

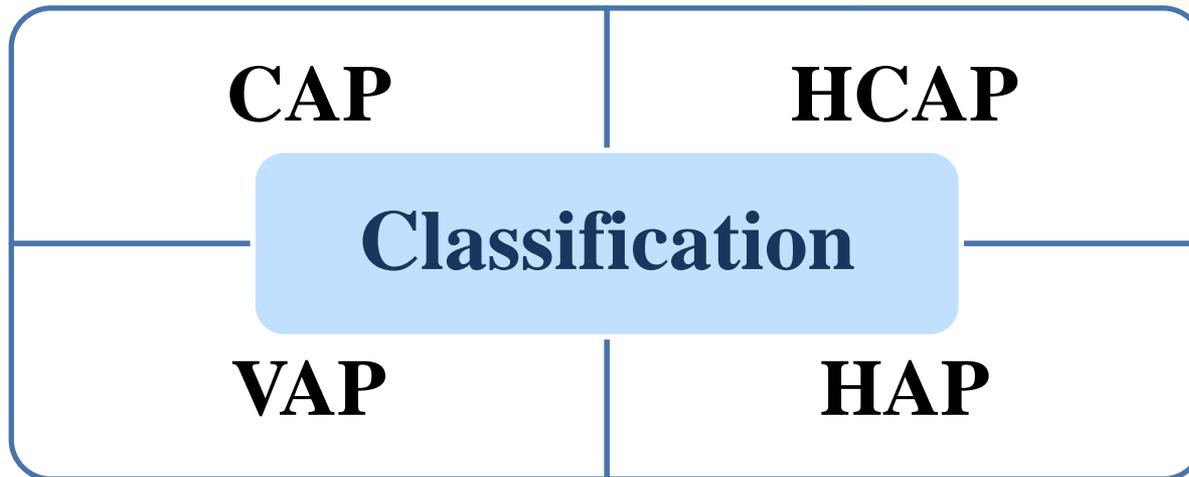
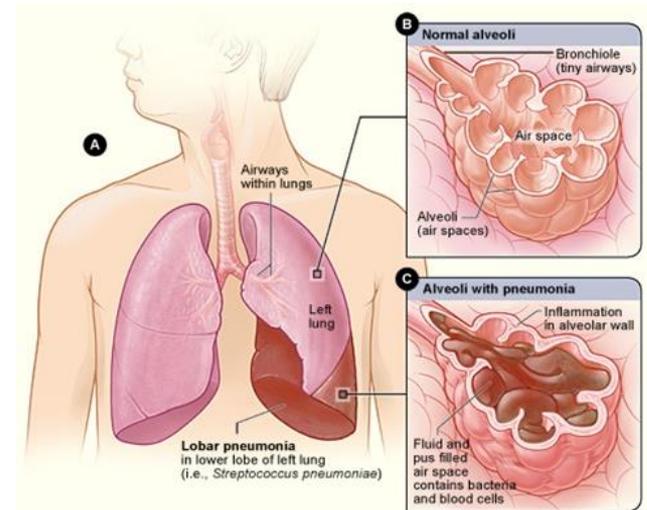
Pneumonia

