The aim of a case-control study is to investigate the association between probiotic yogurt intake before and during pregnancy and gestational diabetes mellitus (GDM) in women age >18 during their 24 to 28 weeks of a singleton pregnancy. The investigators obtain a history of probiotic yogurt intake between cases and controls. Results of the study are shown below.

Probiotic yogurt intake during pregnancy	GDM +	GDM −	*Total*
Low	82	60	142
High	41	66	107
Total	123	126	249

Which of the following best represents the odds of high probiotic yogurt intake in women with GDM compared to women without GDM?

- A. 0.17
- B. 0.45
- C. 0.66
- D. 1.51
- E. 2.20

Proceed To Next Item

A 65-year-old man comes to the office because his family is concerned about his constant cough after smoking. The patient asks about the risk of developing chronic obstructive pulmonary disease (COPD) in adult smokers. A recent cohort study reported that compared to heavy smokers, the relative risk (RR) of COPD for nonsmokers is 0.10 and for moderate smokers is 0.40. The patient is a moderate smoker. Based on the study, which of the following is the RR of COPD for moderate smokers compared to nonsmokers?

- A. 0.10
- B. 0.25
- C. 0.40
- D. 2.5
- E. 4
- F. 10

Proceed To Next Item

A clinical study examines the usefulness of 5 different biomarkers to detect Barrett esophagus (BE), the only known precursor lesion of esophageal adenocarcinoma. Researchers evaluate the performance of each biomarker and report the sensitivity, specificity, and area under the curve (AUC) estimates.

Biomarker	Sensitivity (%)	Specificity (%)	AUC
1	41.7	83.3	0.603
2	68.0	70.8	0.758
3	70.8	91.7	0.879
4	84.0	62.8	0.763
5	91.7	58.3	0.756

Which of the biomarkers is most accurate?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

Proceed To Next Item

Drugs A and B are 2 new experimental drugs being tested for the treatment of a novel respiratory viral infection that causes acute respiratory failure and death in children. Part of the testing process is to analyze the 2-week survival after treatment to determine the clinical efficacy of the experimental drugs. A total of 60 children recently diagnosed with the disease are randomly assigned in a 1:1:1 ratio to receive Drug A, Drug B, or placebo. The absolute risk reduction of Drug A compared to placebo was found to be 0.05, whereas the absolute risk reduction of Drug B compared to placebo was found to be 0.20. Based on these results, which of the following statements comparing the effectiveness of Drugs A and B in treating children infected with the novel virus is most appropriate?

A. Drugs A and B require treating the same number of children to prevent 1 additional death, so they are equally effective

B. Drug A requires treating fewer children to prevent 1 additional death compared to Drug B, so Drug A is less effective than Drug B

C. Drug A requires treating fewer children to prevent 1 additional death compared to Drug B, so Drug A is more effective than Drug B

D. Drug A requires treating more children to prevent 1 additional death compared to Drug B, so Drug A is less effective than Drug B

E. Drug A requires treating more children to prevent 1 additional death compared to Drug B, so Drug A is more effective than Drug B

Proceed To Next Item

A suburban hospital is undergoing an annual review by a health care accreditation organization. As part of the process, iatrogenic infection rates are assessed for all major hospital services. Inpatient surgical infection statistics for the last year are shown below.

Surgical infection	Number of fatal cases	% of all fatal cases	Number of nonfatal cases	% of all nonfatal cases
Cl difficile	2	3	14	6
S aureus, methicillin-sensitive	10	13	25	11
S aureus, methicillin-resistant	40	53	70	32
E coli	10	13	50	23
Cl perfringens	1	1	1	<1
S epidermidis	2	3	30	14
Other	10	13	30	14
Total	**75**	**100**	**220**	**100**

What is the case-fatality rate for methicillin-resistant *S aureus* surgical infections in this hospital?

- A. 40/70
- B. 40/110
- C. 40/75
- D. 53/100
- E. 70/220

A pediatrician examines a population of 1,000 children with a new test to diagnose asthma. The prevalence of asthma in this population is 10%. The sensitivity of the pediatrician's diagnostic test is 95%, and the specificity is 80%. Which of the following is the likelihood that a child from this population with a positive test result really has asthma?

- A. 5 / (5 + 95)
- B. 95 / (95 + 180)
- C. 95 / (95 + 5)
- D. 720 / (720 + 180)
- E. 720 / (720 + 5)

Proceed To Next Item

A residency program organized a barbecue at the beginning of the academic year to welcome the new class of first-year residents. The total number of attendees was 100, including faculty, administrative staff, and residents. Hamburgers, hotdogs, and potato salad were served. The following day, 28 of the attendees had diarrhea and vomiting. All of the attendees were questioned about what they had eaten, and the following table was obtained:

Food item or combination of items	Number of attendees who ate food item or combination of items	Number of attendees who developed diarrhea and vomiting
Hamburgers only	15	2
Hotdogs only	12	1
Potato salad only	10	3
Hamburgers and potato salad	25	5
Hotdogs and potato salad	8	3
Hamburgers, hotdogs, and potato salad	30	14

Which of the following best describes the attack rate among all of the attendees who had potato salad?

Potato salad only	10	3
Hamburgers and potato salad	25	5
Hotdogs and potato salad	8	3
Hamburgers, hotdogs, and potato salad	30	14

Which of the following best describes the attack rate among all of the attendees who had potato salad?

- A. 8%
- B. 11%
- C. 13%
- D. 20%
- E. 28%
- F. 30%
- G. 34%
- H. 47%

Researchers develop a new test to detect the presence of a recently identified biomarker for hepatocellular carcinoma (HCC). The initial evaluation of the test shows the following:

