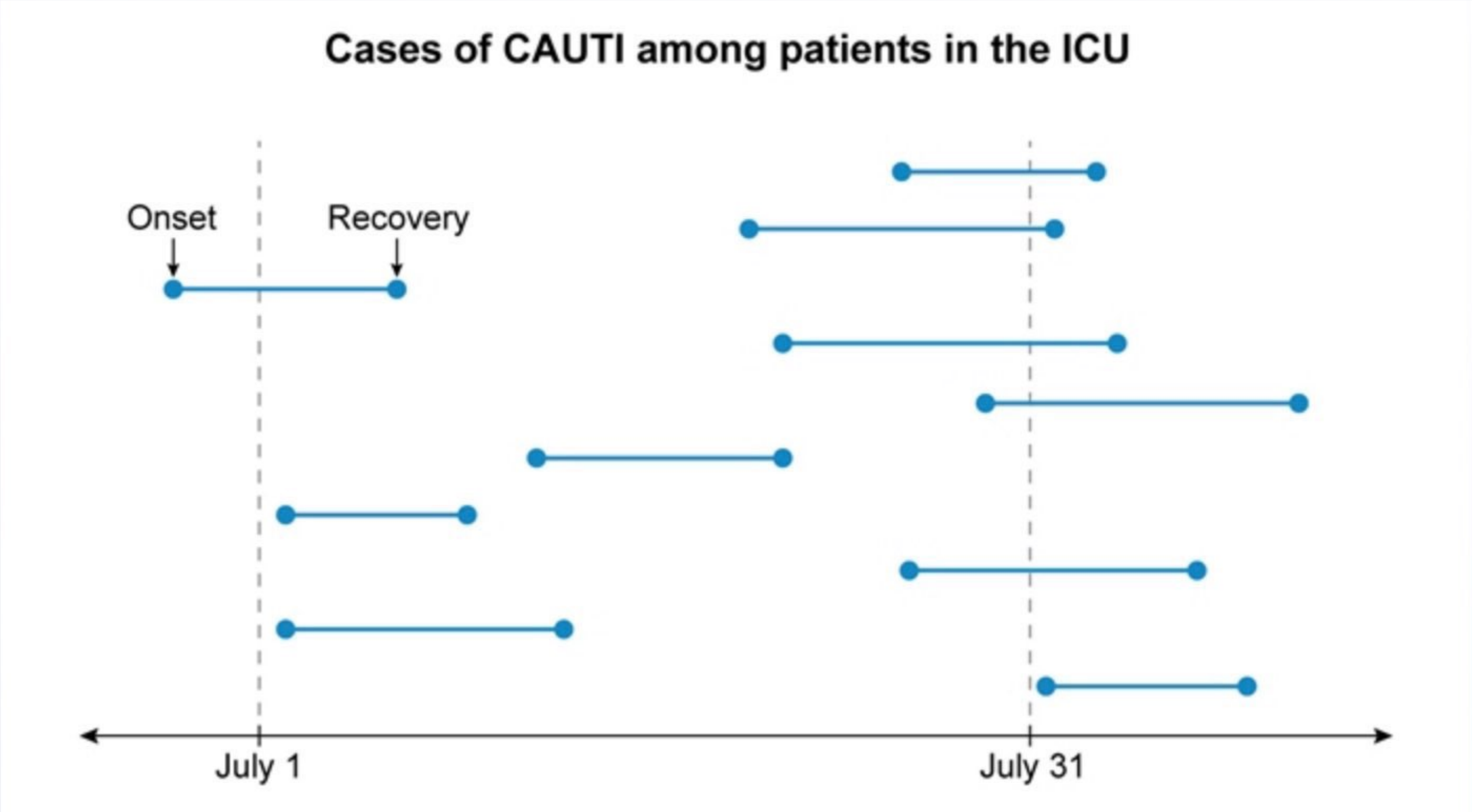
A study is conducted to estimate the prevalence of catheter-associated urinary tract infection (CAUTI) in the intensive care unit (ICU) of an urban hospital. The plot below shows the number of cases of CAUTI in this hospital during the month of July among patients in the ICU. Based on the plot, which of the following is the number of prevalent cases on July 31?