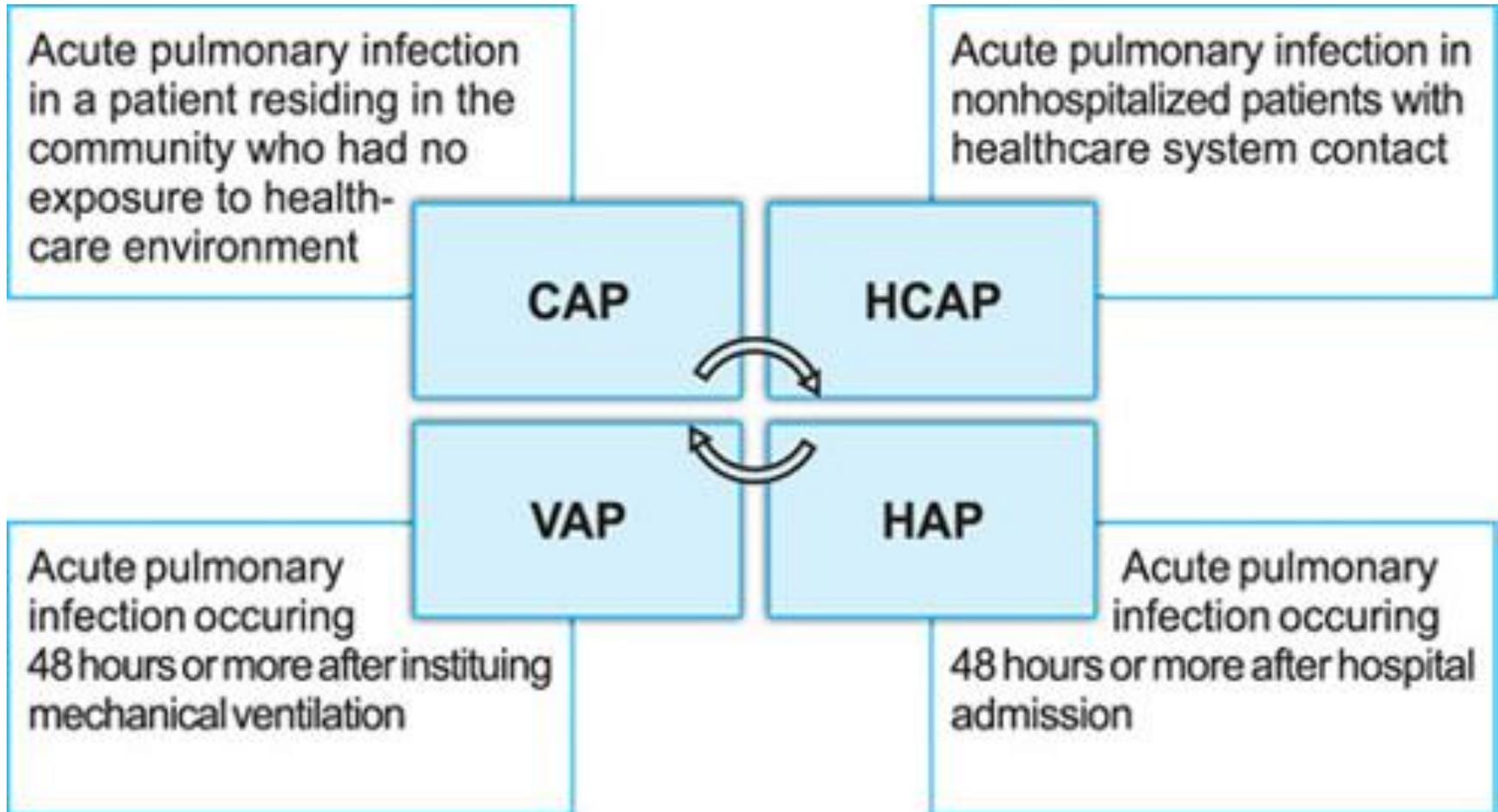
Dr.M.Jafarzadeh Infectious disease specialist



DEFINITION

- Pneumonia is an infection of the **pulmonary parenchyma**.
- Despite significant **morbidity and mortality** , it is often misdiagnosed, mistreated, and underestimated.





