

# Hospital Acquired and Ventilator Associated Pneumonia

A plain-English guide for you and your family

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## WHAT IS HAPPENING

Hospital-acquired pneumonia (HAP) and ventilator-associated pneumonia (VAP) are lung infections that happen when someone has been in the hospital for at least two days or has had a breathing tube in place for two days or longer. Hospitals have tougher germs than you find at home — bacteria like *Pseudomonas aeruginosa* (a water-loving germ that hides in sinks and breathing equipment), MRSA (a staph germ that laughs at common antibiotics), *Acinetobacter*, *Klebsiella*, and *E. coli*. When a breathing tube goes in, it holds the airway open so a machine can breathe for the person, but it also skips every defense the body normally uses: the nose hairs that trap dust, the cough that clears junk, and the tiny beating hairs (cilia) that sweep mucus and germs up and out like an escalator. Germs sitting on hands, bed rails, and equipment can slide right down the tube into the lungs. Once they land in the warm, moist lung tissue, they start copying themselves fast. The immune system sends white blood cells racing to the spot and cranks up body temperature to slow the germs down. The infected lung tissue leaks fluid and pus, which blocks oxygen from crossing into the blood, so oxygen levels drop and breathing gets faster and harder. On the chest X-ray, doctors see a new white cloud where the infection is. The lungs make thick, yellow or green spit to trap the germs, but without a strong cough the spit just sits there and makes things worse. The person looks sicker — tired, confused, heart pounding. This is why the care team works so hard on prevention: keeping the head of the bed tilted up, brushing teeth twice a day with a chlorhexidine rinse, suctioning spit out carefully above the tube cuff before moving the tube, and getting people off the breathing machine as soon as it is safe. When infection does happen, doctors start several strong antibiotics right away (often three at once to cover all the likely tough germs) and send spit samples to the lab to find out exactly which germ it is so they can narrow down to the right antibiotic within 48 to 72 hours.

## What you might feel

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- New fever or temperature changes
- New or worsening cough with thick, yellow or green mucus

- Faster breathing or feeling short of breath
- Low oxygen levels on pulse oximeter (hypoxemia)
- New confusion or change in mental state
- New crackling or bubbling sounds in the lungs (rales) heard with a stethoscope
- Drop in blood pressure or signs of shock
- Higher white blood cell count or a big shift in the blood differential
- New shadowy patches or white areas on chest X-ray
- Thick mucus that is hard to suction from the breathing tube (in ventilated patients)

## **Call the doctor right away if...**

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- Oxygen level below 90% even with extra oxygen, or needing a ventilator
- Blood pressure dropping despite fluids (septic shock)
- New confusion, extreme sleepiness, or difficulty waking the patient
- Breathing over 30 times per minute or using neck and chest muscles to breathe
- Kidney function worsening or urine output dropping sharply

## **What the care team will do**

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- Draw blood cultures from two different sites and collect coughed-up mucus (sputum) or endotracheal aspirate (mucus from breathing tube) for culture within 1 hour before giving the first antibiotic dose
- Start IV vancomycin and IV piperacillin-tazobactam within 1 hour of pneumonia diagnosis
- Raise the head of the bed to 30 to 45 degrees at all times unless a medical reason prevents it
- Perform oral care with chlorhexidine (germ-killing mouth rinse) or toothbrushing every 12 hours
- Do a spontaneous awakening trial (turn off sedatives) and spontaneous breathing trial (test if patient can breathe without ventilator) every morning unless contraindicated
- Turn the patient to a new position every 2 hours and get the patient out of bed to a chair daily if stable
- Suction the airway only when you hear secretions or the ventilator alarms for high pressure, not on a schedule
- Monitor temperature, white blood cell count, oxygen saturation, and chest X-ray daily to track if antibiotics are working

## Medicines you may be given — and why

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### Vancomycin

Vancomycin stops tough bacteria like MRSA (methicillin-resistant *Staphylococcus aureus*, a germ that regular penicillin drugs cannot kill) from building their protective outer wall. Without that wall, the bacteria burst open and die.

### Linezolid

Linezolid stops tough bacteria like MRSA and VRE (vancomycin-resistant enterococci) from making the proteins they need to survive. Without new proteins, the bacteria cannot grow or multiply, and they die off.

### Piperacillin-Tazobactam

Piperacillin punches holes in the protective wall of many bacteria (including *Pseudomonas* and other Gram-negative germs common in hospitals). Tazobactam shields piperacillin from bacterial scissors (enzymes called beta-lactamases) that would normally chop it up, so the combo can kill resistant bacteria.

### Meropenem

Meropenem is a powerful antibiotic that kills a very wide range of bacteria, including tough Gram-negative germs like *Pseudomonas* and *Klebsiella* and many resistant strains. It punches holes in the bacterial cell wall, causing the bacteria to burst and die. It is stable against most bacterial defense enzymes (beta-lactamases).

### Cefepime

Cefepime kills a broad range of bacteria, including many Gram-negative germs like *Pseudomonas* and *Enterobacter* and some Gram-positive bacteria. It breaks down the bacterial cell wall by binding to the proteins that hold it together, causing the bacteria to burst and die. It resists many bacterial defense enzymes.

### Aztreonam

Aztreonam kills Gram-negative bacteria like *Pseudomonas*, *E. coli*, and *Klebsiella* by breaking their cell wall. It is safe for people allergic to penicillin because its chemical shape is completely different. It does NOT work on Gram-positive bacteria like MRSA or anaerobes (bacteria that live without oxygen).

### Amikacin

Amikacin kills tough Gram-negative bacteria like *Pseudomonas* and resistant *Enterobacteriaceae* by jamming their protein-making machinery. It sneaks inside the bacteria

and causes them to build broken, useless proteins, which kills the bacteria. It is often added when other antibiotics are not enough.

### **Colistin (Polymyxin E)**

Colistin is a last-resort antibiotic for extremely resistant Gram-negative bacteria like carbapenem-resistant *Pseudomonas*, *Acinetobacter*, and *Klebsiella* (CRE). It punches holes in the bacteria's outer membrane, causing their insides to leak out and the bacteria to die. It is toxic and used only when no other options remain.

### **Where this information comes from**

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- ATS/IDSA Hospital-Acquired Pneumonia and Ventilator-Associated Pneumonia Guidelines 2016
- CDC Healthcare-Associated Infections (HAI) — Pneumonia
- IDSA Clinical Practice Guidelines
- Cochrane Reviews on hospital-acquired pneumonia

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