

CIC Study Group

Week 6



HAI Prevention Program

Agenda

Review

- Chapter 13 Descriptive Statistics
- Chapter 14 Process Control Charts
- Chapter 15 Risk-Adjusted Comparisons

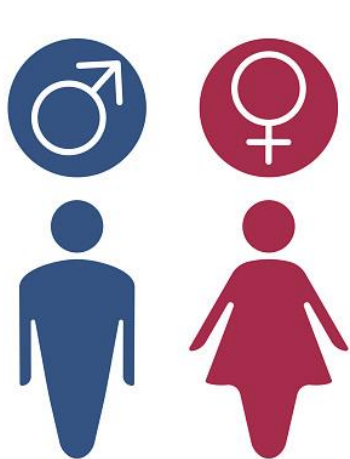
Chapter 13

Descriptive Statistics

Types of Data

Categorical data, also known as **qualitative** or **discrete data**, fit into mutually exclusive groups. Categorical data can be **nominal** or **ordinal**.

- ❖ Nominal data have categories that are just names; they lack a logical order.
 - ❖ **Example: Assigned Gender at Birth [Male/Female]**
- ❖ Ordinal data categories are inherently ordered.
 - ❖ **Example: Age Group, Patient Satisfaction Level**



Types of Data, Cont.

Quantitative data are numeric and measure concepts like “how many” or “how much”. Quantitative data can be **discrete** or **continuous**.

- ❖ Discrete data includes whole numbers or integers.
 - ❖ **Example: Number of Patients on Transmission-based Precautions**
- ❖ Continuous data includes infinite possible values and can be plotted on a number line.
 - ❖ **Example: Weight, Temperature**



Measures of Central Tendency

Mean

- ❖ What each value in the dataset would be if all values contributed equally to the dataset's total value – also known as the “average”.
- ❖ Sum all the values for a given data set and divide by the total number of data points.
- ❖ Most affected by outlier data.

Median

- ❖ The middle value when data are arranged in numerical order.
- ❖ If a data set has an even number of observations, the median is the average of the two middle values.
- ❖ Ignores extreme values.

