Case Study: Using Stents to Prevent Strokes

Colby Community College

Efficacy of a Medical Treatment

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

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.

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.

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.

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.

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.

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.

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:

Data Gathering

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

- 30 days after enrollment

Data Gathering

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

- 30 days after enrollment
- 365 days after enrollment

Data Gathering

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

- 30 days after enrollment
- 365 days after enrollment

Data

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

Data Gathering

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

- 30 days after enrollment
- 365 days after enrollment

Data

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

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?

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?

$$\frac{\text{number of treatment group that had a stroke}}{\text{total size of treatment group}}$$

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?

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

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?

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

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?

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?

$$\frac{\text{number of control group that had a stroke}}{\text{total size of control group}}$$

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?

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

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!

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.

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.

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

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?

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.

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

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.

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.

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.

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.

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.

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