

Chapter 12

Prevention of Lower Respiratory Tract Infection

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Key points

- Pneumonia is the healthcare-associated infection that results in the highest mortality; prevention is therefore vital.
- Prevention measures include raising the head of the bed to facilitate chest movement, use of gloves when handling respiratory secretions and proper use, cleaning and disinfection of respiratory equipment.

Introduction

The cough reflex, together with a healthy respiratory mucosa with its ciliary epithelium, antimicrobial secretions, phagocytosis and other local immunity mechanisms, effectively prevents microorganisms from reaching the lower respiratory tract (LRT). Microorganisms are normally cleared from the LRT efficiently.

Pneumonia is the healthcare-associated infection that results in the highest mortality; prevention is therefore vital. Post-operative pneumonia is a common surgical complication, often resulting from the patient failing to cough or breathe deeply because of pain. In these patients infection is due to common respiratory pathogens.

Ventilator-associated pneumonia is a more serious condition seen in intensive care units in intubated and ventilated patients. In this group of patients, mechanical or chemical injury to the ciliated epithelium impairs the normal removal of mucus and microorganisms from the lower airways. In addition, reduction of gastric pH due to H2 blocking agents is associated with colonisation of the upper gastrointestinal tract and oropharynx by aerobic Gram-negative bacilli derived from the patient's own bowel. These microorganisms may then pass into the LRT and cause infection. These patients have usually had prolonged hospitalisation and received (sometimes several courses of) antibiotics. (See Table 12.1) Because of this, the microorganisms involved are often multidrug-resistant (MDR) opportunistic pathogens. These microbes may also be introduced into the respiratory tract via contaminated equipment or the hands of staff. However, often they are microorganisms that have first colonised the patient's bowel. (See Figure 12.1)

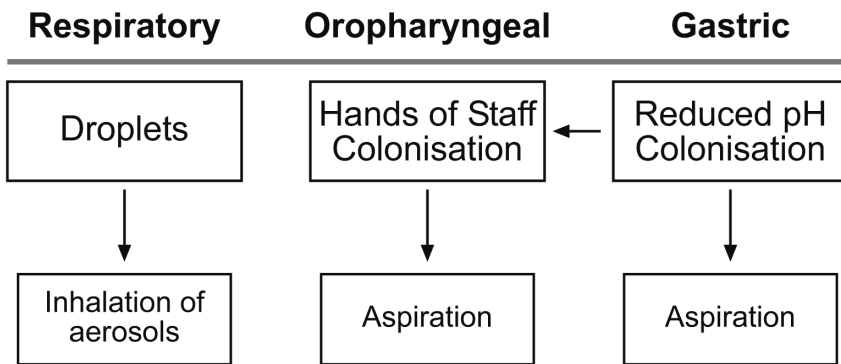
Definition and diagnosis

Healthcare-associated pneumonia is a LRT infection that appears during or after hospitalisation in a patient who was not incubating the infection on admission. It is diagnosed by the following:

- clinical signs,
- pyrexia,
- purulent sputum,

Table 12.1. Risk factors for healthcare-associated pneumonia

Condition of patient	Severely ill, e.g., septic shock Age (elderly or neonate) Surgical operation (chest \ abdomen) Major injuries Chronic obstructive lung diseases Existing cardiopulmonary disease Cerebrovascular accidents Coma Heavy smoker
Therapy	Sedation General anaesthesia Tracheal intubation Tracheostomy Prolonged artificial ventilation Enteral feeding Broad-spectrum antibiotic therapy H ₂ blockers Immunosuppressive and cytotoxic drugs

**Figure 12.1.** Mode of acquisition of healthcare-associated pneumonia

- relevant X-ray changes and
- preferably microbiological diagnosis from bronchial lavage, transtracheal aspirate or protected brush culture.

Etiologic agents of healthcare-associated pneumonia

Early onset healthcare-associated pneumonia (within one week of admission) is usually caused by community-acquired microorganisms such as *Streptococcus pneumoniae* and *Haemophilus influenzae*. Pneumonia occurs in intensive care and after surgery, particularly in patients with existing pulmonary disease.