Pneumonia

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PATHOPHYSIOLOGY

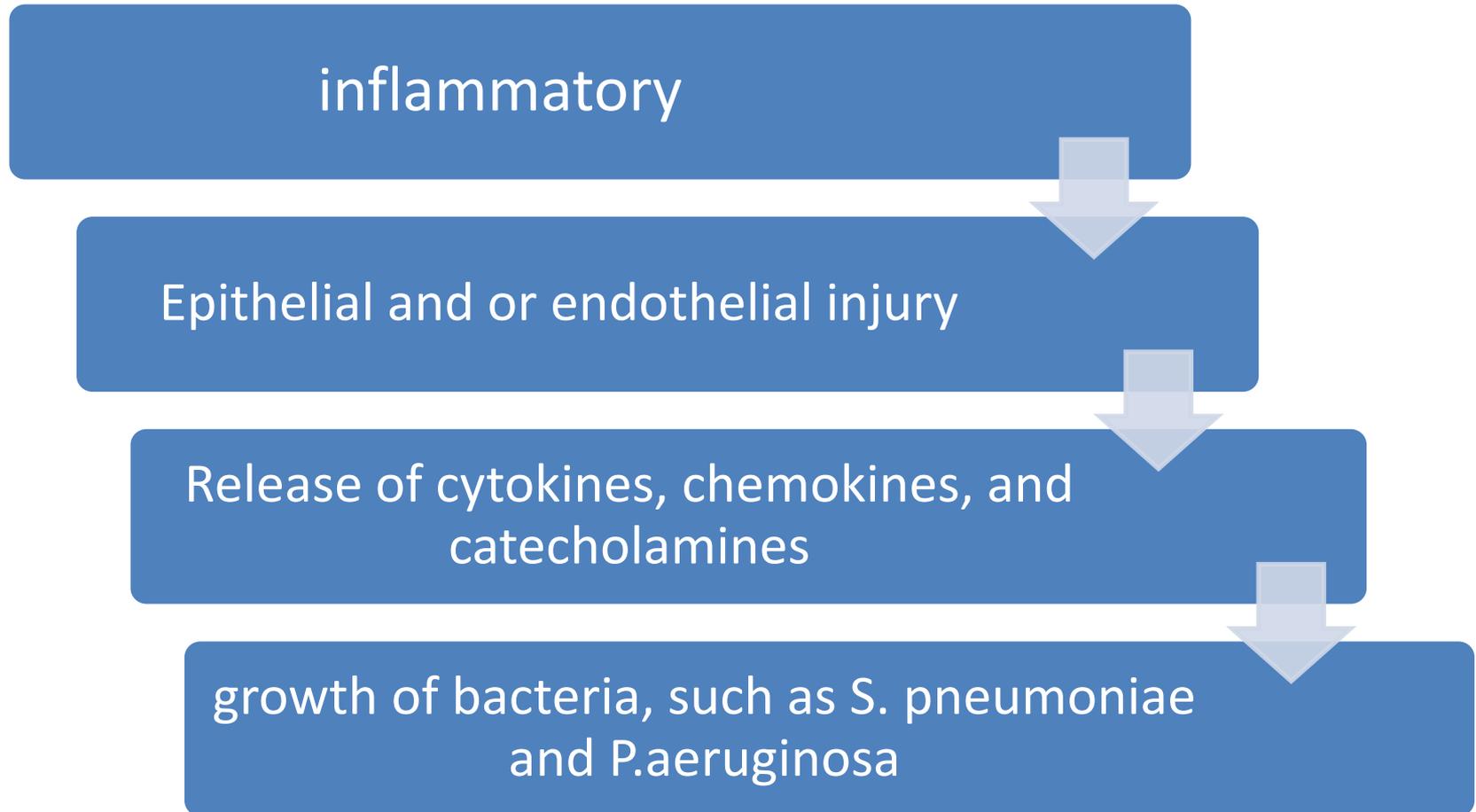
Pneumonia is the result of the :

proliferation of microbial pathogens at the alveolar level

host's response to them

Typically, this introduction occurred through **microaspiration** of **oropharyngeal organisms** into the lower respiratory tract.