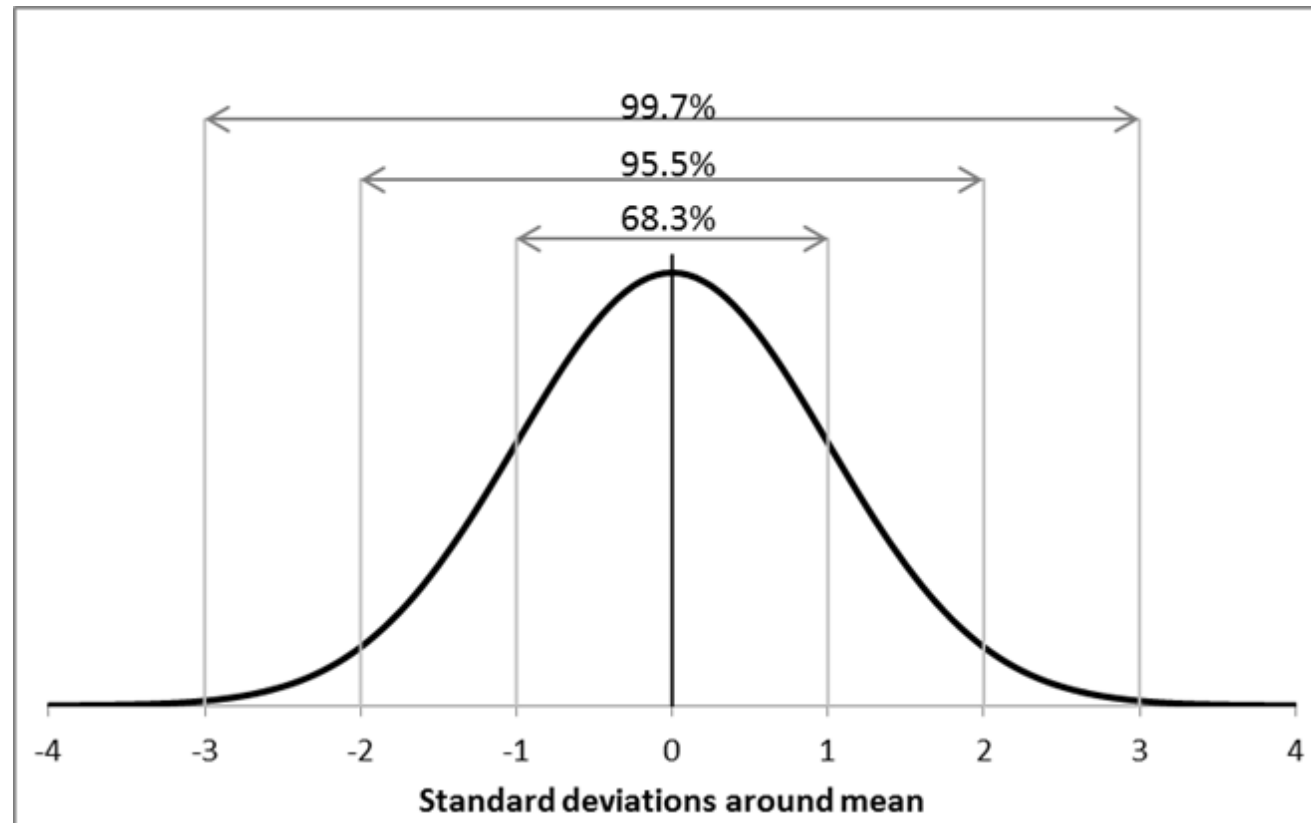
Mode

- ❖ The value that occurs the most often in a given data set.
- ❖ Generally, more useful for qualitative data.
- ❖ The least stable measure of central tendency

Standard Deviation

Deviation refers to the distance between a data point and the mean of its data set.
Standard deviation is a summary measure of how far data points spread out around the mean.

- *Positive deviation = $>$ mean
- *Negative deviation = $<$ mean
- *No deviation = mean



Ratios

A **ratio** is a comparison of any two quantitative values.

Figure 13-6. Ratio formula

$$\frac{x \text{ numerator}}{y \text{ denominator}} \times 10^n$$

$$\left\{ \begin{array}{l} 10^0 = 1 \\ 10^1 = 10 \\ 10^2 = 100 \\ 10^3 = 1000 \\ 10^4 = 10,000 \\ 10^5 = 100,000 \end{array} \right\}$$

Proportions

A **proportion** is a specific kind of ratio that compares a part to the whole.

Figure 13-7. Proportion formula

$$\frac{\text{X number of events or persons of interest}}{\text{Y total number of events or persons (of which the numerator is a subset)}} \times 10^n$$

$10^0 = 1$
 $10^1 = 10$
 $10^2 = 100$
 $10^3 = 1000$
 $10^4 = 10,000$
 $10^5 = 100,000$