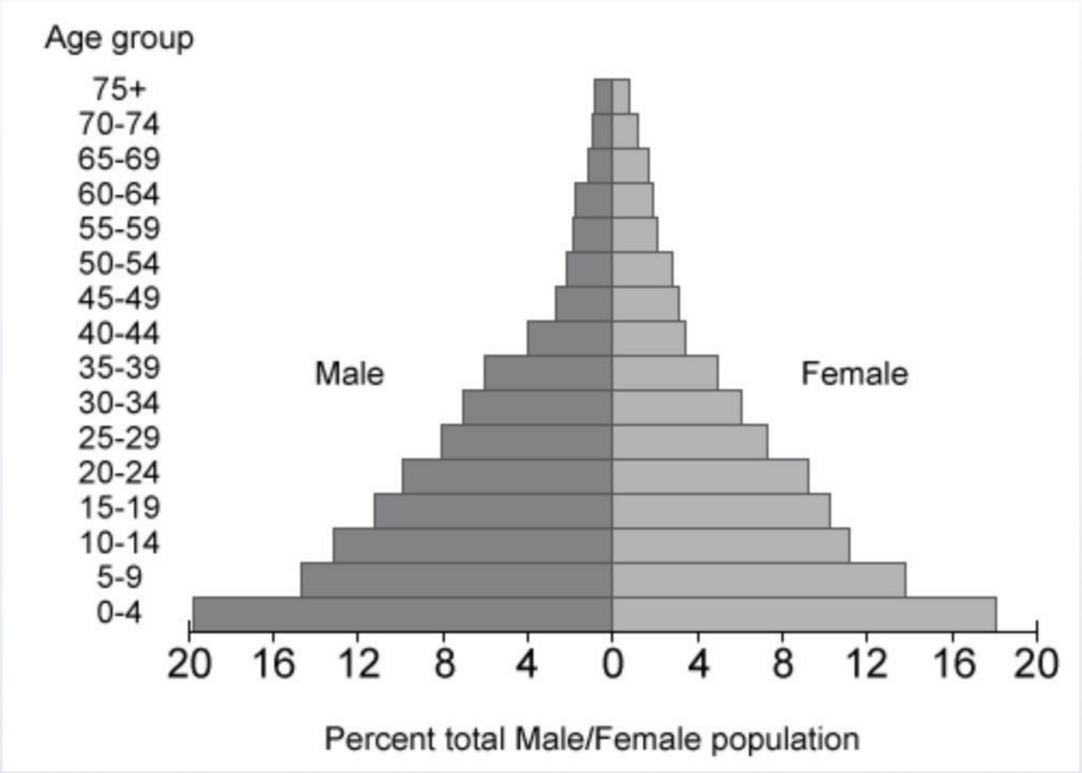
	HCC		
	Present	**Not Present**	
Test positive	45	30	75
Test negative	5	120	125
	50	150	200

Which of the following is the likelihood that a patient with a negative test does not have HCC?

- A. 0.10
- B. 0.20
- C. 0.60
- D. 0.80
- E. 0.96

Proceed To Next Item

The population pyramid of a certain country is shown below.

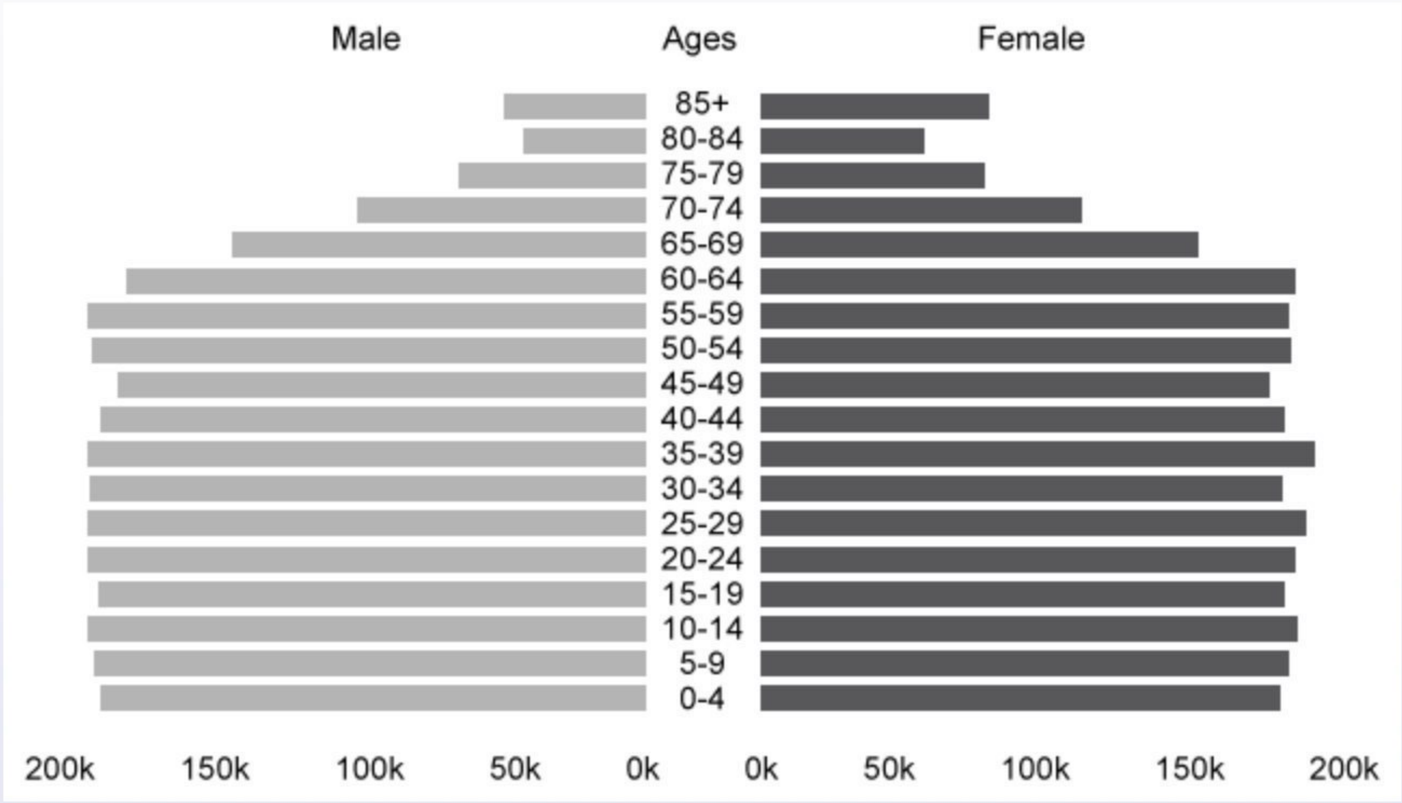


Based on the diagram, which of the following best characterizes this population?

- A. High mortality rate
- B. Long life expectancy
- C. Low birth rate
- D. Shrinking population
- E. Stable population

Proceed To Next Item

The population pyramid of all races and ethnicities for a certain state in the United States is shown below.



Which of the following statements best describes the population of this specific state?

- A. Life expectancy is low due to its high mortality rate
- B. The high birth rate indicates the population is growing
- C. The population is shrinking due to the migration of older people
- D. The similar number of people in each age cohort indicates the population is stable
- E. The state has a young population because of its high birth rate

Proceed To Next Item

Researchers at an academic trauma center conducted a randomized clinical trial comparing 2 surgical techniques (Technique A and Technique B) for repairing a mandible fracture. They examined rates of infectious complications and rates of malocclusion (defined as misaligned dental arches on visual examination when the jaw is closed). A total of 100 patients were enrolled in the study. Outcome assessments of each patient were conducted at 2 weeks, 4 weeks, and 8 weeks after surgery. Results showed that the relative rate of infection with Technique A compared with Technique B was 0.86 with a 95% confidence interval of 0.57-1.28; the 2 techniques had similar malocclusion rates at 8 weeks after surgery. Which of the following statements most accurately represents the comparison of Technique A and Technique B in a clinical care setting?