A possible model for pneumonia



Inflammatory mediators

interleukin 6 and TNF

fever

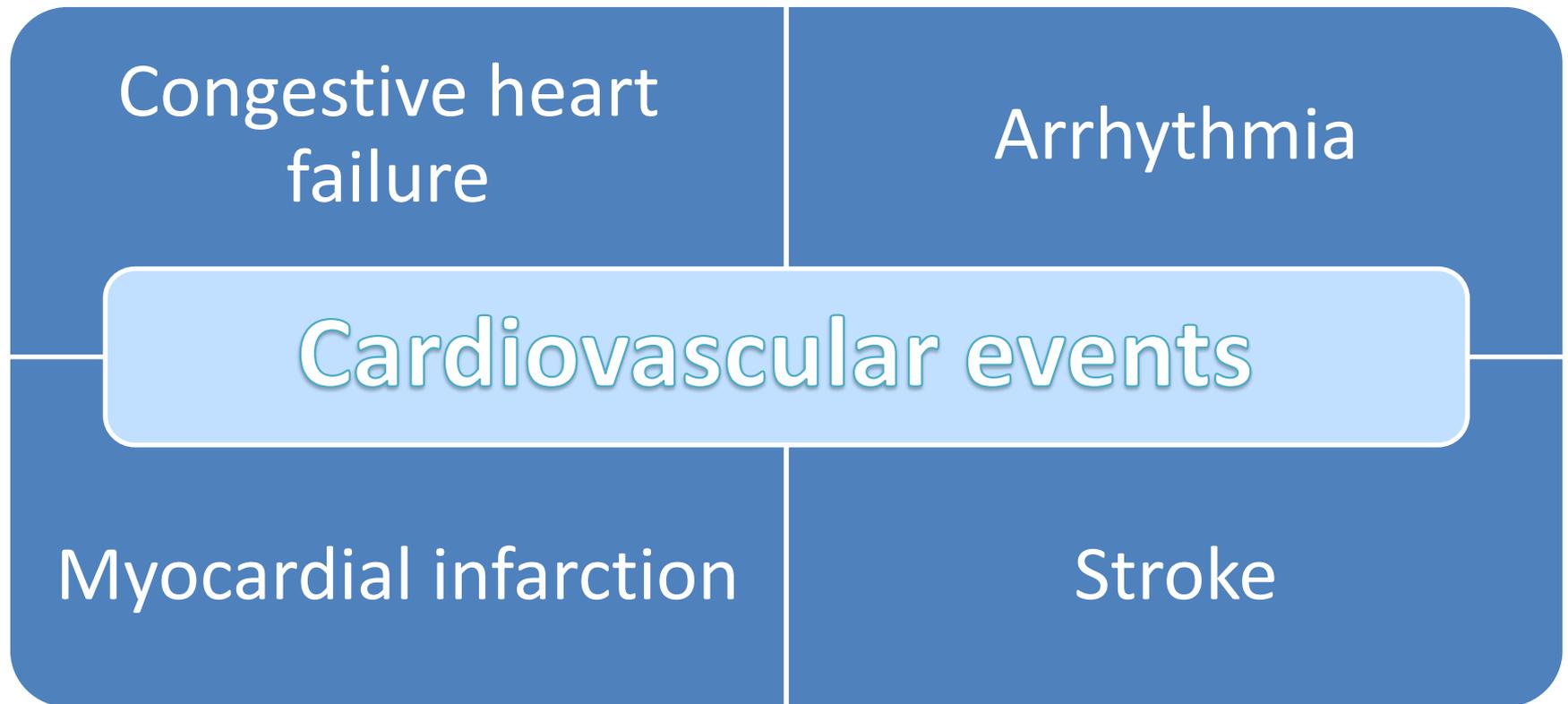
interleukin 8 and
GCSF

increase local
neutrophil
numbers

- **interleukin 6** and **tumor necrosis factor**
- **chemokines** such as **interleukin 8** and **granulocyte colony-stimulating factor**