Rates

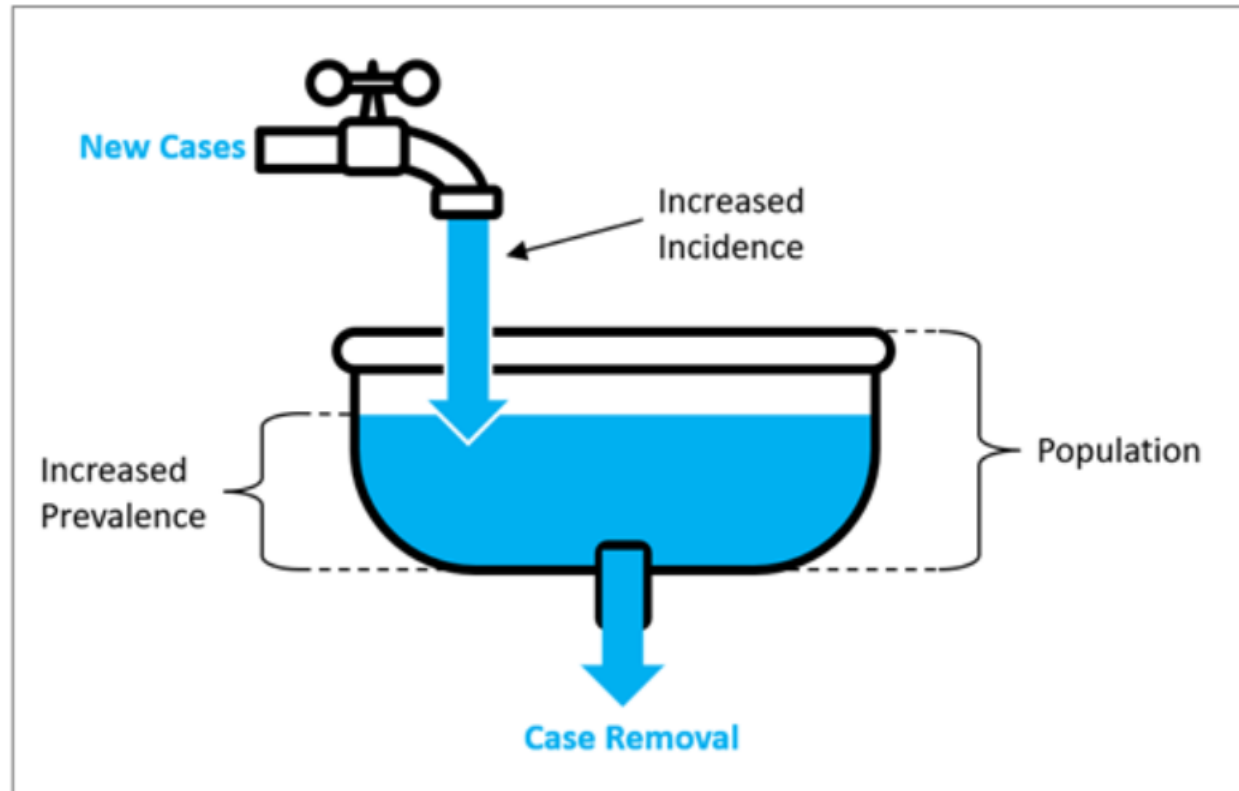
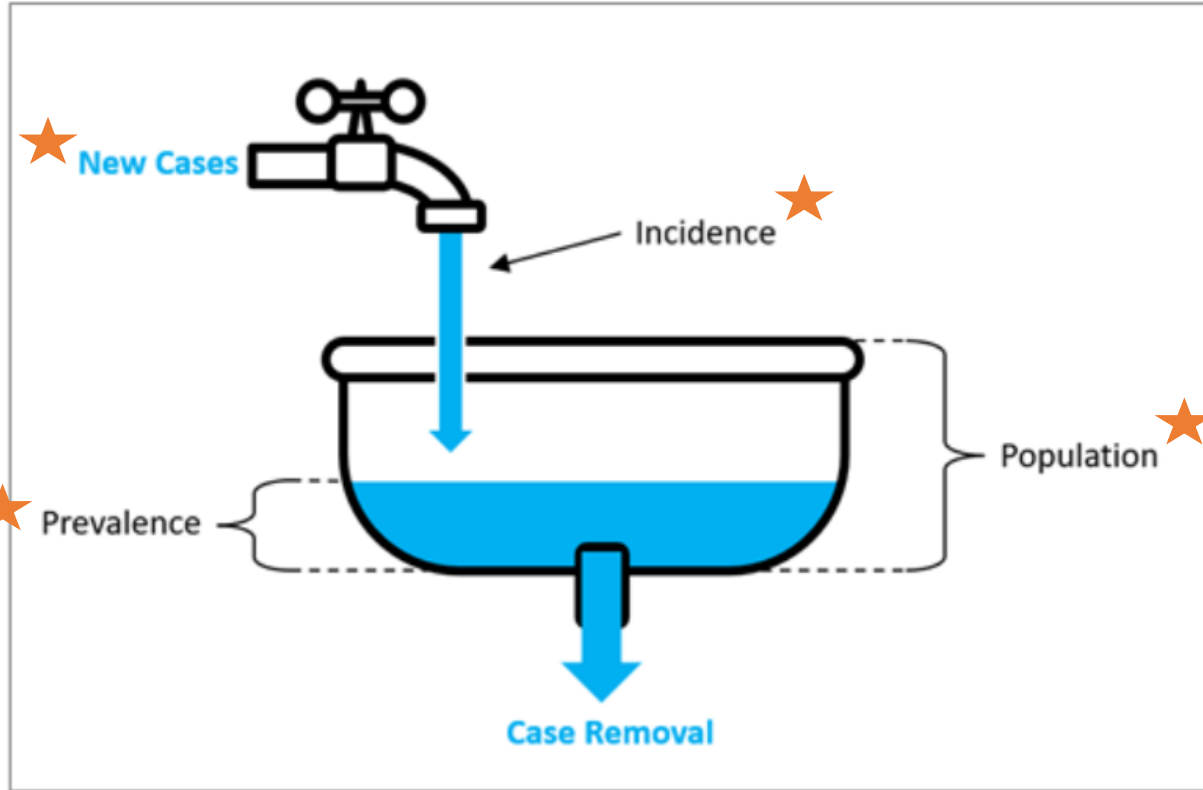
A **rate** is a specific kind of ratio that includes a unit of time.

Figure 13-8. Rate formula

$$\frac{\text{X number of events during the time period}}{\text{Y number of events, persons, etc. at risk during the time period}} \times 10^n$$

$10^0 = 1$
 $10^1 = 10$
 $10^2 = 100$
 $10^3 = 1000$
 $10^4 = 10,000$
 $10^5 = 100,000$

Incidence and Prevalence



Incidence Proportion

Incidence Proportion or Cumulative Incidence is a person-based calculation that incorporates the number of people at risk. It is the proportion of the total population at risk who can be newly counted as cases during the specified time period.

Figure 13-11. Incidence formula

$$\frac{\text{number of NEW cases during a given time period}}{\text{total population at risk (of which the numerator is a subset) during that time period}} \times 10^n$$

Incidence Rate

Incidence Rate or Incidence density is a person-based calculation which incorporates the amount of time that each person was actually at risk rather than treating the population as if they were at risk for the entire specified period of time.

Figure 13-12. Incidence rate formula

$$\frac{\text{number of NEW cases during a given time period}}{\text{total time at risk}} \times 10^n$$

Patient-days and Device-days

The examples show counts taken at: A) 12:00 am and B) 11:00 pm.