- A. Neither surgery technique is superior
- B. Technique A is superior to Technique B
- C. Technique B is superior to Technique A
- D. The techniques should not be used in a clinical care setting

Proceed To Next Item

A study is conducted to assess whether quantitative measurement of heat shock protein 90 alpha (Hsp90α) in plasma can improve diagnostic accuracy and help monitor treatment response in liver cancer patients. A total of 300 individuals (100 liver cancer patients and 200 healthy controls) participate in the study. Analyses reveal that 90 of the liver cancer patients have an abnormally high plasma Hsp90α level and that 12 of the healthy controls have an abnormally high plasma Hsp90α level. An abnormally high plasma Hsp90α level indicates a positive test for liver cancer. Which of the following values best represents the specificity of this test?

- A. 6%
- B. 10%
- C. 33%
- D. 90%
- E. 94%

Proceed To Next Item

For a case-control study designed to investigate a possible association between endometriosis and systemic lupus erythematosus (SLE), 1,040 women with SLE and 1,260 women without SLE are selected. The investigators inquire about a history of endometriosis in both groups of women. Among women with SLE, 240 had a history of endometriosis; among women without SLE, 210 had a history of endometriosis. Which of the following is the estimated odds ratio of endometriosis in women with SLE compared to women without SLE?

- A. 0.1
- B. 0.7
- C. 0.8
- D. 1.2
- E. 1.5

Proceed To Next Item

Researchers conduct a randomized controlled trial to determine whether prophylactic administration of tranexamic acid (TXA) in addition to prophylactic oxytocin in women undergoing vaginal delivery has an effect on the incidence of postpartum hemorrhage (PPH), defined as blood loss ≥500 mL. Study participants are women in labor who have a planned vaginal delivery of a live singleton at ≥35 weeks gestation. They are randomly assigned to receive 1 g TXA or placebo intravenously in addition to prophylactic oxytocin after delivery. The relative risk of PPH among women receiving TXA in addition to oxytocin is 0.80 (95% confidence interval of 0.66-0.96). Which of the following is the most appropriate conclusion about the effect of TXA in addition to prophylactic oxytocin after delivery on the risk of PPH?

- A. Adding TXA is associated with a 20% increase in the risk of PPH
- B. Receiving TXA in addition to prophylactic oxytocin decreases the risk of PPH by 80%
- C. The risk of PPH is reduced by 20% when TXA is added to prophylactic oxytocin
- D. The risk of developing PPH in the TXA treatment group is 0.8%
- E. TXA prophylaxis has no significant effect on the risk of PPH

Proceed To Next Item

A test is used to diagnose dementia in a population of 1,000 women age ≥75. The test has a sensitivity of 80% and a specificity of 90%. The test is then used as a diagnostic tool in 2 other populations of women of the same age: population 1 has a prevalence of dementia of 15%, and population 2 has a prevalence of dementia of 30%. Which of the following best describes how the negative predictive values (NPV) and the positive predictive values (PPV) from populations 1 and 2 relate to each other?

- A. NPV and PPV do not change as prevalence changes
- B. NPV in population 1 < NPV population 2; PPV in population 1 < PPV population 2
- C. NPV in population 1 < NPV population 2; PPV in population 1 > PPV population 2
- D. NPV in population 1 > NPV population 2; PPV in population 1 < PPV population 2
- E. NPV in population 1 > NPV population 2; PPV in population 1 > PPV population 2

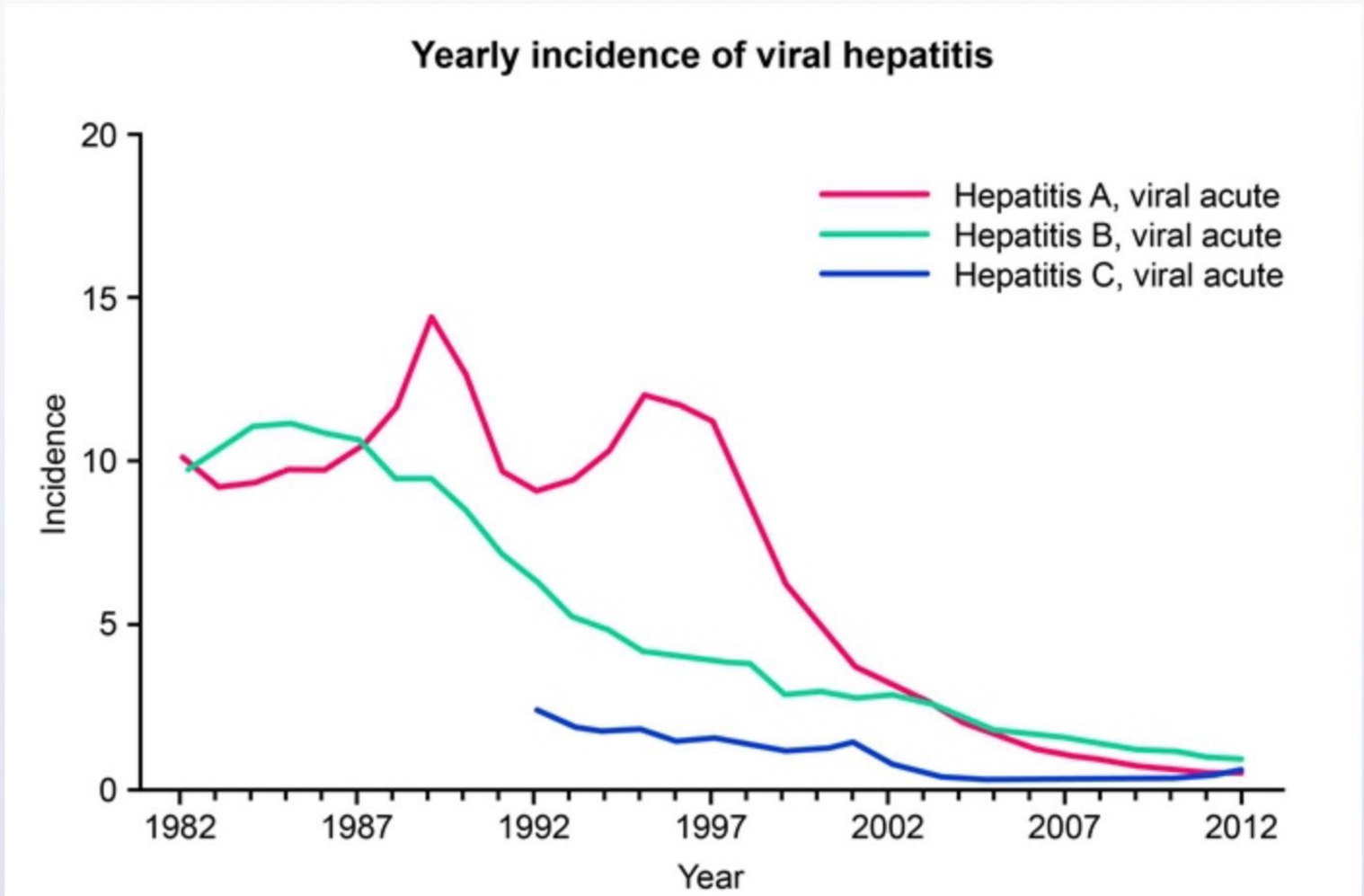
Proceed To Next Item

A healthy 31-year-old woman comes to the office as she and her husband desire a second child. The husband is infertile and the patient's son, who was conceived via donor insemination, was recently diagnosed with glycogen storage disease type II (Pompe disease). This rare autosomal recessive disease is known to affect 1 in 40,000 of the general population. Genetic testing confirms that the patient is a carrier for the disease. A different sperm donor is selected with no personal or family history of Pompe disease; however, his carrier status is unknown. What is the probability of the patient having an affected child with the new sperm donor?