Cardiovascular events with pneumonia

in the elderly with pneumococcal pneumonia and influenza



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Classic pneumonia

Edema

protein exudate and often bacteria in the alveoli

Red
hepatization

erythrocytes in the intraalveolar exudate

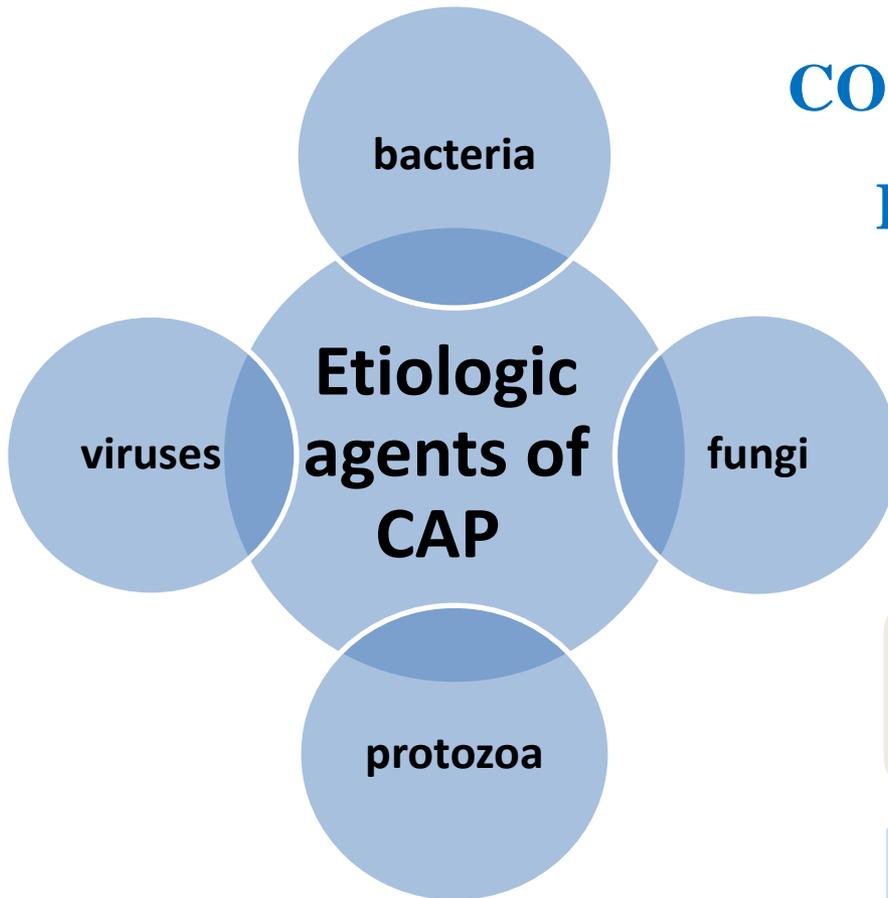
Gray
hepatization

neutrophil is the predominant cell, fibrin deposition is abundant, and bacteria have disappeared , improvement in gas exchange

Resolution

macrophage reappears as the dominant cell , debris of neutrophils, and bacteria and fibrin have been cleared

COMMUNITY-ACQUIRED PNEUMONIA (CAP)



Newer viral pathogens

- **Metapneumoviruses**
- **Coronaviruses :**
SARS , MERS , SARS-CoV-2

- severe acute respiratory syndrome ([SARS](#)) and Middle East respiratory syndrome ([MERS](#)), and the recently discovered coronavirus that originated in Wuhan, China, and is designated [SARS-CoV-2](#).

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Pathogens

Typical

- S. Pneumoniae
- Haemophilus influenzae
- S. aureus
- Gram-negative bacilli :
Klebsiella pneumoniae
P. aeruginosa.

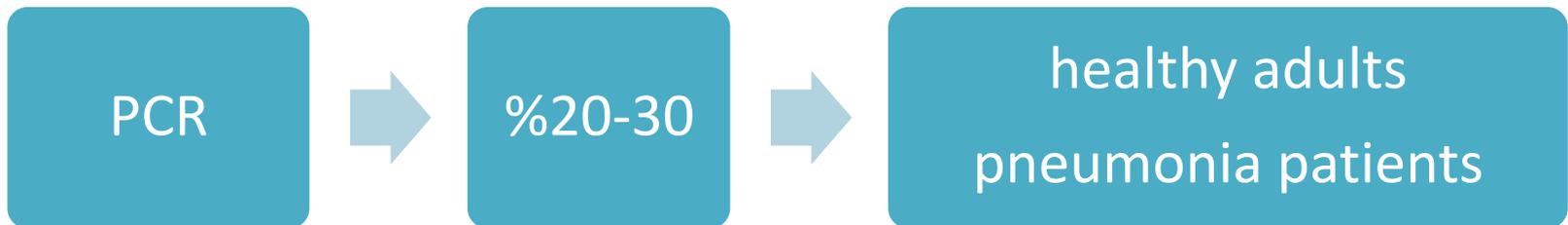
Atypical

- Mycoplasma pneumoniae
- Chlamydia pneumoniae
- Legionella
- respiratory viruses : influenza,
Adenoviruses , coronaviruses
human metapneumoviruses ,RSV



Cases due to *M.pneumoniae* and *C.pneumoniae*, however, appear to be increasing, especially among young adults.

- Viruses are recognized as increasingly important in pneumonia .
- The most common are influenza, parainfluenza, and RSV .



Atypical organisms

cannot be cultured on **standard** media or seen on **Gram's** stain, but their frequency and importance have significant implications for **therapy**.

Atypical organisms

resistant to all β -lactams and require treatment with a **macrolide**, a **fluoroquinolone**, or a **tetracycline**.

In the **10–15%** of **CAP** cases that are **polymicrobial**, the etiology usually includes a combination of **typical and atypical** pathogens.

S. aureus
pneumonia

is known to **complicate influenza**
virus infection

MRSA

as a **primary etiologic** agent of CAP &
necrotizing pneumonia

Despite a careful **history**, physical examination, and radiographic studies, the causative pathogen is often difficult to predict with certainty, and in more than **half** of cases a specific etiology is **not determined**.