A. Count at 12:00 am (midnight):

Date	Mr X Pt Day	Mr Y Pt Day
01/01	Mr X admitted at 8:00 am Mr X not counted because the count for 01/01/10 was taken at 12:00 am on 01/01/10 and he was not yet admitted X	Mr Y admitted at 12:00 am Mr Y is counted because the count for 01/01 was taken at 12:00 am and that's when he was admitted 1
01/02	1	2
01/03	2	3
01/04	3	4
01/05	Mr X discharged at 5:00 pm 4 Counted for 01/05 because he was in the hospital at 12:00 am on 01/05 when the count for that day was taken	Mr Y discharged at 12:01 am 5 Counted for 1/05 because he was in the hospital at 12:00 am on 1/05 when the count for that day was taken
Total	4 patient days	5 patient days

Attack Rate

An **attack rate** – which represents the risk of acquiring a disease during an outbreak – is a type of incidence proportion.

$$\frac{\text{number of NEW cases during a given time period}}{\text{total population at risk (of which the numerator is a subset) during that time period}} \times 10^n$$

Point Prevalence and Period Prevalence

Point Prevalence and Period Prevalence are both calculated using the same formula but differ based on how data collection events are examined.

Figure 13-13. Prevalence formula

$$\frac{\text{number of EXISTING cases at a given point in time}}{\text{total population at risk (of which the numerator is a subset) at a given point in time}} \times 10^n$$

Relative Risk (Risk Ratio)

The Relative Risk (RR) or Risk Ratio is used to compare the risk of an event occurring in an exposed group to the risk of it occurring in an unexposed group.

$$RR = \frac{\text{risk of outcome in the group with exposure to the risk factor}}{\text{risk of outcome in the group without exposure}}$$

$$\text{Relative Risk} = A/A+B \div C/C+D$$

	With Outcome	Without Outcome	Total
Exposed	A (9)	B (5)	A + B (14)
Not Exposed	C (6)	D (22)	C + D (28)
Total	A + C (15)	B + D (27)	N (42)

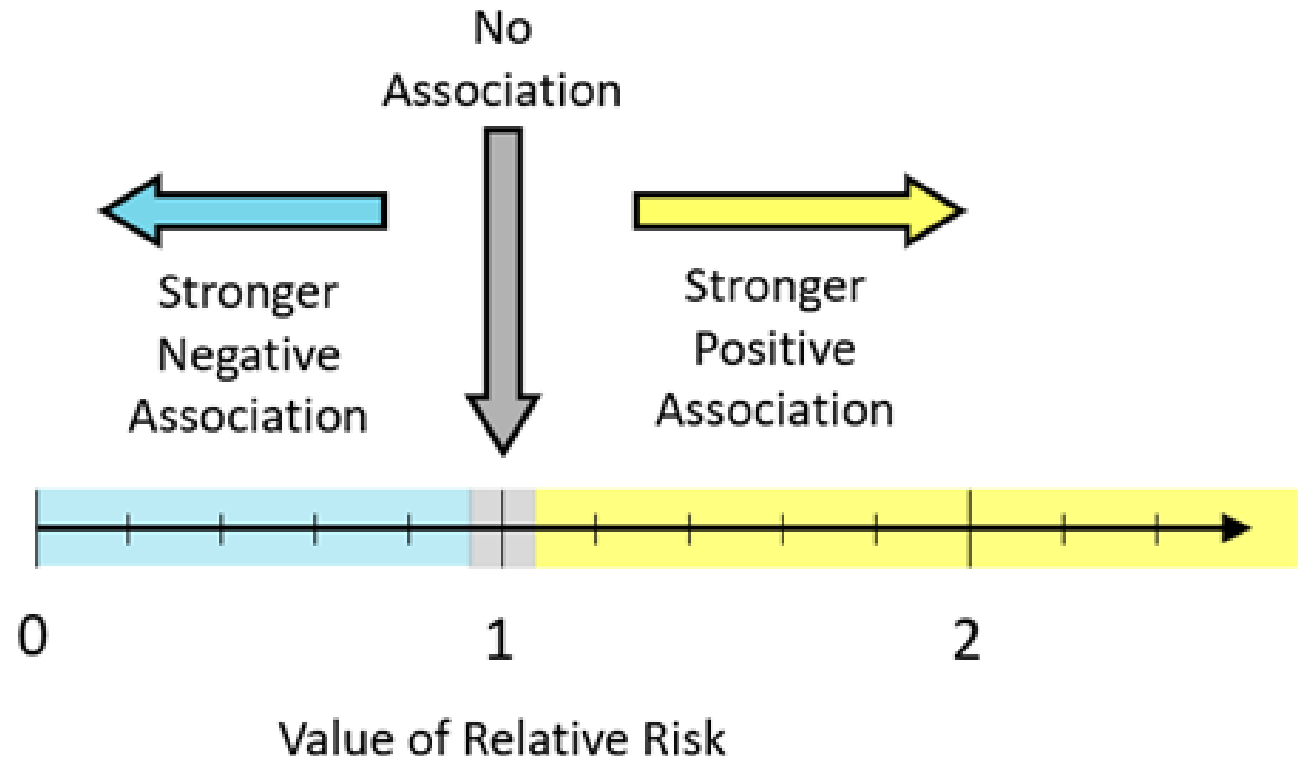


$$\text{Relative Risk} = \frac{64\%}{21\%} = 3.0$$

● = Individual with outcome
● = Individual without outcome

Interpretation of Relative Risk (RR)

