# Case Study: Using Stents to Prevent Strokes

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## Efficacy of a Medical Treatment

A classic challenge in statistics is to determine how effective a medical treatment truly is.

## Note

The terms introduced in this first chapter will be revisited later.

## Definition

A **stent** is a device put inside blood vessels that assist in patient recovery after cardiac events and reduce the risk of an additional heart attack or death.

## Case Study

Many doctors have hoped that stents would have similar benefits for patients at risk of strokes.

The question researchers need to answer is:

***Does the use of stents reduce the risk of stroke?***

## Experiment

The researchers conducted an experiment with 451 at-risk patients. Each volunteer patient was randomly assigned into one of two groups.

## Treatment group (224 patients)

These patients received a stent and medical management.

## Note

The medical management included medications, management of risk factors, and help in lifestyle modification.

## Control group (227 patients)

These patients received the same medical management, but did not receive a stent.

## Data Gathering

The researchers studied the effect of stents at two time points:

- 30 days after enrollment
- 365 days after enrollment

## Data Set

| Patient | group | 0-30 days | 0-365 days |
|---|---|---|---|
| 1 | treatment | no event | no event |
| 2 | treatment | stroke | stroke |
| 3 | treatment | no event | no event |
| 4 | treatment | no event | stroke |
| ⋮ | ⋮ | ⋮ | ⋮ |
| 451 | control | no event | no event |

## Note

Listing each patient line-by-line is very cumbersome.

## Descriptive Statistics

| | 0-30 days | | 0-365 days | |
|---|---|---|---|---|
| | *stroke* | *no event* | *stroke* | *no event* |
| *treatment* | 33 | 191 | 45 | 179 |
| *control* | 13 | 214 | 28 | 199 |
| *total* | 46 | 405 | 73 | 378 |

## Question

*What percentage of the treatment group had a stroke in the first year?*

$$\frac{\text{number of treatment group that had a stroke}}{\text{total size of treatment group}} = \frac{45}{224} = 0.20 = 20\%$$

## Question

*What percentage of the control group had a stroke in the first year?*

$$\frac{\text{number of control group that had a stroke}}{\text{total size of control group}} = \frac{28}{227} = 0.12 = 12\%$$

## Note

This means an additional 8% of patients with a stent had a stroke!

## Definition

A **summary statistic** is a single number summarizing a large amount of data.

## Why is this important?

1. Many doctors expected stents to reduce the chance of a stroke.
2. Does the data show a "real" difference between the groups?

## Note

The second question is a real subtle one and most of the statistical tools we discuss will be used to address this question.

## Signifigance

What is the chance of getting a head when flipping a quarter?

Theoretically it is 50%. But if you flip a large number of coins, you rarely get exactly half heads and half tails.

| heads | | tails | | total |
|---|---|---|---|---|
| 5,045 | 50.4% | 4,955 | 49.5% | 10,000 |
| 4,969 | 49.7% | 5,031 | 50.3% | 10,000 |
| 5,064 | 50.6% | 4,936 | 49.4% | 10,000 |
| 5,091 | 50.9% | 4,909 | 49.1% | 10,000 |
| 4,972 | 49.7% | 5,028 | 50.3% | 10,000 |
| 5,021 | 50.2% | 4,979 | 49.8% | 10,000 |
| 5,007 | 50.1% | 4,993 | 49.9% | 10,000 |
| 5,031 | 50.3% | 4,969 | 49.7% | 10,000 |
| 5,056 | 50.6% | 4,944 | 49.4% | 10,000 |
| 5,006 | 50.1% | 4,994 | 49.9% | 10,000 |

## Note

The published results of the study can be summarized as:

*There was compelling evidence of harm by stents in this study of stroke patients.*

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Chimowitz MI, Lynn MJ, Derdeyn CP, et al. 2011. Stenting versus Aggressive Medical Therapy for Intracranial Arterial Stenosis. New England Journal of Medicine 365:993-1003. http://nejm.org/doi/full/10.1056/NEJMoa1105335

## Be careful

Do not generalize the results of this study to all patients and all stents.

- This study considered patients with very specific characteristics who volunteered to be a part of the study and may not be representative of all stroke patients.
- There are many types of stents and this study only considered the self-expanding Wingspan stent.

## Percentages Review

- **Percentage of:** To find a percentage of an amount, replace the % symbol with division by 100 and multiply by the amount.

  Example: 6% of 1200 responses is $\frac{6}{100} \cdot 1200 = 72$

- **Decimal to Percentage:** To convert from a decimal to a percentage, multiply by 100%.

  Example: $0.25 \rightarrow 0.25 \cdot 100\% = 25\%$

- **Fraction to Percentage:** To convert from a fraction to a percentage, divide the denominator into the numerator and multiply by 100%.

  Example: $\frac{3}{4} = 0.75 \rightarrow 0.75 \cdot 100\% = 75\%$

- **Percentage to Decimal:** To convert from a percentage to a decimal number, replace the % by division by 100.

  Example: $85\% \rightarrow \frac{85}{100} = 0.85$