- A. 1/4
- B. 1/240
- C. 1/400
- D. 1/800
- E. 1/40,000
- F. 1/160,000

Proceed To Next Item

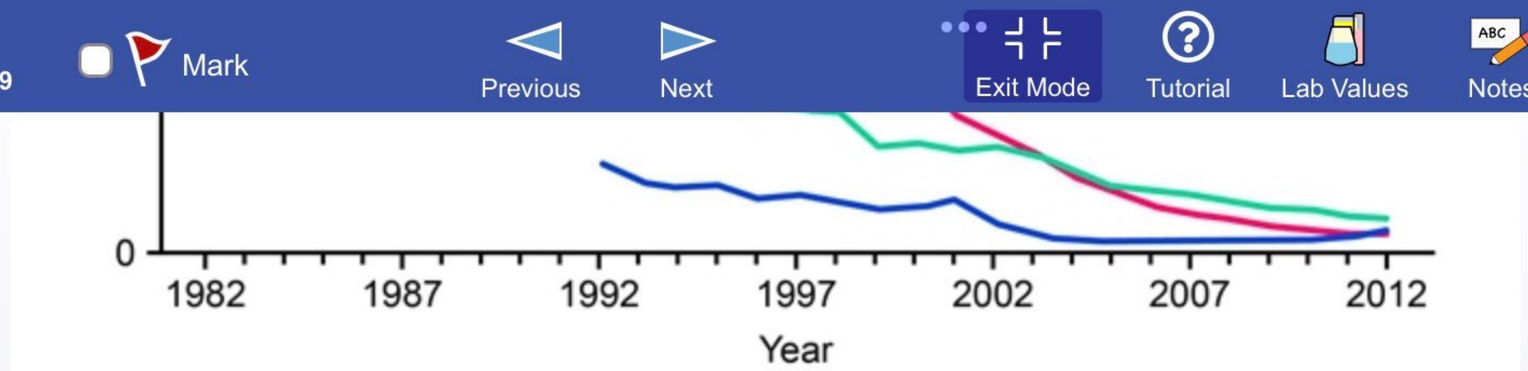
The graph below shows the yearly incidence of viral hepatitis per 100,000 population from 1982-2012 in the United States (US).



Viral hepatitis incidence (per 100,000 population) in United States, 1982-2012

During this period, the total population in the US continued to increase, as shown in the table below:

Year	1982	1987	1992	1997	2002	2007	2012
US							



Viral hepatitis incidence (per 100,000 population) in United States, 1982-2012

During this period, the total population in the US continued to increase, as shown in the table below:

Year	1982	1987	1992	1997	2002	2007	2012
US population (in millions)	~230	~243	~258	~275	~290	~303	~315

At any given time point, the number of individuals at risk for hepatitis infection is assumed to be equal to the total US population. Based on these data, which of the following is most likely to be true?

- A. After 2006, hepatitis B prevalence surpassed hepatitis A and hepatitis C prevalence
- B. In 1987, there were as many individuals with hepatitis A as with hepatitis B in the US
- C. In 1989, there were more individuals with hepatitis A than with hepatitis B in the US
- D. In 1997, there were more new cases of hepatitis A than of hepatitis B and C combined
- E. The number of new cases of hepatitis A diagnosed in 1982 and 1998 were exactly the same

Proceed To Next Item

The prevalence of a chronic disease that affects mostly older individuals has been constant in a population for the last 15 years. As a result of worsening economic conditions that have no effect on the disease itself, many young healthy individuals emigrate from the population. Which of the following is the most likely effect of the emigration on the estimate of disease prevalence over the next few years?

- A. The prevalence would decrease
- B. The prevalence would increase
- C. The prevalence would remain the same
- D. It is not possible to determine the effect on prevalence from the information given

Proceed To Next Item

A group of psychiatrists conducts a double-blind placebo-controlled randomized trial to determine the efficacy and safety of cariprazine for the treatment of depressive episodes associated with bipolar I disorder (bipolar depression) in adults. The treatment response rate was 46% for cariprazine versus 32% for placebo, and the rate for all adverse events was 7% for cariprazine versus 5% for placebo. The differences in rates were statistically significant. Which of the following is the approximate number of patients who must be exposed to cariprazine to cause harm to 1 person who otherwise would not have been harmed?

- A. 2
- B. 8
- C. 14
- D. 21
- E. 50

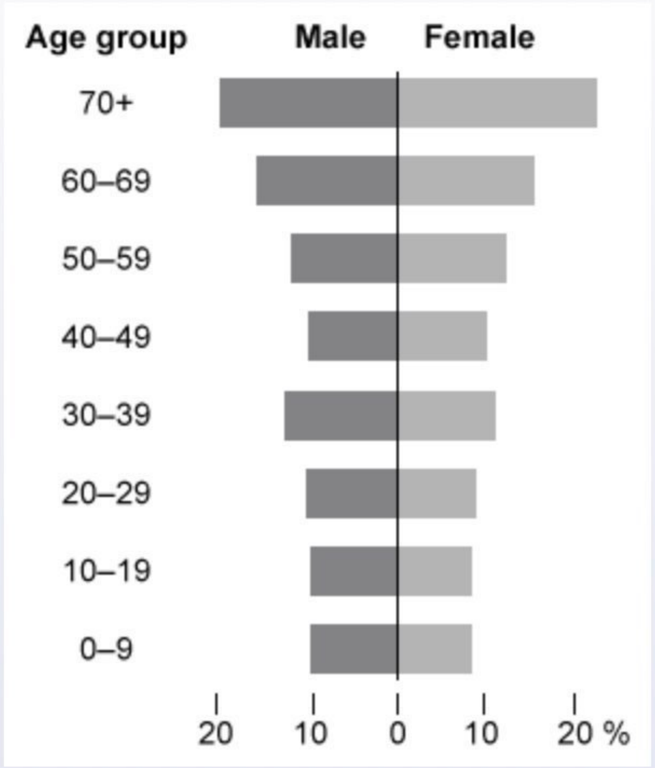
Proceed To Next Item

A study is conducted to assess the effectiveness of a new medication X added to standard antihypertensive therapy compared to standard antihypertensive therapy alone for preventing the development of proteinuria in patients recently diagnosed with essential hypertension. Five years after diagnosis, 97 of 100 patients on the medication X + standard antihypertensive therapy regimen have not developed proteinuria, and 90 of 100 patients on a standard antihypertensive therapy regimen have not developed proteinuria. According to these results, which of the following represents the approximate number of patients with essential hypertension who need to be treated with medication X to prevent an additional patient from developing proteinuria within 5 years?