- ❖ If the $RR < 1$ the risk of outcome was higher in the group without exposure; The risk factor and the disease are negatively associated.
- ❖ If the $RR = 1$ the risk of outcome was the same for both groups; There is no association between the risk factor and outcome.
- ❖ If the $RR > 1$ the risk of outcome was higher in the group with exposure; The risk factor and the outcome are positively associated.



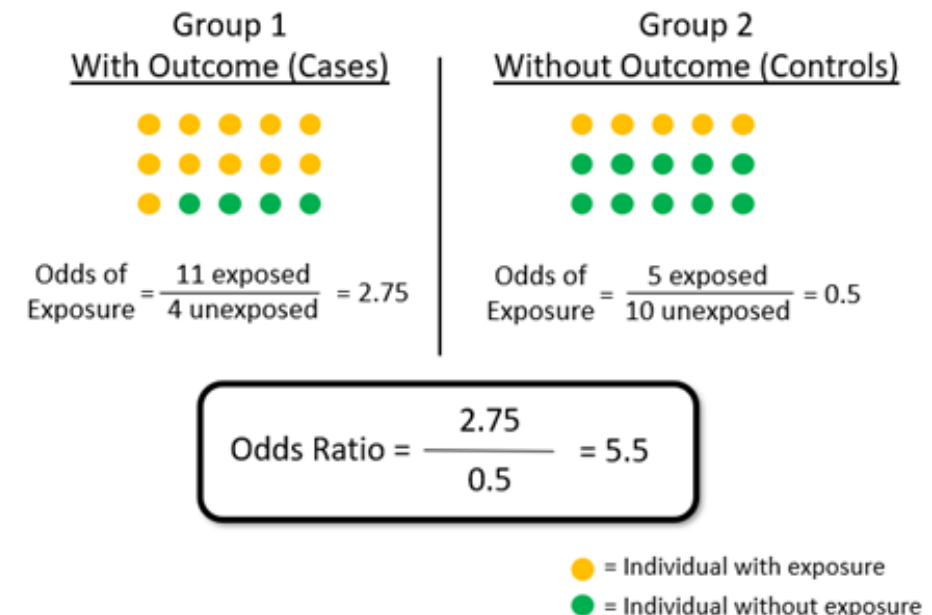
Odds Ratio

The **odds ratio (OR)** compares two groups based on their odds of exposure to a risk factor – the variable researchers do not manipulate.

$$OR = \frac{\text{odds of exposure in group with outcome (cases)}}{\text{odds of exposure in the group without outcome (controls)}}$$

$$\text{Odds Ratio} = A \times D \div B \times C$$

	With Outcome	Without Outcome	Total
Exposed	A (11)	B (5)	A + B (16)
Not Exposed	C (4)	D (10)	C + D (14)
Total	A + C (15)	B + D (15)	N (30)



Interpretation of Odds Ratio

- ❖ If the $OR < 1$ the odds of exposure are higher among the controls; individuals with the outcome are less likely to have been exposed to the risk factor.
- ❖ If the $OR = 1$ the odds of exposure are the same for both groups; no association was found between the outcome and having been exposed to the risk factor.
- ❖ If the $OR > 1$ the odds of exposure are higher among the cases; individuals with the outcome are more likely to have been exposed to the risk factor.

CDC Archive

EXAMPLES: Calculating Risk Ratios

Example A: In an outbreak of tuberculosis among prison inmates in South Carolina in 1999, 28 of 157 inmates residing on the developed tuberculosis, compared with 4 of 137 in wing.(11) These data are summarized in the two-by-two table because it has two rows for the exposure and two columns for the disease status. Here is the general format and notation.

Table 3.12A General Format and Notation for a 2x2 Table

	Ill	Well	
Exposed	a	b	$a + b = H_1$
Unexposed	c	d	$c + d = H_0$
Total	$a + c = V_1$	$b + d = V_0$	T



Exercise 3.8

Calculate the odds ratio for the tuberculosis data in Table 3.12. Would you say that your odds ratio is an accurate approximation of the risk ratio? (Hint: The more common the disease, the further the odds ratio is from the risk ratio.)

[Check your answer.](#)

Sensitivity vs. Specificity

Accuracy is the closeness of the result obtained to the true value and is described by two terms: **sensitivity** and **specificity**.