TABLE 126-2 Epidemiologic Factors Suggesting Possible Causes of Community-Acquired Pneumonia

FACTOR	POSSIBLE PATHOGEN(S)
Alcoholism	<i>Streptococcus pneumoniae</i> , oral anaerobes, <i>Klebsiella pneumoniae</i> , <i>Acinetobacter</i> spp., <i>Mycobacterium tuberculosis</i>
COPD and/or smoking	<i>Haemophilus influenzae</i> , <i>Pseudomonas aeruginosa</i> , <i>Legionella</i> spp., <i>S. pneumoniae</i> , <i>Moraxella catarrhalis</i> , <i>Chlamydia pneumoniae</i>
Structural lung disease (e.g., bronchiectasis)	<i>P. aeruginosa</i> , <i>Burkholderia cepacia</i> , <i>Staphylococcus aureus</i>
Dementia, stroke, decreased level of consciousness	Oral anaerobes, gram-negative enteric bacteria
Lung abscess	CA-MRSA, oral anaerobes, endemic fungi, <i>M. tuberculosis</i> , atypical mycobacteria
Travel to Ohio or St. Lawrence river valley	<i>Histoplasma capsulatum</i>
Travel to southwestern United States	Hantavirus, <i>Coccidioides</i> spp.
Travel to Southeast Asia	<i>Burkholderia pseudomallei</i> , avian influenza virus
Stay in hotel or on cruise ship in previous 2 weeks	<i>Legionella</i> spp.
Local influenza activity	Influenza virus, <i>S. pneumoniae</i> , <i>S. aureus</i>
Exposure to infected humans	SARS-CoV-2
Exposure to birds	<i>H. capsulatum</i> , <i>Chlamydia psittaci</i>
Exposure to rabbits	<i>Francisella tularensis</i>
Exposure to sheep, goats, parturient cats	<i>Coxiella burnetii</i>

Abbreviations: CA-MRSA, community-acquired methicillin-resistant *Staphylococcus aureus*; COPD, chronic obstructive pulmonary disease; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

Pneumonia

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EPIDEMIOLOGY OF CAP

- > 5 million CAP cases occur annually in the United States.
- Influenza + CAP is the eighth leading cause of death in this country.
- CAP causes more than 55,000 deaths annually and results in more than 1.2 million hospitalizations.
- ~70% of patients are treated as outpatients and 30% as inpatients.
- The mortality rate among outpatients is usually <5% but ranges from ~12% to 40% among hospitalized patients .

EPIDEMIOLOGY OF CAP

- In the United States, CAP is the leading cause of death from infection among patients >65 years of age.
- Moreover, 18% of hospitalized CAP patients are readmitted within 1 month of discharge.
- The overall yearly CAP cost is estimated at \$17 billion.
- The overall incidence among adults is ~16–23 cases per 1000 persons per year, with the highest rates at the extremes of age.

Risk factors for CAP

- Alcoholism
- Asthma
- Immunosuppression
- Institutionalization
- Age >70 years
- Decreased cough and gag reflexes
- Reduced antibody responses increase

Risk factors for pneumococcal pneumonia

- Dementia
- Seizure disorders
- Heart failure
- Serebrovascular disease
- Alcoholism
- Tobacco smoking
- COPD
- HIV infection.

CA-MRSA

in patients with skin colonization or infection with CA-MRSA and after viral infection.

Enterobacteriaceae

hospitalized , given antibiotics , who have comorbidities such as alcoholism, heart failure, or renal failure.

P.aeruginosa

in patients with severe structural lung disease : bronchiectasis, cystic fibrosis, or severe COPD .

Legionella

diabetes, hematologic malignancy, cancer, severe renal disease, HIV infection, smoking, male gender, and a recent hotel stay or trip on a cruise ship.

VENTILATOR-ASSOCIATED PNEUMONIA(VAP)

is pneumonia that develops 48 hours or longer after mechanical ventilation is given by means of an endotracheal tube or tracheostomy .

results from the invasion of the lower respiratory tract and lung parenchyma by microorganisms.

Intubation compromises the **integrity** of the oropharynx and trachea and allows oral and gastric secretions to enter the lower airways.