- A. 3
- B. 7
- C. 10
- D. 15
- E. 70

Proceed To Next Item

A study is conducted to describe the age-sex distribution of a certain country. According to national data, the population pyramid of the country has the shape shown below.



Based on the population pyramid, which of the following is most likely true about this country and its population?

A. The country seems to have high birth rates; therefore, the population must be growing

B. The country seems to have a high death rate; therefore, the population must be shrinking

C. The country seems to have a low birth rate; therefore, the population must be old

D. The country seems to have a short life expectancy; therefore, the population must be young

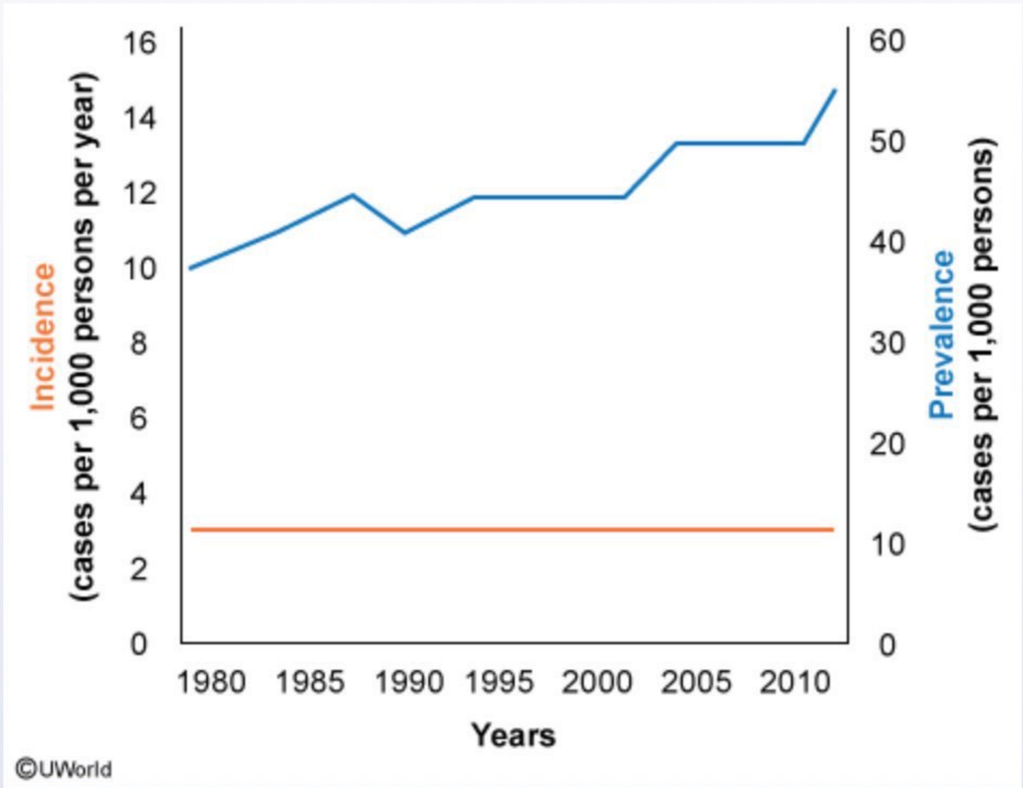
E. The country seems to have a similar percentage of people in each age cohort; therefore, the population must be stable

A state's population for 2016 was estimated at 4,000,000. At the beginning of the same year, the state reported having 20,000 cases of a rare and fatal neurodegenerative condition. At the end of 2016, the state reported 7,000 new cases, as well as 1,000 deaths attributable to this condition. Another 40,000 deaths from all other causes were also reported at the end of the year. What was the cumulative incidence of the disease in 2016?

- A. 1,000 / 4,000,000
- B. 6,000 / 3,980,000
- C. 6,000 / 4,000,000
- D. 7,000 / 3,980,000
- E. 7,000 / 4,000,000
- F. 26,000 / 3,959,000
- G. 41,000 / 4,000,000

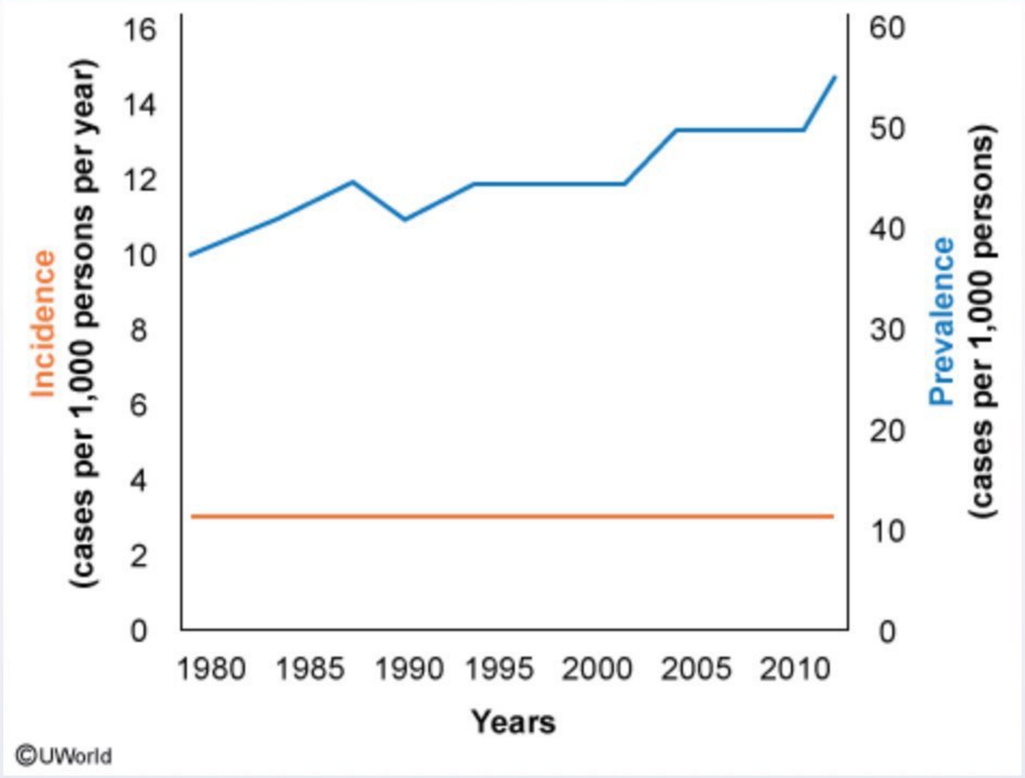
Proceed To Next Item

An epidemiological study is initiated to assess the impact of type II diabetes mellitus in a large population with little migration. Disease incidence and prevalence are monitored and recorded as the number of cases per 1,000 individuals over a 30-year period.



Which of the following is the most likely explanation for the change in disease prevalence seen in the graph?

- A. Decreased hospitalization rate
- B. High mortality in diabetics
- C. Improved quality of care
- D. Increased accuracy of diagnostic testing
- E. Increased exposure to risk factors



Which of the following is the most likely explanation for the change in disease prevalence seen in the graph?

