Kaplan USMLE Step 1: Calculating a drug’s half-life

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If you’re preparing for the United States Medical Licensing Examination® (USMLE®) Step 1 exam, you might want to know which questions are most often missed by test-prep takers. Check out this example from Kaplan Medical, and read an expert explanation of the answer. Also check out all posts in this series.

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This month’s stumper

A new investigational drug is undergoing Phase I clinical trials. The half-life of this drug is nine hours. A healthy volunteer has an adverse reaction, and the drug is immediately discontinued.

How long will it take until the plasma drug level is about 6% of the initial steady state level?

A. Nine hours.
B. 18 hours.
C. 27 hours.
D. 36 hours.
E. 45 hours.
F. 54 hours.
The correct answer is D.

Kaplan Medical explains why

The rule of thumb is that the levels decrease by half every half-life. Therefore, 50% will remain after one half-life, 25% will remain after two half-lives, 12.5% will remain after three half-lives, and 6.25% will remain after four half-lives. In this case, the half-life of this drug is nine hours, so it will reach about 6% of steady state levels in 36 hours:

- One half-life: 50% drug left, time = Nine hours.
- Two half-lives: 25% drug left, time = 18 hours.
- Three half-lives: 12.5% drug left, time = 27 hours.
- Four half-lives: 6.25% drug left, time = 36 hours.
Tips to remember

- The half-life ($t_{1/2}$) is the time it takes for the plasma concentration of a drug or the amount of drug in the body to be reduced by 50%.
- 50% will remain after one half-life, 25% after two half-lives, 12.5% after three half-lives, and 6.25% after four half-lives.

For more prep questions on USMLE Steps 1, 2 and 3, view other posts in this series.