CAUTI = catheter-associated urinary tract infection; ICU = intensive care unit.

- A. 1 (1%)
- B. 4 (0%)
- ✓ C. 5 (88%)
- D. 8 (2%)

Explanation

Prevalence refers to the **proportion of diseased individuals** in a particular at-risk population, often measured in the following ways:

- **Period prevalence** refers to the number of disease cases in a period (eg, from July 1 to July 31) divided by the number of people in the at-risk population (ie, **prevalent cases** at the beginning of a period plus any **incident cases** during the period).
- **Point prevalence** refers to the number of **disease cases** that are active at a **specific point** in time (eg, July 31) divided by the number of people in the at-risk population.

In this example, a study determined the number of cases of catheter-associated urinary tract infection (CAUTI) among patients in the intensive care unit during the month of July. There were 9 cases of CAUTI in July; a tenth case developed after July 31. Four of the 9 patients recovered before July 31; therefore, the number of cases of CAUTI still active on July 31 was 5.

(Choice A) Only 1 patient had developed CAUTI before July 1; this represents the number of point-prevalent cases on July 1.

(Choice B) Four patients with CAUTI recovered during the month of July.

(Choice D) Eight cases of CAUTI developed between July 1 and July 31; this represents the number of incident cases during July.

(Choice E) There were 9 cases of CAUTI during the month of July; this represents the number of period-prevalent cases.

Educational objective:

Unlike period prevalence, point prevalence considers only the number of disease cases that are active at a

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Biostatistics	Biostatistics & Epidemiology	Prevalence and incidence
Subject	System	Topic

A study is conducted to evaluate the properties of a new test for diagnosing ovarian cancer. The study enrolled 200 patients who truly have ovarian cancer and 300 patients who truly do not. Study results showed that the test is 80% sensitive and 70% specific. Based on this information, which of the following is the approximate number of false negative test results found in this study?

- A. 40 (78%)
- B. 90 (12%)
- C. 160 (6%)
- D. 200 (1%)
- E. 210 (2%)

Omitted
Correct answer
A

78%
Answered correctly

06 secs
Time Spent

2023
Version

Explanation

	Positive condition	Negative condition	
Positive test result	TP	FP	PPV = TP / (TP + FP)
Negative test result	FN	TN	NPV = TN / (TN + FN)

	Positive condition	Negative condition	
Positive test result	TP	FP	PPV = TP / (TP + FP)
Negative test result	FN	TN	NPV = TN / (TN + FN)
	Sensitivity = TP / (TP + FN)	Specificity = TN / (TN + FP)	

FN = false negative; **FP** = false positive; **NPV** = negative predictive value; **PPV** = positive predictive value; **TN** = true negative; **TP** = true positive.

Of the **individuals who truly have a disease** (ie, "positive condition" in the 2 × 2 table), some will have a positive test result for the disease (ie, **true positive [TP]**) whereas others will have a negative test result despite truly having the disease (ie, **false negative [FN]**). The number of FN is equal to the number of individuals who truly have the disease (ie, TP + FN) minus the number of TP:

FN = (TP + FN) − TP

Given that 200 patients truly have ovarian cancer ("positive condition"), this means that (TP + FN) = 200. To calculate TP (and subsequently determine FN), it is possible to use the sensitivity of the test (ie, a test's ability to correctly identify individuals with the disease), given by:

Sensitivity = TP / (TP + FN)

In this case, the sensitivity of the test is TP / (TP + FN) = 80% (or 0.80). Using this information, the number of TPs can be calculated:

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In this case, the sensitivity of the test is TP / (TP + FN) = 80% (or 0.80). Using this information, the number of TPs can be calculated:

Sensitivity = TP / (TP + FN)
0.80 = TP / 200
TP = 160

Now the number of FN can be determined:

FN = (TP + FN) − TP = 200 − 160 = 40

The number of TP and FN can be more quickly calculated using the following equations:

TP = (Sensitivity) × (Number of patients who truly have the disease)
FN = (1 − Sensitivity) × (Number of patients who truly have the disease)

(Choices B, C, and E) 90 is the number of false positives (FP), 160 is the number of TP, and 210 is the number of true negatives (TN) found in the study.

