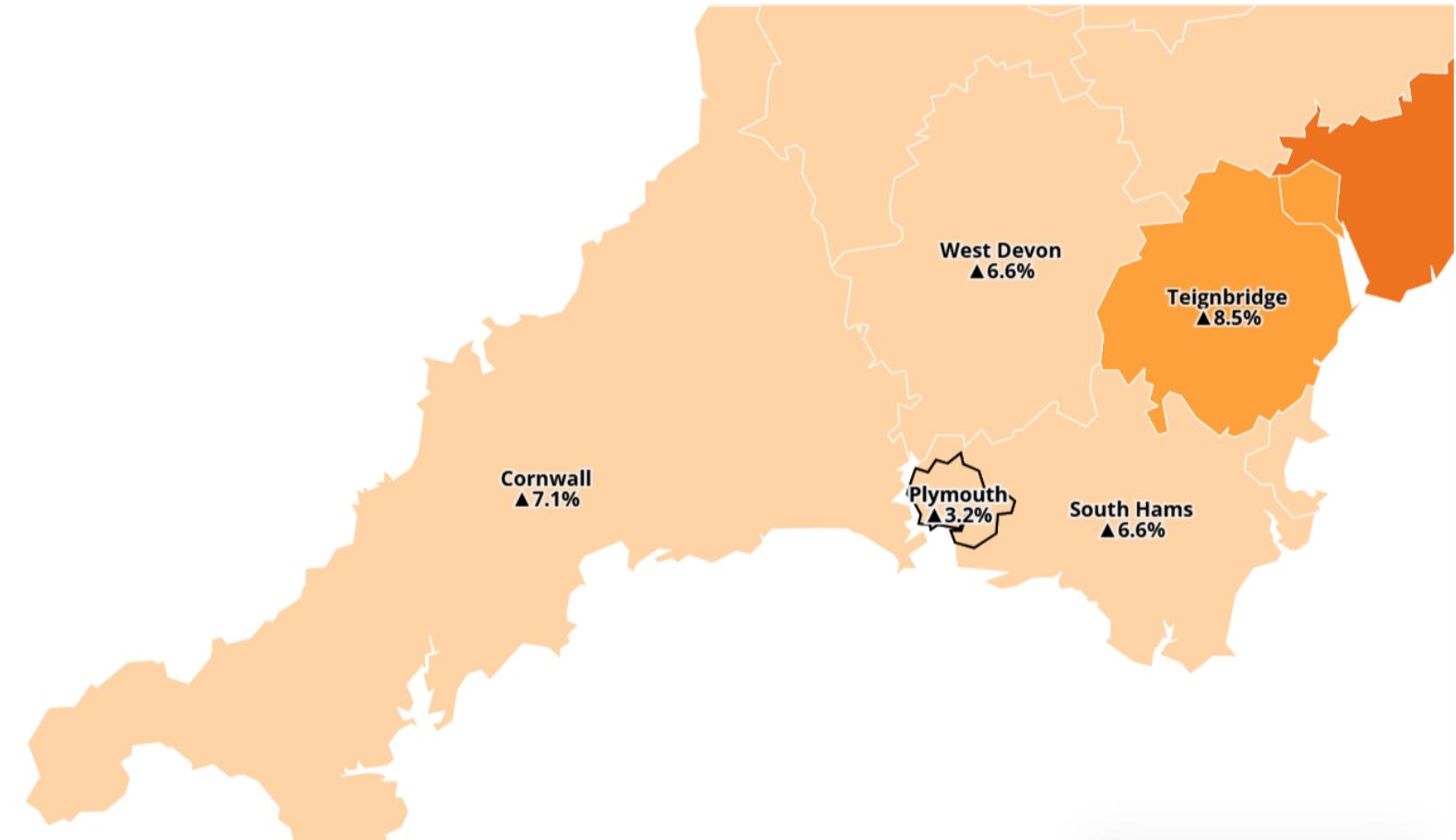


Population change in local authority areas near Plymouth between 2011 and 2021

Percentage change



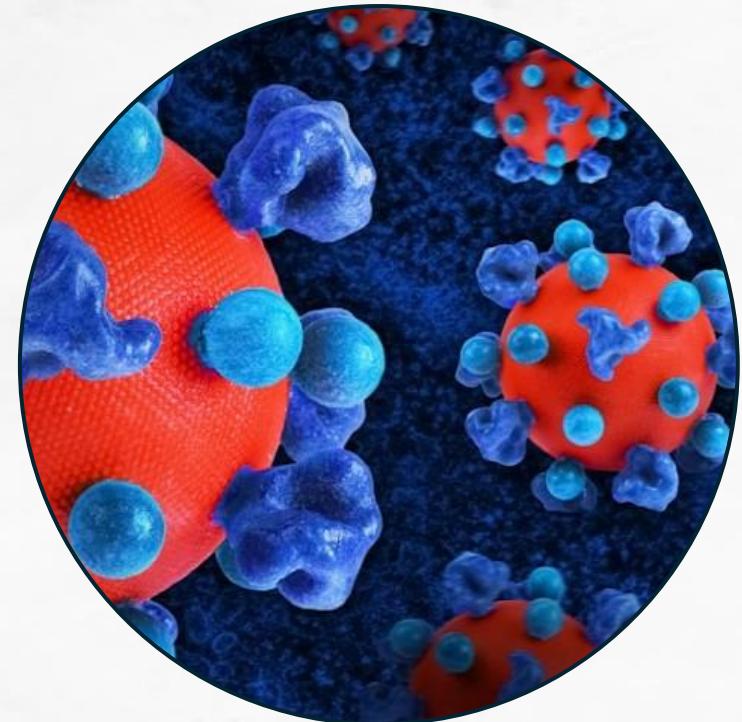
Nearby areas like [Teignbridge](#) and [Cornwall](#) have seen their populations increase by around 8.5% and 7.1%, respectively, while others such as [West Devon](#) saw an increase of 6.6% and [South Hams](#) saw smaller growth (6.6%).



<https://www.ons.gov.uk/visualisations/censuspopulationchange/>

Summary

- A career in medicine, doesn't always mean being a doctor or nurse.
- Statistics and data careers mean you can work in lots of different fields.
- You can make a difference with data.





Questions?

Nicola Rennie

Royal Statistical Society William Guy Lecturer 2024 – 2025
Lancaster Medical School, Lancaster University | Office for National Statistics