Sensitivity

- ❖ The ability of a test to detect **all true cases** of the disease
- ❖ The **absence** of a **false-negative** result.
- ❖ $A/A+C$

Specificity

- ❖ The ability of a test to correctly identify a **negative** result when the disease is absent.
- ❖ The **absence** of **false-positive** results.
- ❖ $D/B+D$

a True +	b False +
c False -	d True -

Concept Check

All 72 patients in a hemodialysis center were tested from Hepatitis C (HCV). Eight of the patients were identified as HCV positive. During the following year, two of the dialysis patients who previously tested negative for HCV converted to HCV positive. What was the incidence for that year?

- A. 2.8 percent
- B. 3.1 percent
- C. 13.8 percent
- D. 7.2 percent

Concept Check

All 72 patients in a hemodialysis center were tested from Hepatitis C (HCV). Eight of the patients were identified as HCV positive. What is the prevalence?

- A. 0.9 percent
- B. 9 percent
- C. 1 percent
- D. 11 percent

Concept Check

An Infection Preventionist collected the following data from the ICU for the month of November. How would they calculate the CAUTI rate for the month of November?

November 2024
6 CAUTIs
240 patient days
180 catheter days

- A. $(6 \div 240) \times 1000 = 25$ per 1000 patient days
- B. $(6 \div 180) \times 1000 = 33.3$ per 1000 catheter days
- C. $(180 \div 240) \times 1000 = 750$ per 1000 patient days
- D. $(240 \div 180) \times 1000 = 1333.3$ per 1000 patient days

Concept Check

Fifteen people were infected with *Salmonella* at a picnic where 75 ate egg salad sandwiches. What was the attack rate of *Salmonella* among those who ate the egg salad sandwiches?

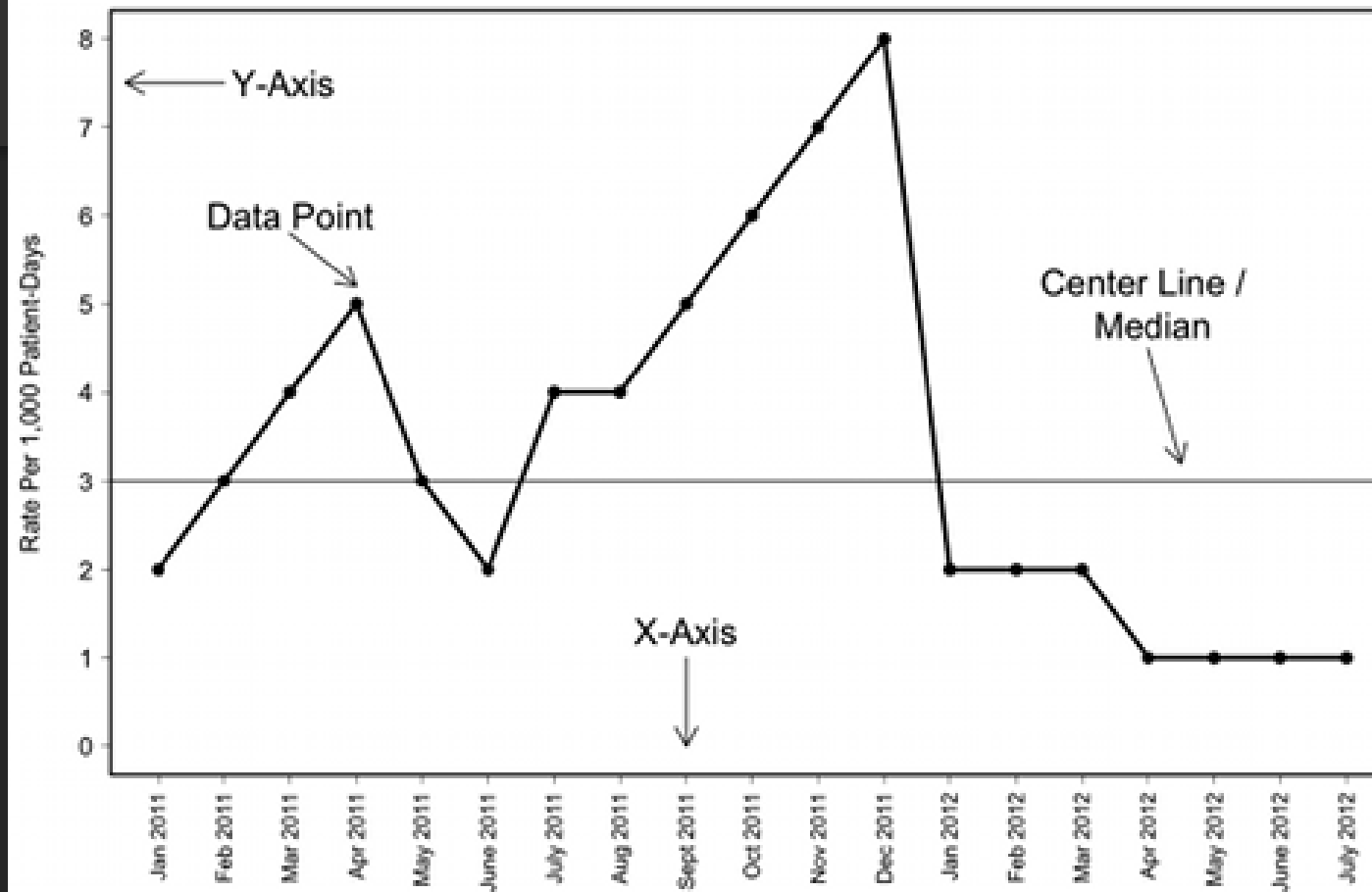
- A. 15 percent
- B. 0.20 percent
- C. 18 percent
- D. 20 percent