(Choice D) 200 is the number of individuals who truly have ovarian cancer (ie, TP + FN) in the study.

Educational objective:
False negatives (FN) refer to individuals who test negative for a disease but who truly have the disease. The number of FN can be calculated using the number of individuals who truly have the disease and the sensitivity of the test, or by using the formula: FN = (1 − Sensitivity) × (Number of patients who truly have the disease).

Biostatistics	Biostatistics & Epidemiology	Sensitivity, specificity, NPV, PPV
Subject	System	Topic

Miscellaneous

A group of geneticists plans to conduct a study on the distribution of allelic variants for a particular gene in a rat population. In the sample population of 15 rats, the genotype distribution is 5 AA, 5 Aa, and 5 aa. The phenotypes represented by the various allele combinations do not provide any specific benefit for survival. During the study, rats will be allowed to mate randomly, but no new rats will be introduced to the population. Based on the information provided, are the current allele and genotype frequencies in this population in Hardy-Weinberg equilibrium?

- A. No, because there is no selective advantage for this gene
- B. No, because this is an isolated community with no genetic diversity
- C. No, because this population size is too small
- D. Yes, because these features contribute to a stable gene pool

Proceed To Next Item

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- A. No, because there is no selective advantage for this gene (9%)
- B. No, because this is an isolated community with no genetic diversity (12%)
- ✓ C. No, because this population size is too small (47%)
- D. Yes, because these features contribute to a stable gene pool (28%)

Omitted
Correct answer
C

47%
Answered correctly

09 secs
Time Spent

2023
Version

Explanation

Hardy-Weinberg equilibrium	
Principle	• Genetic variation (ie, frequencies of alleles & genotypes) will remain constant in the absence of disturbing factors

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Principle	• Genetic variation (ie, frequencies of alleles & genotypes) will remain constant in the absence of disturbing factors
Criteria	• Large population size • Random mating • No natural selection • No migration • No spontaneous mutations

The Hardy-Weinberg principle states that genetic variation (ie, allele and genotype frequencies) will remain constant over successive generations in the absence of evolutionary forces within a population. To produce a nonevolving population in which genetic variation remains constant (ie, Hardy-Weinberg equilibrium), all of the following criteria must be met:

- **Large population size:** A large population minimizes the effect of genetic drift, which is variation in allele frequency due to chance alone. The ideal population would be infinite.
- **Random mating:** All individuals are equally likely to mate with other individuals, regardless of phenotype.
- **No natural selection:** All individuals are equally likely to survive because no particular phenotype is advantageous for survival.
- **No migration:** No individuals with unique alleles enter or exit the population.
- **No spontaneous mutations:** No appreciable rate of mutation prevents creation of new alleles within the

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The Hardy-Weinberg principle and criteria can apply to any group of organisms, and the population in this scenario satisfies certain criteria: there is random mating, and there is no natural selection, or migration **(Choices A and B)**. However, with only 15 rats, the **population is small** and therefore does not satisfy all criteria for Hardy-Weinberg equilibrium. In contrast to large populations (ie, >1000 individuals), a small population will be significantly affected by genetic drift, resulting in changing frequencies of alleles over successive generations **(Choice D)**.

Educational objective:
A population is in Hardy-Weinberg equilibrium when the frequency of alleles at a particular locus remains constant over successive generations within that population. To satisfy all criteria for the equilibrium, there must be a large population size, random mating, no natural selection, no migration, and no spontaneous mutations.

References

- Hardy-Weinberg equilibrium in the large scale genomic sequencing era.