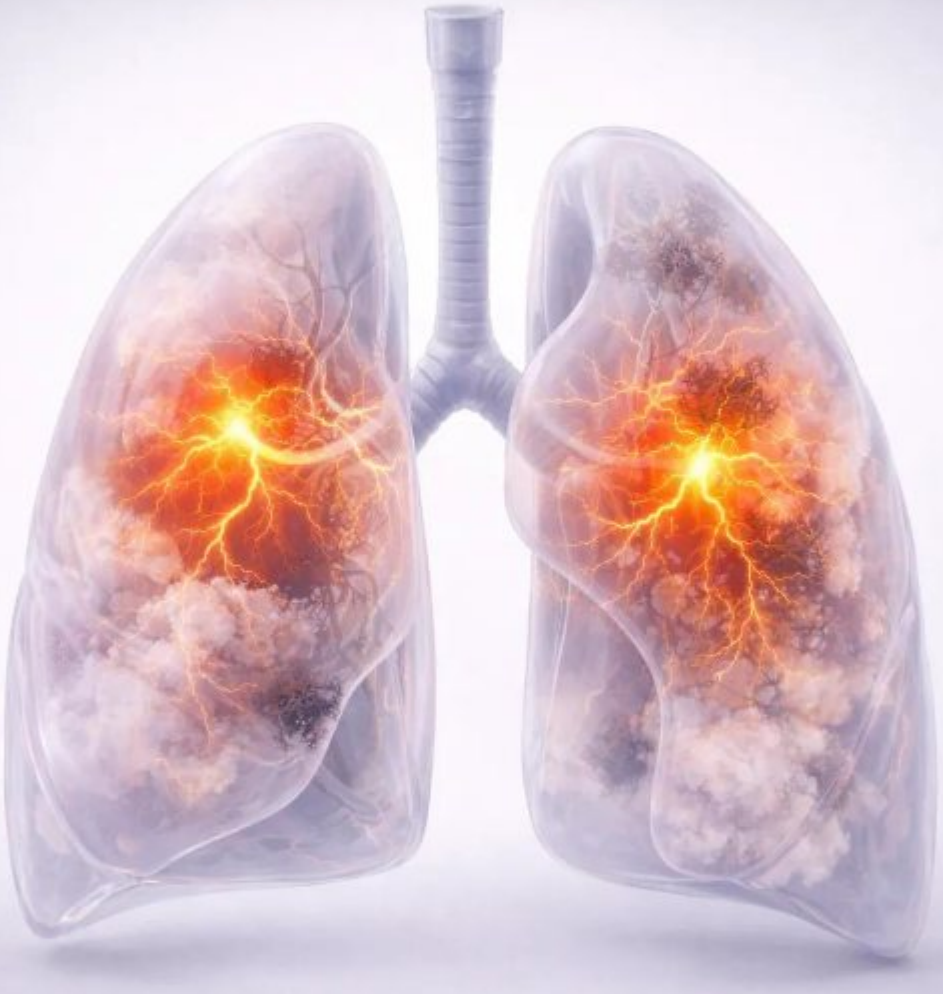
PNEUMONIA

National Standard Treatment Guideline



Ministry of Health
Republic of Maldives

ADB

JFPR
Japan Fund for Prosperous and Resilient Asia and the Pacific

From the People of Japan

World Health Organization
Maldives

National Standard Treatment Guidelines

- Acid Peptic Disease
- Acute Anxiety
- Acute Pancreatitis
- Acute Psychosis
- Acute kidney Injury
- Arrhythmia
- Chronic Liver Disease
- Chronic Pancreatitis
- Chronic kidney disease
- Congenital Heart Diseases
- Dementia
- Depression
- Diabetes Mellitus Type 1
- Diabetes Mellitus Type 2
- Gestational Diabetes
- Epilepsy
- Heart Failure
- Hyponatremia
- Hypernatremia
- Hypokalemia
- Hyperkalemia
- Interstitial Lung Disease
- Liver Failure
- Obesity
- Obstructive Sleep Apnoea
- Osteoarthritis
- Ovarian Cancer
- Pneumonia
- Stroke
- Upper Gastrointestinal bleed
- Unstable Angina

Version No	Version Date	Description of change
1	8 November 2025	Initial release

DOCUMENT NUMBER: MOH-QA/G/25/238-0

Technical Lead and Editor

Dr. Sangeeta Sharma
Professor, Neuropsychopharmacology, Institute of Human Behaviour & Allied Sciences (IHBAS) & President (Honorary), Delhi Society for Promotion of Rational Use of Drugs (DSPRUD), New Delhi, India

Technical Contributors and Reviewers for STGs

Maldivian Contributors

INTERNAL MEDICINE

Dr. Fathimath Nadia
Senior Consultant in Internal Medicine,
Indira Gandhi Memorial Hospital (IGMH), Male', Maldives

Dr. Moosa Murad
Senior Consultant in Internal Medicine,
Indira Gandhi Memorial Hospital (IGMH), Male', Maldives

Dr. Ibrahim Hassan
Senior Specialist Registrar Internal Medicine,
Medical Director of Kulhudhuffushi Regional Hospital.