Late onset healthcare-associated pneumonia is usually caused by Gram-negative bacilli, e.g., *Klebsiella pneumoniae*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Serratia marcescens*, *Enterobacter* species and *Acinetobacter*.

Respiratory syncytial and other respiratory viruses cause severe pneumonia spread by contact, particularly to immunocompromised patients and young children. *Legionella* infection may be acquired from the hospital air conditioning system or from water supplies, particularly by immunocompromised patients. Fungi, e.g., *Candida albicans* and, rarely, *Aspergillus fumigatus*, may also cause healthcare-associated pneumonia. *Legionella* and *Aspergillus* infections are not spread between patients.

Pneumocystis carinii causes pneumonia in immunosuppressed patients, particularly if HIV positive, however this is usually a community-acquired infection. Opportunistic pulmonary diseases caused by different mycobacteria including *Mycobacterium tuberculosis* can be transmitted to other patients.

Important Measures for Prevention

Table 12.2 outlines many of the important measures to prevent healthcare-associated pneumonia. Additional measures include:

- Hand hygiene before and after contact with patients, whether or not gloves are worn.

- Use of disposable or reprocessed gloves when handling respiratory secretions.
- Use of sterile disposable or reprocessed gloves and catheters for tracheal aspiration and tracheostomy care.
- Proper cleaning and disinfection of respiratory equipment. (See Table 12.3)
- Education of staff in patient care and cleaning areas.

Table 12.2. Basic methods of prevention

Risk	Prevention
Patients	Treat lung disease prior to surgery, if possible. Elevate head of the bed to 30°. Avoid unnecessary suctioning of airways. Oral cavity care at least 6 times a day. Deep breathing and coughing exercises before and after operation. Percussion and postural drainage to stimulate coughing. Mobilise early after operation.
Artificial ventilation	Decontamination of respiratory equipment routinely. Use ventilator tubing up to one week if a heat-moisture exchanger is in place. Do not tip condensate into patient when reconnecting ventilator tubing. Closed suction tubes are expensive and do not increase protection for staff or patients. Sterile or boiled water in humidifiers changed every 8-24 hours. Suction bottles changed daily. [Autoclaved or disposable] A ventilator-close filter changed with tubing may reduce the need to disinfect after each patient. Bacterial or viral filters have no proven efficacy.

Minimal requirements

- Adequately decontaminated equipment.
- Hand hygiene before and after patient contact.
- Gloves and disposable suction catheters for tracheal aspiration if available.
 - Change gloves between patients and procedures
 - Dispose of or decontaminate suction catheters between patients

Table 12.3. Cleaning and Disinfection of Respiratory Equipment

Risk factors	Prevention
Humidifiers	Cleaning, drying and filling with sterile distilled or freshly boiled water every 8 to 24 hours. Never store with fluid in them.
Nebulizers	Autoclaving or thermal disinfection preferred after cleaning.
Endotracheal airway tubes, face masks, tubing, ambu-bags	Autoclaving or thermal disinfection. Disposable items are safe but expensive. Chemical disinfection may be required.
Oral cavity cleaning solution	Sterile or freshly boiled water for each use.
Spirometry	Mouthpiece for each patient should be sterile, disinfected or disposable.
Endotracheal airway/suction tube	Sterile, disposable, for each procedure. May use for 24 hours on the same patient. Flush for each aspiration with sterile or freshly boiled water.
Suction bottles and tubing	Washing in detergent and dried or disinfected with solution of chlorine-releasing agent, rinsed and dried. Preferably disinfect in washing machine or autoclave or disinfect in hot water and dried. Disposables available but expensive.

References and Further Reading

1. Johanson Jr WG, Dever LL. Nosocomial pneumonia. *Intensive Care Med* 2003;29:23-9.
2. Isakow W, Kollef MH. Preventing Ventilator-Associated Pneumonia: An Evidence-Based Approach of Modifiable Risk Factors. *Sem Resp Crit Care Med* 2006;27:5-17.