Etiologic agents of VAP

NON-MDR PATHOGENS	MDR PATHOGENS
<i>Streptococcus pneumoniae</i>	<i>Pseudomonas aeruginosa</i>
Other <i>Streptococcus</i> spp.	Methicillin-resistant <i>S. aureus</i>
<i>Haemophilus influenzae</i>	<i>Acinetobacter</i> spp.
Methicillin-sensitive <i>Staphylococcus aureus</i>	Antibiotic-resistant Enterobacteriaceae
Antibiotic-sensitive Enterobacteriaceae	ESBL-positive strains
<i>Escherichia coli</i>	Carbapenem-resistant strains
<i>Klebsiella pneumoniae</i>	<i>Legionella pneumophila</i>
<i>Proteus</i> spp.	<i>Burkholderia cepacia</i>
<i>Enterobacter</i> spp.	<i>Aspergillus</i> spp.
<i>Serratia marcescens</i>	

Abbreviations: ESBL, extended-spectrum β -lactamase; MDR, multidrug-resistant.

MDR pathogens can vary significantly from hospital to hospital .

Most hospitals have problems with *P. aeruginosa* and MRSA .

Fungal and viral pathogens cause VAP , usually affecting severely immunocompromised patients.

EPIDEMIOLOGY

- Pneumonia is a **common complication** among patients requiring mechanical **ventilation**.
- Prevalence estimates vary between **6 and 52 cases per 100** patients, depending on the population studied.
- On any given day in the **ICU**, an average of **10% of patients** will have pneumonia VAP in the overwhelming majority of cases .
- diagnosis is not static but changes with the **duration of mechanical ventilation**, with the highest hazard ratio in the **first 5 days** and a plateau in additional cases (**1% per day**) after **~2 weeks**.
- The cumulative rate among patients who remain ventilated for as long as **30 days** is as high as **70%**.

Three factors are critical in the pathogenesis of VAP:

1

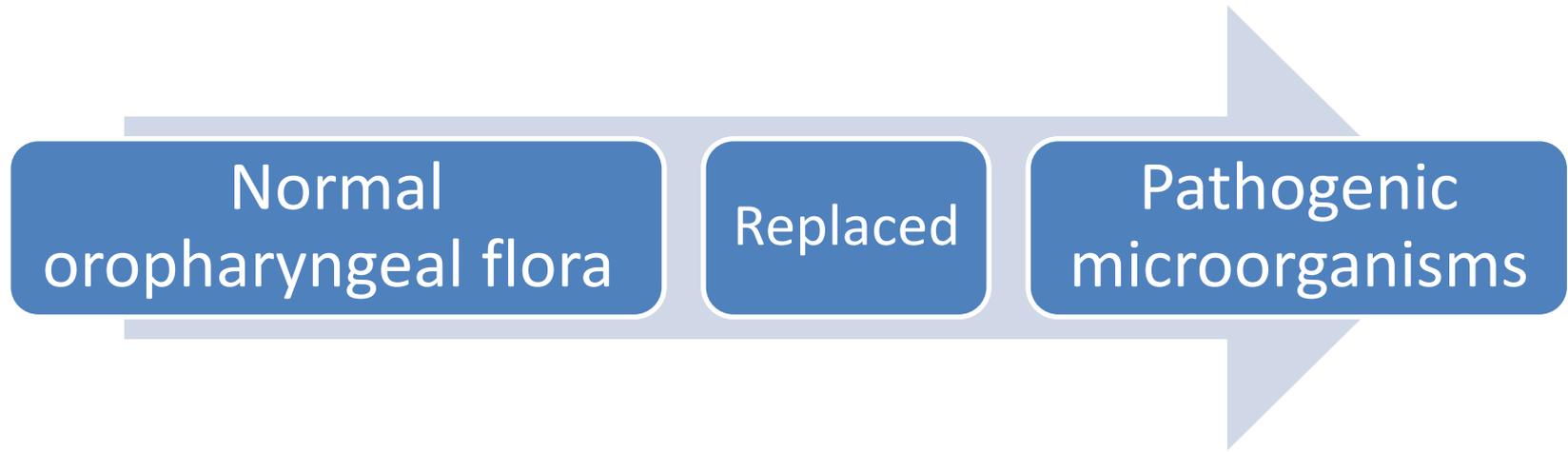
Colonization of the oropharynx with pathogenic microorganisms .

2

Aspiration of these organisms from the oropharynx into the lower respiratory tract .

3

Compromise of normal host **defense mechanisms** .



The **most important risk factors** are antibiotic selection pressure, cross-infection from other **infected/colonized patients** or **contaminated equipment**, severe systemic illness, and **malnutrition**.