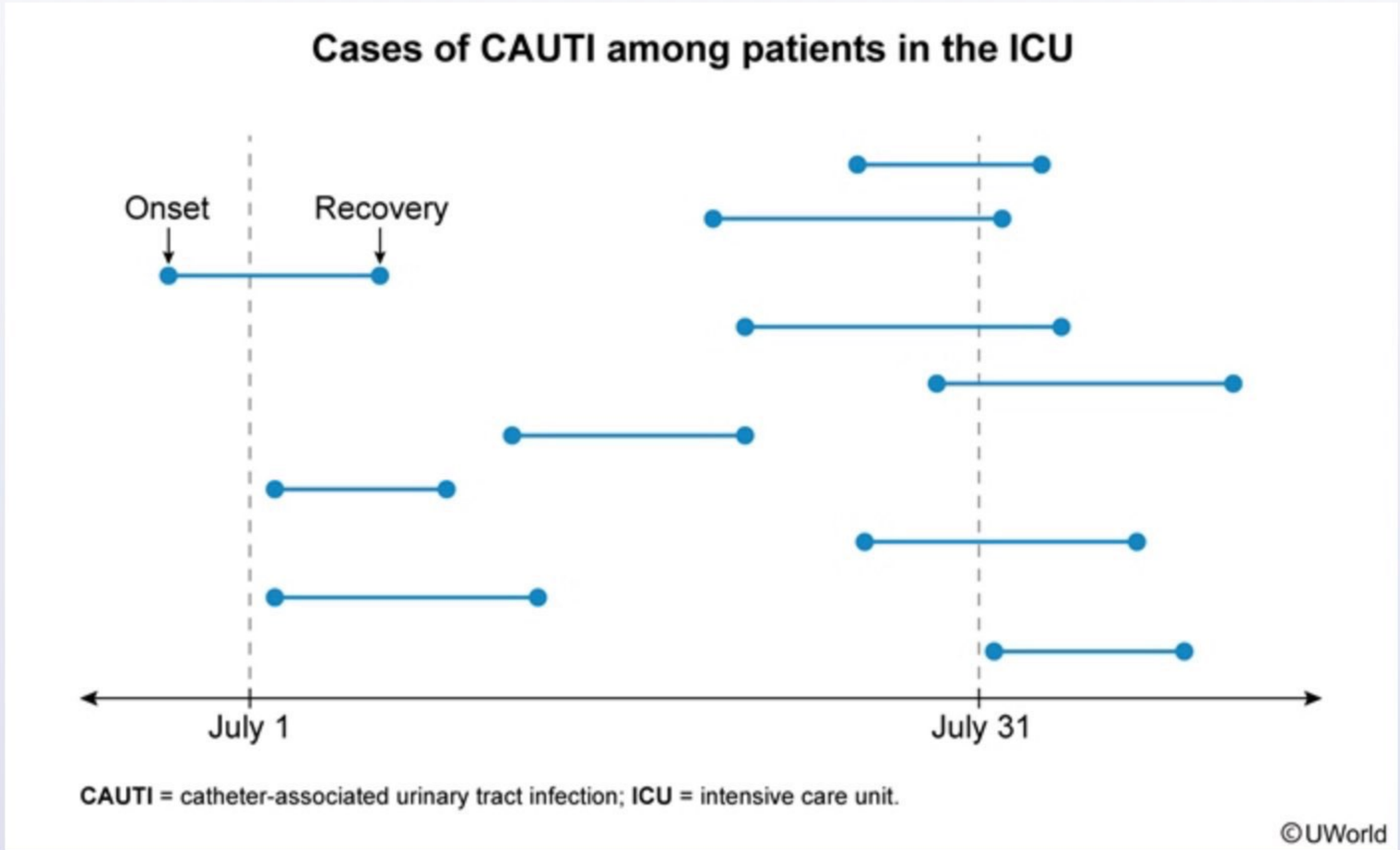
- A. Decreased hospitalization rate
- B. High mortality in diabetics
- C. Improved quality of care
- D. Increased accuracy of diagnostic testing
- E. Increased exposure to risk factors
- F. Increased number of new diabetes cases
- G. Selective survival bias

A 28-year-old woman comes to the office to establish care. She recently moved to New York to begin a job as a copy editor at a major newspaper. She has no known medical problems. The patient is in a monogamous relationship with her husband. She usually eats fast food for lunch, and she and her husband cook in the evenings. She goes to the gym about once every 2 weeks. The patient's temperature is 36.7 C (98 F), blood pressure is 118/64 mm Hg, pulse is 60/min, and respirations are 14/min. Her BMI is 24.6 kg/m^2. Physical examination is unremarkable. Laboratory results are within the normal range. Counseling this patient regarding diet and exercise habits would be an example of which of the following?

- A. Case finding
- B. Cognitive-behavioral therapy
- C. Community-level intervention
- D. Health promotion
- E. Health risk assessment
- F. Precontemplative stage intervention
- G. Tertiary prevention