Chapter 14

Process Control Charts

Run Chart

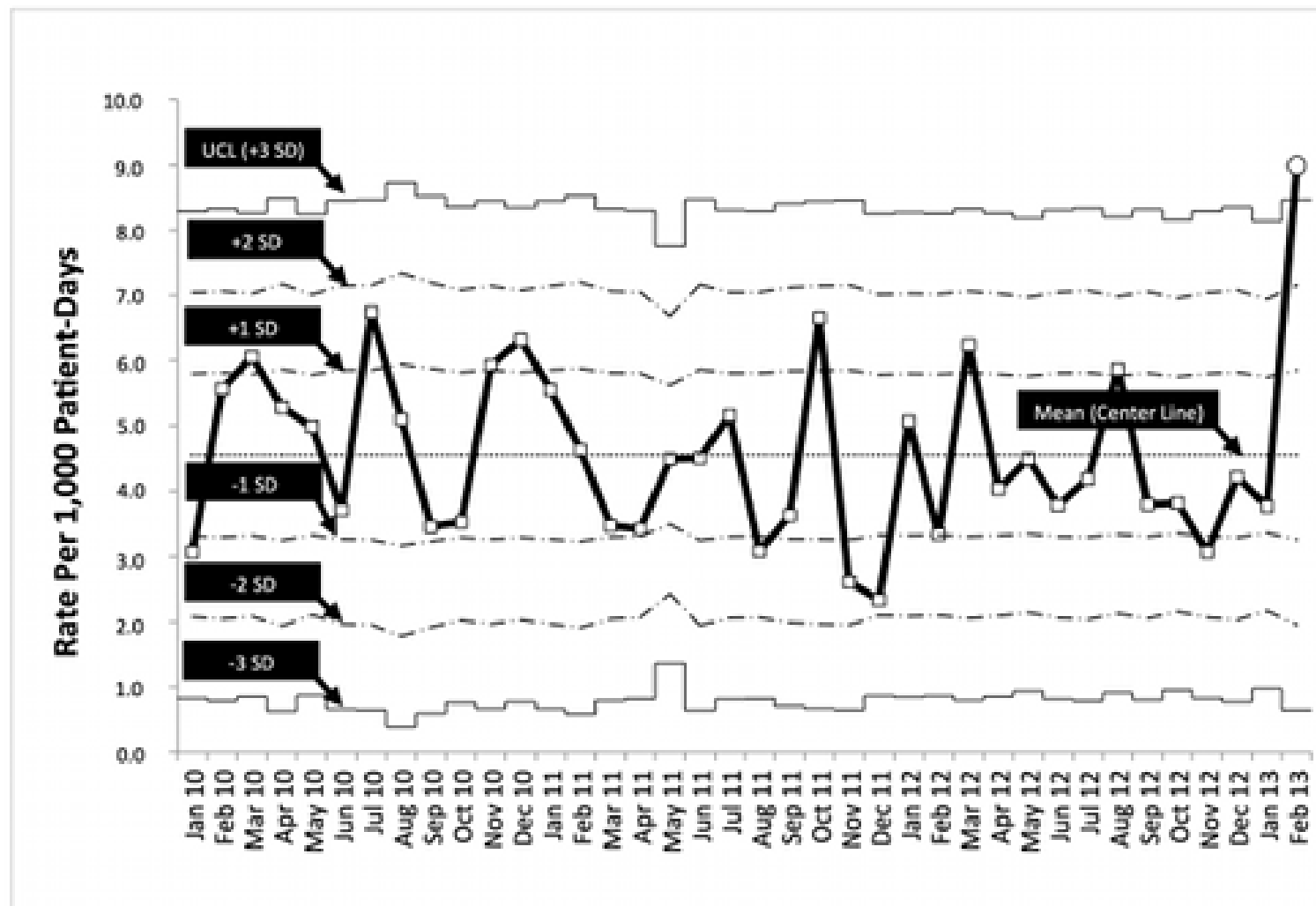
Figure 14-1.



Anatomy of a run chart.

Control Chart

Figure 14-4.