Of these factors, **antibiotic exposure** poses the **greatest risk** by far.

- Almost all intubated patients experience **microaspiration** and are at least transiently **colonized** with pathogenic bacteria.
- However, only around **one-third** of **colonized** patients develop **VAP**.

Hospital-acquired pneumonia (HAP)

HAP is pneumonia that develops 48 hours or longer after admission to a hospital in nonventilated patients.

VAP and HAP are the most common nosocomial infection : 22% of hospital acquired infections.

10% of patients who required mechanical ventilation acquire VAP .

Hospital-acquired pneumonia (HAP)

HAP has been the **second most common** type of nosocomial infection and is associated with significant **morbidity and mortality**.

It is a leading cause of infection-related deaths in hospitalized patients, with attributable **mortality** rates of **20% to 33%** reported.

Higher mortality rates have been observed when patients are bacteremic or have pneumonia caused by **P. aeruginosa** or **Acinetobacter** species.

The **morbidity** associated with nosocomial pneumonia includes longer duration of mechanical ventilation and ICU and hospital stays, in addition to an attributable cost of about \$40,000.

Risk factors of nosocomial pneumonia

1

Patient related

2

Infection control related

3

Intervention related

Risk factors of nosocomial pneumonia

1 Patient related risk factors

- Age >70 years
- severe underlying disease
- malnutrition
- coma
- metabolic acidosis

- comorbid illnesses :
- COPD
- Alcoholism
- Azotemia
- CNS dysfunction

Risk factors of nosocomial pneumonia

2 Infection control related risk factors :

- Lack of hand hygiene
- Glove-use practices
- The use of contaminated respiratory equipment

Risk factors of nosocomial pneumonia

3 Intervention-related risk factors :

- Sedatives and narcotics
- Corticosteroids and cytotoxic
- The prolonged use of antibiotics
- Surgical procedures, especially involving the chest and abdomen

50% to 60% of cases of nosocomial pneumonia

Aerobic gram-negative bacilli, with members of the family Enterobacteriaceae :

- *K. pneumoniae*
- *Escherichia coli*
- *Serratia marcescens*

- *Acinetobacter*
- *Enterobacter*
- *Pseudomonas*

Nosocomial pneumonia

S. aureus causes 13% to 40% of nosocomial pneumonia

MRSA strains now are major pathogens in this setting.

S. pneumoniae and *H. influenzae* together cause only about 5% to 15% of nosocomial pneumonia .

predominantly seen in infections developing early in the hospital course.

Health care–associated pneumonia (HCAP)

A distinct syndrome that is a hybrid of
CAP and HAP

After extensive outpatient contact with
health care system

A new clinical classification of pneumonia

Health care–associated pneumonia (HCAP)

Hospitalized for 2 or more days within 90 days of developing infection

Patients attending hospital or hemodialysis clinics

Patients receiving intravenous antibiotic therapy, Wound care , Chemotherapy at home within 30 days of developing infection

Residents of long-term care facilities or nursing homes.

aerobic gram-
negative bacilli :

P. aeruginosa

S. pneumoniae

HCAP

mixed aerobic-
anaerobic

S. aureus : MRSA

**the overall mortality is higher in patients with HCAP
(10.3%–19.8%) than in CAP (4.3%–10%)**

Pneumonia in the Setting of Aspiration

The clinical setting in which aspiration :

any disease state in which **consciousness** is altered

Abnormal **gag and swallowing** reflexes

illnesses predisposing to **dysphagia** either from neurologic disease or upper gastrointestinal tract disease or surgery

conditions leading to mechanical disruption of **glottic closure** such as tracheostomy or nasogastric tubes

10% of cases from the community and in 30% of cases from continuing care facility cases.

The bacteriologic findings in aspiration pneumonia

Reflect the microbiota of the oropharynx

Anaerobic alone or in combination with oral aerobic

Bacteroides , Porphyromonas , Prevotella , Fusobacterium

Anaerobic gram-positive cocci

A purple rectangular tag with a hole on the left side is the central focus. It is placed on a light brown cork surface. A thin, light-colored wooden ring is looped around the tag. Three white daisies with yellow centers are scattered around: one in the foreground to the right of the tag, and two in the background, one slightly to the left and one to the right, both out of focus.

Thank
you!