A superbug that could not be treated with 26 different antibiotics has killed a woman in the USA

The 70-year-old returned to the USA from India in August last year with an infected swelling in her pelvis. The infection arose after the woman broke her right leg. She was seriously ill when she arrived at the hospital in Nevada - her immune system was going into overdrive in an attempt to fight the infection causing inflammation throughout her body.

Eventually, she died from septic shock.

Samples of the infection taken from the wound were sent for testing to the Centre for Disease Control.

They showed she was infected with a bacterium called Klebsiella pneumoniae - which normally lives in the gut without causing any problems. However this sample proved to be resistant to all 26 available antibiotics in the USA, including the group of drugs known as carbapenems used as a 'last resort' to treat drug-resistant infections. This superbug produces an enzyme which makes them resistant to carbapenems.

The young and old are most at risk of antibiotic-resistant infections. This is because these two groups have low immunity, making them more susceptible to infection.

Such resistant bacteria are primarily created in hospital conditions. Antibiotics are used to kill bacteria, but some antibiotic-resistant bacteria propagate, spreading throughout medical centres, and beyond.

Each year in the United States, at least 2 million people become infected with bacteria that are resistant to antibiotics and at least 23 000 people die each year as a direct result of these infections.

Prof Laura Piddock commented:

"In circumstances such as this, where doctors are faced with the inability to treat a life-threatening infection, they need the flexibility to use antibiotics licensed for use in other countries and shown to be active in the laboratory against the patient's infecting bacterium."

Dr David Brown, chief scientist at Antibiotic Research UK, said: "It is still quite unusual for a bacterial infection to be resistant to such a large number of antibiotics. However, the ease of global travel does mean that such cases will increase."
Task

Using the information above and your own understanding of how antibiotic-resistant bacteria evolve, answer the following questions.

1. Which people are most at risk to resistant infections and why?

2. How many types of antibiotic are available in the USA?

3. Why are some potentially useful antibiotics not available to doctors treating patients with infections?

4. What do you know about *Klebsiella pneumoniae*?
   **Extension:** Why might doctors be particularly concerned about this bacterium?

5. Describe how antibiotic-resistant bacteria might be 'created' and spread in a hospital environment.
   **Extension:** If you were in charge of infection management in your local hospital what procedures would you put in place to prevent the spread of resistant bacteria? What role can you play in helping to reduce antibiotic resistance?

6. Using numbers with one significant figure, estimate the percentage of people who recover from infection by antibiotic-resistant bacteria.

7. How might cases of infection by drug resistant bacteria be increased by global travel?
   **Extension:** How could this risk be reduced?

8. Describe how the rise of antibiotic resistance provides evidence for the process of evolution.
**Suggested answers**

1. Young and elderly people are most at risk. They have low immunity to infection and disease.

2. 26 types

3. Prof Laura Piddock implies that different countries have different antibiotics available to doctors. Antibiotics have to be licensed for use. Perhaps if an antibiotic is available for use in one country doctors in other countries should also be free to use it.

Some may be licensed to treat one or two specific infections only but they may have been shown to be effective against other bacteria in the lab. Perhaps these should be made available without going through all the stages in drug development.

4. It is a bacterium. It is found naturally in the gut. It is normally harmless. Some forms are resistant to antibiotics.

**Extension:** It's a very ubiquitous bacterium which is found in lots of people. It could pose a serious risk to people if the ability to produce the enzyme which renders carbapenems ineffective, is passed on to other bacteria and becomes widespread.

5. The idea of mutation producing new strains some of which are resistant to antibiotics. These are not killed when exposed to antibiotics. They survive, reproduce and percentage of resistant bacteria in population increases.

**Extension:** Possible answers might include – scrupulous hygiene management and cleaning routines; reduce number of visitors; treat cases that do not involve wounds, surgery etc. in a different hospital; reduce the number of operations e.g. no cosmetic surgery.

Your role could include taking care not to spread infection; looking after your own health by cleaning teeth, eating well; not taking antibiotics for minor infections; taking the full course of prescribed antibiotics; deciding to become a research scientist in this field!

6. 2 000 000 cases

\[ 23 \text{ 000 deaths} = 20 \text{ 000 deaths (1 significant figure)} \]

\[(20 \text{ 000} \div 2 \text{ 000 000}) \times 100 = 1\% \text{ deaths therefore 99\% survive.} \]

7. Cases such as the woman from Nevada introduce new, resistant forms of bacteria into a country and its hospital environment.

**Extension:** Taking antibiotics to the patient rather than moving the infected person. Not allowing an infected person to travel if they have a resistant strain unknown in their destination country. Preventing infected people from travelling e.g. a person with TB unless they can prove themselves free of infection.

8. Bacteria reproduce at a fast rate. Mutations in bacteria produce new strains. Resistant strains are not killed by antibiotics so survive and reproduce – passing the resistant gene/ mutation to the next generation.

**Sources of information**

- [www.bbc.co.uk/news/health-38609553](http://www.bbc.co.uk/news/health-38609553)
- [www.antibioticresearch.org.uk/about-antibiotic-resistance/](http://www.antibioticresearch.org.uk/about-antibiotic-resistance/)
- [www.biotopics.co.uk/g11/antibiotic_types.html](http://www.biotopics.co.uk/g11/antibiotic_types.html)