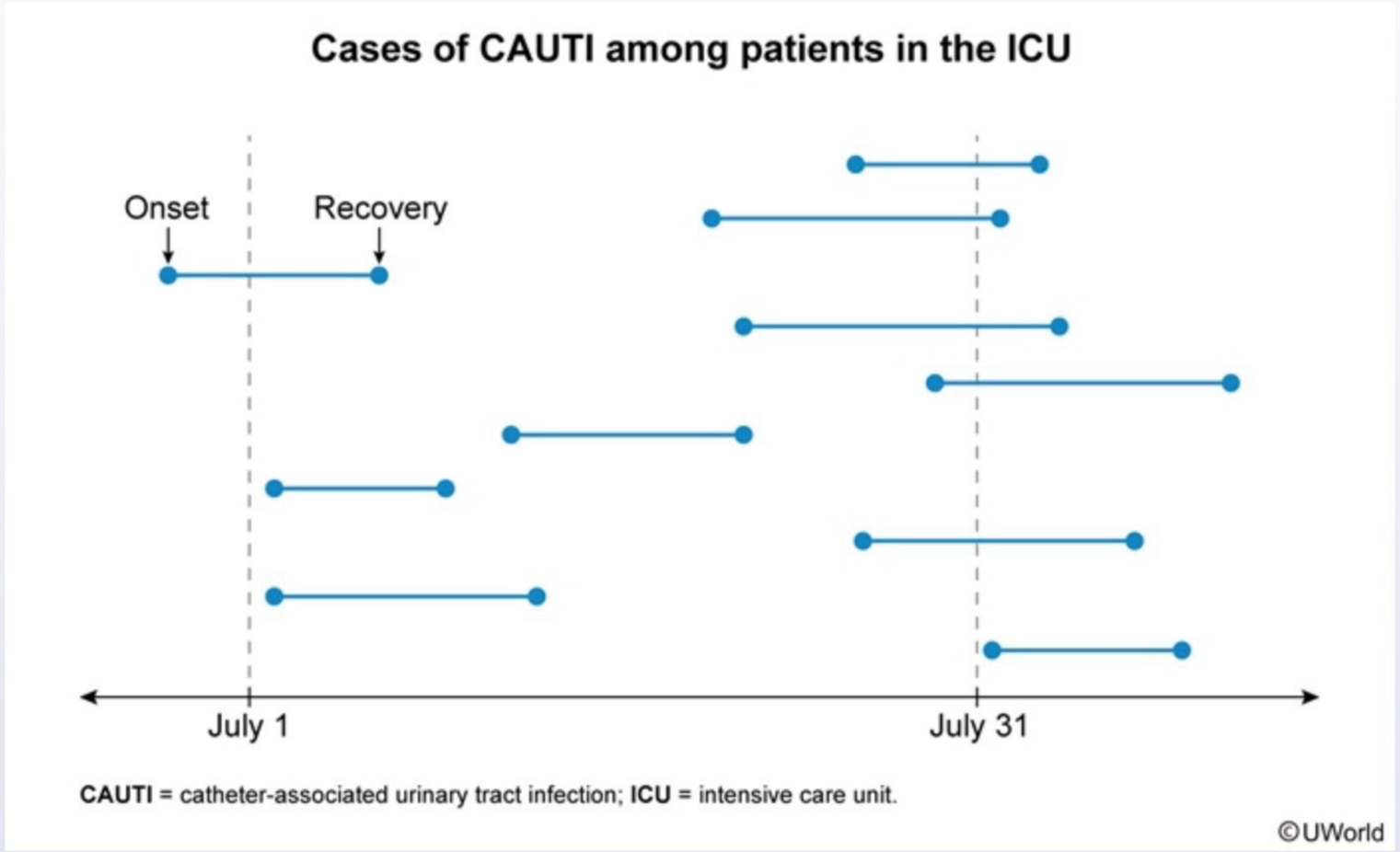
Proceed To Next Item

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?



- A. 1
- B. 4
- C. 5
- D. 8

...tal 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
- B. 4
- C. 5
- D. 8
- E. 9

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
- B. 90
- C. 160
- D. 200
- E. 210

Proceed To Next Item

A randomized controlled trial is conducted to compare transcatheter aortic valve replacement (TAVR), using a self-expanding transcatheter aortic valve bioprosthesis, with surgical aortic valve replacement in patients with severe aortic stenosis. The objective is to determine the difference in risk of death from any cause. Seven hundred forty-seven patients with severe aortic stenosis who are at increased surgical risk are recruited and randomly assigned to groups for treatment with TAVR or surgical valve replacement. Follow-up assessments are performed at discharge and at 1 month, 6 months, and 1 year. The 1-year follow-up results are as follows:

	Death from any cause		
	Yes	**No**	**Total**
TAVR	57	333	390
Surgical valve replacement	68	289	357
Total	125	622	747

Which of the following best represents the absolute risk reduction for death from any cause in patients treated with TAVR compared to those treated with surgical replacement?

- ✓ A. (68/357) − (57/390) = 0.044 (68%)
- B. [(68/357) − (57/390)] / (68/357) = 0.233 (10%)
- C. (57/390) / (68/357) = 0.767 (9%)
- D. (68/357) / (57/390) = 1.303 (2%)
- E. 1 / [(68/357) − (57/390)] = 22.562 (8%)

Omitted

Absolute risk reduction (ARR) describes the difference in risk of an unfavorable outcome between the treatment group (eg, new treatment) and the control group (eg, standard treatment):

$$\textbf{ARR} = (\text{Risk}_{\text{control}} - \text{Risk}_{\text{treatment}})$$

In this example, $\textbf{Risk}_{\textbf{control}}$ is the risk of death from any cause in the group treated with surgical aortic valve replacement and is determined by dividing the number of deaths in that group (68) by the total number of patients in that group (357). $\textbf{Risk}_{\textbf{treatment}}$ is the risk of death from any cause in the group treated with transcatheter aortic valve replacement (TAVR) and is determined by dividing 57 by 390. Therefore, the ARR for death from any cause in patients treated with TAVR compared to those treated with surgical replacement is calculated as follows:

$$\textbf{ARR} = (68/357) - (57/390) = 0.044$$

ARR can be used to determine the number needed to treat (NNT), calculated as:

$$\text{NNT} = 1 / \text{ARR}$$

NNT is the number of patients who need to be treated with a treatment (eg, TAVR) to prevent 1 additional negative event (eg, death from any cause) when compared to a control group (eg, surgical replacement). A lower NNT indicates a more effective treatment because fewer patients need to be treated to prevent 1 additional negative outcome. In this example, the approximate NNT with TAVR to prevent 1 additional death from any cause is:

$$\text{NNT} = 1 / [(68/357) - (57/390)] = 22.562$$ **(Choice E)**

(Choice B) $[(68/357) - (57/390)] / (68/357) = 0.233$ represents the relative risk reduction (RRR) for death from any cause in the TAVR group compared to the surgical replacement group: $\text{RRR} = (\text{Risk}_{\text{control}} - \text{Risk}_{\text{treatment}}) / \text{Risk}_{\text{control}}$. Unlike ARR, which quantifies the absolute difference in risk between the groups, RRR describes the

NNT = 1 / ARR

NNT is the number of patients who need to be treated with a treatment (eg, TAVR) to prevent 1 additional negative event (eg, death from any cause) when compared to a control group (eg, surgical replacement). A lower NNT indicates a more effective treatment because fewer patients need to be treated to prevent 1 additional negative outcome. In this example, the approximate NNT with TAVR to prevent 1 additional death from any cause is:

NNT = 1 / [(68/357) − (57/390)] = 22.562 **(Choice E)**

(Choice B) [(68/357) − (57/390)] / (68/357) = 0.233 represents the relative risk reduction (RRR) for death from any cause in the TAVR group compared to the surgical replacement group: RRR = ($Risk_{control}$ − $Risk_{treatment}$) / $Risk_{control}$. Unlike ARR, which quantifies the absolute difference in risk between the groups, RRR describes the difference in risk between the groups as a proportion of baseline risk (ie, risk in the control group).

(Choices C and D) Switching the numerator and denominator changes the interpretation of the relative risk (RR, the ratio of the probability of an event occuring in one group compared to the other group). In this example, (57/390) / (68/357) represents the RR of death from any cause in the TAVR group compared to the surgical replacement group; (68/357) / (57/390) represents the RR of death from any cause in the surgical replacement group compared to the TAVR group.

Educational objective:
Absolute risk reduction (ARR) describes the difference in risk between control and treatment groups. It is calculated as follows: ARR = ($Risk_{control}$ − $Risk_{treatment}$).

References

- Measures of effect in epidemiological research.
- Measures of effect: relative risks, odds ratios, risk difference, and "number needed to treat."

A group of researchers conducted a case-control study to estimate the association between exposure to a certain pesticide and head and neck squamous cell carcinomas. Controls were matched to cases by age and gender. Exposure status was determined by interviewing the subjects. On matched-pair analysis, the odds ratio is 7.5 (95% confidence interval: 2.3-14.8). Based on this information, which of the following is most likely to affect the validity of this study?