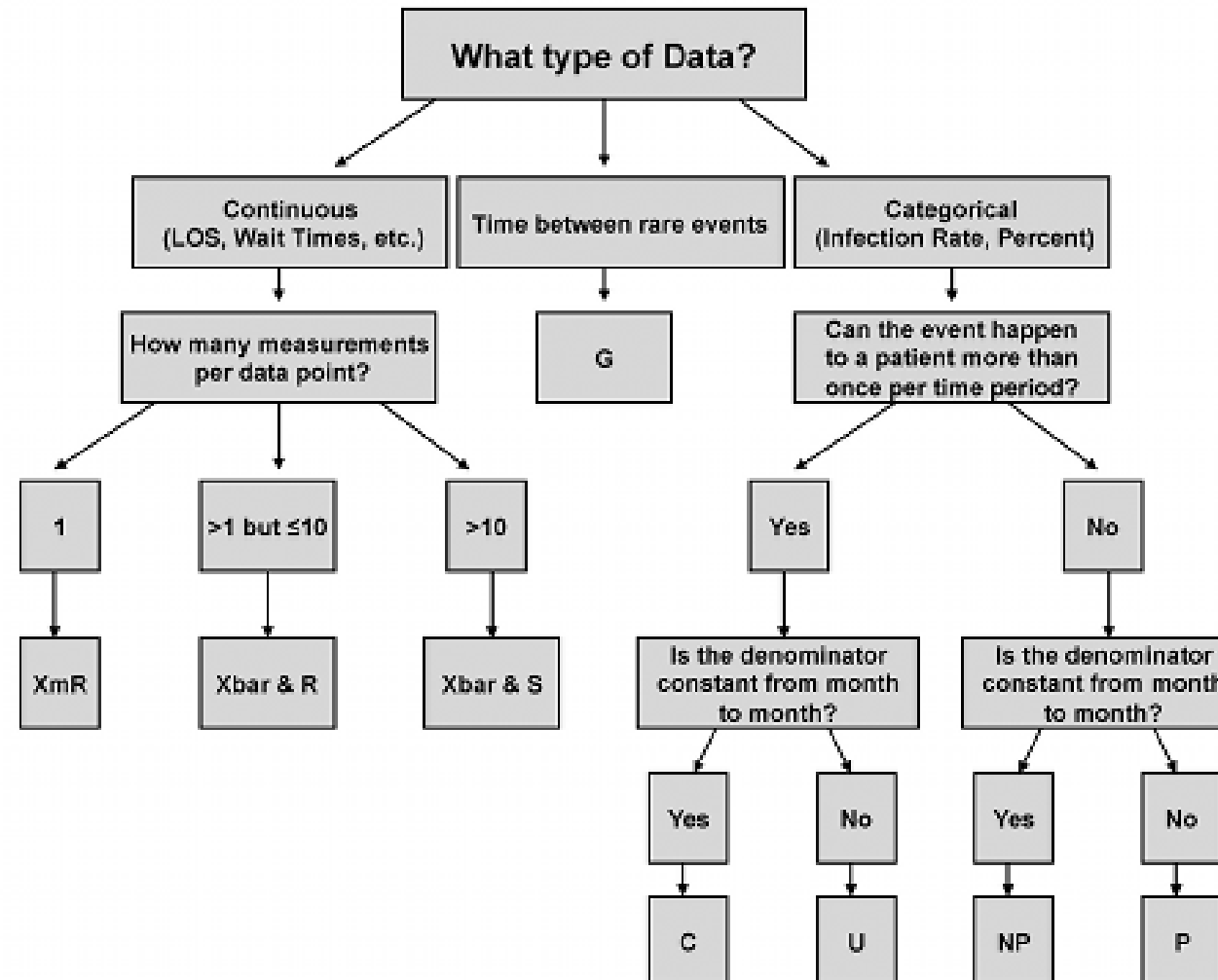


Example control chart for CLABSI using data from Table 14-1

Source: <https://text.apic.org/toc/epidemiology-surveillance-performance-and-patient-safety-measures/process-control-charts>

Choose the Correct Chart

Figure 14-6.



Choosing the correct control chart type for your data.

Chapter 15

Risk Adjusted Comparisons

National Healthcare Safety Network (NHSN)

$$SIR = \frac{\text{Observed (O) HAIs}}{\text{Predicted (P) HAIs}}$$

The Standardized Infection Ratio (SIR) is the primary summary measure used by the National Healthcare Safety Network (NHSN) to track healthcare-associated infections (HAIs).

SIR < 1	SIR > 1
Fewer infections than predicted given the baseline data.	More infections than predicted given the baseline data.
Infections have been prevented since the baseline period.	Infections have increased since the baseline period.
1 minus the SIR = percent reduction If the SIR for CAUTI in a post-surgical stepdown unit is 0.45, there was a 55% reduction in infection from the baseline period.	SIR minus 1 = percent increase If the SIR for CLABSI in a dialysis unit is 1.25, there was a 25% increase in infection from the baseline period.

Week 7 Assignments

Action Items

Assigned chapter readings:

- Chapter 16 Quality Concepts.
- Chapter 19 Qualitative Research Study.
- Chapter 20 Research Study Design.

Next Cohort Meeting: January 10, 2025