- A. Confounding bias by age (17%)
- B. Healthy worker bias (26%)
- ✓ C. Misclassification bias (36%)
- D. Nonresponse bias (17%)
- E. Placebo effect (1%)

Omitted
Correct answer
C

36%
Answered correctly

02 secs
Time Spent

2023
Version

Explanation

Misclassification bias results from an **incorrect categorization** of subjects regarding their **exposure status, outcome status, or both**.

- Nondifferential misclassification reflects equal misclassification rates between groups, making them look more similar than they are and pushing the association toward the null value (eg, odds ratio = 1) (ie, bias toward null hypothesis)

toward null hypothesis)

- Differential misclassification reflects unequal misclassification rates between groups and can push the association toward or away from the null value

Case-control studies that rely on **questionnaires or interviews** to determine **exposure status** are particularly susceptible to **misclassification bias** in the form of **recall bias**. Subjects who have experienced an adverse event such as head and neck squamous cell carcinoma (HNSCC) are more likely to recall previous potential exposures (eg, pesticide exposure) than subjects who have not experienced an adverse event.

In this case-control study, cases (ie, HNSCCs) may have a better recall of past pesticide exposures than controls (ie, no HNSCCs); this may cause differential misclassification bias when assessing exposure status.

(Choice A) Confounding bias occurs when an extraneous variable distorts the relationship between an exposure and a disease, such as when the association between pesticide (exposure) and HNSCC (disease) varies by age (confounder). In this study, cases and controls were pair-matched by age and sex; for example, a 35-year-old woman with HNSCC (case) was matched with a 35-year-old woman without HNSCC (control). This matching removes differences in age and sex between groups in the analysis, making confounding by age (and sex) very unlikely.

(Choice B) Healthy worker bias occurs in cohort studies of occupational exposures in an employed population when the comparison group is the general population. Compared to the employed population (ie, healthy enough to work), the general population can include unhealthy subjects (ie, not healthy enough to work); therefore, the mortality rate in the general population may be higher than in an employed population, and comparing mortality rates between these 2 cohorts is biased.

(Choice D) Nonresponse bias occurs when respondents differ from nonrespondents in such meaningful ways that threaten the generalizability of study results. It most often occurs when data is collected by mailed surveys or questionnaires; in this study, patients were directly interviewed, making nonresponse bias less likely.

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(Choice E) The placebo effect occurs in randomized controlled trials and refers to patients' expectations affecting an outcome. In this case, the study is a case-control.

Educational objective:
Misclassification bias is an incorrect categorization of subjects regarding their exposure, outcome status, or both. In case-control studies, recall bias usually leads to misclassification of the exposure status.

Biostatistics	Biostatistics & Epidemiology	Bias
Subject	System	Topic

A randomized controlled study investigated the effects of single-dose dexmedetomidine on emergence delirium (ED) in children who were under anesthesia induced with sevoflurane. A total of 2,500 patients age 2-7 who were scheduled for tonsillectomy were enrolled in the study; 80% were randomized to receive dexmedetomidine 0.5 µg/kg or volume-matched normal saline over 10 minutes after induction of anesthesia. The primary outcome was the incidence of ED within 30 minutes after extubating. The results show an incidence of ED of 300 cases per 1,000 patients for dexmedetomidine and 500 cases per 1,000 patients for saline. Which of the following is the best estimate of the absolute risk reduction for ED following dexmedetomidine compared to saline?

- A. 0.80 × 2,500 (0%)
- ✓ B. (500 / 1,000) − (300 / 1,000) (66%)
- C. (300 / 1,000) / (500 / 1,000) (9%)
- D. 1 / [(500 / 1,000) − (300 / 1,000)] (14%)
- E. [(500 / 1,000) − (300 / 1,000)] / (500 / 1,000) (8%)

Omitted
Correct answer
B

66%
Answered correctly

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Time Spent

2023
Version

Explanation

Common measures of therapeutic efficacy		
Term	**Definition**	**Calculation**
	Percentage indicating the actual	

Common measures of therapeutic efficacy		
Term	**Definition**	**Calculation**
Absolute risk reduction (ARR)	Percentage indicating the actual difference in event rate between control & treatment groups	ARR = control rate – treatment rate
Relative risk reduction (RRR)	Percentage indicating relative reduction in the treatment event rate compared to the control group	RRR = ARR / control rate
Relative risk (RR)	Ratio of the probability of an event occurring in the treatment group compared to the control group	RR = treatment rate / control rate
Number needed to treat (NNT)	Number of individuals who need to be treated to prevent a negative outcome in 1 patient	NNT = 1 / ARR

This randomized controlled study compared the incidence of emergence delirium (ED) in children who underwent tonsillectomy while under anesthesia induced with sevoflurane. Participants were randomized to receive dexmedetomidine 0.5 µg/kg (ie, treatment group) or volume-matched normal saline (ie, control group) over 10 minutes after induction of anesthesia. A total of 2,500 patients were enrolled in the study, but only 2,000 (= 0.80 × 2,500) were randomized into treatments **(Choice A)**. The incidence of ED was as follows:

- Dexmedetomidine (treatment group): 300 cases per 1,000 patients (or 300 / 1,000)
- Saline (control group): 500 cases per 1,000 patients (or 500 / 1,000)

- Dexmedetomidine (treatment group): 300 cases per 1,000 patients (or 300 / 1,000)
- Saline (control group): 500 cases per 1,000 patients (or 500 / 1,000)

These results indicate that the **absolute risk reduction** (ARR) (ie, control rate − treatment rate) in ED between groups is **(500 / 1,000)** − **(300 / 1,000)** = 0.20. ARR = 0.20 indicates that 20% of patients did not develop ED as a result of having received dexmedetomidine rather than saline.

(Choice C) The calculation (300 / 1,000) / (500 / 1,000) = 0.60 provides the relative risk (RR) (ie, treatment rate / control rate). RR = 0.60 indicates that the risk of ED in the dexmedetomidine group is 0.60 the risk of ED in the saline group.

(Choice D) The calculation 1 / [(500 / 1,000) − (300 / 1,000)] = 5 provides the number needed to treat (NNT) (ie, 1 / ARR). NNT = 5 indicates that 5 of the patients undergoing tonsillectomy had to be given dexmedetomidine 0.5 µg/kg over 10 minutes after induction of anesthesia with sevoflurane to avoid 1 case of ED (compared to saline).

(Choice E) The calculation [(500 / 1,000) − (300 / 1,000)] / (500 / 1,000) = 0.40 provides the relative risk reduction (RRR) (ie, ARR / control rate). RRR = 0.40 indicates that dexmedetomidine offers a 40% reduction in ED compared to saline.

Educational objective:
Absolute risk reduction (ARR) is the difference in event rate between a control group and a treatment group (ie, the percentage of patients improved by treatment). It is calculated as:

ARR = control rate − treatment rate

Biostatistics	Biostatistics & Epidemiology	Risk, rate, prevalence and incidence
Subject	System	Topic