Dr. Aminath Munaza
Consultant in Internal Medicine, Hulhumale' Hospital

Dr. Mihuna Ibrahim
Consultant in Internal Medicine, Hulhumale' Hospital

Dr. Ahmed Zooshan
Consultant in Internal Medicine, Indhira Gandi Memorial Hospital

Dr. Shivir Sharma Dahal
Consultant in Internal Medicine, ADK Hospital

Dr. Quraisha Haneef
Consultant in Internal Medicine, ADK Hospital.

Dr. Muhammad Asad UR Rehman Khan
Consultant in Internal Medicine, Tree Top Hospital.

ENDOCRINOLOGY

Dr. Ibrahim Faisal
Consultant in Endocrinology, Indhira Gandi Memorial Hospital.

Dr. Mariyam Niyaz
Consultant in sub specialist in Endocrinology,
Indhira Gandi Memorial Hospital.

Dr. Mohamed Shiruhan
Consultant in sub specialist in Endocrinology,
Indhira Gandi Memorial Hospital.

NEPHROLOGY

Dr. Ahmed Abdulla
Consultant Sub specialist in Nephrology,
Indhira Gandi Memorial Hospital.

RHEUMATOLOGY

Dr. Ibrahim Sujau
Consultant Sub specialist in Rheumatology,
Indhira Gandi Memorial Hospital.

Dr. Sariu Ali Didi
Consultant in Rheumatology, ADK Hospital.

PSYCHIATRY

Dr. Shanooha Mansoor
Consultant in Psychiatry, Indhira Gandi Memorial Hospital.

Dr. Shooga Moosa
Consultant in Psychiatry, Indhira Gandi Memorial Hospital.

Dr. Abdulla Nazim
Consultant in Psychiatry, Indhira Gandi Memorial Hospital.

GASTROENTEROLOGY

Dr. Abdullah Isneen Hilmy
Consultant Sub specialist in Gastroenterology,
Indhira Gandi Memorial Hospital.

PULMONOLOGY

Dr. Mohamed Ismail
Consultant in Pulmonology, Indhira Gandi Memorial Hospital

ORTHOPEDICS

Dr. Ahmed Azim Abdul Shukoor
Consultant in Orthopedics, Hulhumale' Hospital

CARDIOLOGY

Dr. Mohamed Shaneez Najmy
Consultant in Cardiology, Indhira Gandi Memorial Hospital

Dr. Migdhaadh Shareef
Consultant in Cardiology, Indhira Gandi Memorial Hospital

Dr. Aishath Eleena
Consultant in Pediatric Cardiology, Indhira Gandi Memorial Hospital

EMERGENCY MEDICINE

Dr. Fahira Ahmed Rasheed
Consultant in Emergency Medicine,
Indhira Gandi Memorial Hospital

ENT

Dr. Ahmed Shifaz
Consultant in Otolaryngology,
Indhira Gandi Memorial Hospital

OBSTETRICS & GYNAECOLOGY

Dr. Hawwa Inaya Abduraheem
Consultant in Obstetrics and Gynaecology,
Hulhumale' Hospital

Dr. Aminath Juhaina Hameed
Consultant in Obstetrics and Gynaecology,
Hulhumale' Hospital

Dr. Nashwa Samir Hussein Abdulla
Consultant in Obstetrics and Gynaecology,
Medica Hospital

Dr. Shirmeen Mohamed
Consultant in Obstetrics and Gynaecology,
Indhira Gandi Memorial Hospital

PAEDIATRICS

Dr. Abbasa Abdul Hamid
Consultant sub specialist in Paediatric Neurology, Hulhumale' Hospital

Dr Ismail Ejaz Ali
Consultant in Paediatrics, ADK Hospital

Dr.Nusaiba Farouk Hassan
Consultant in Paediatrics, Indhira Gandi Memorial Hospital

Dr. Amany Naseer
Consultant in Paediatrics and Medical Director of
Addu Equatorial Hospital

RADIOLOGY

Dr. Basma Ibrahim Sobir
Consultant in Radiology, Indhira Gandi Memorial Hospital

DENTAL

Dr. Nadeema Rasheed
Consultant in Orthodontics,
Indhira Gandi Memorial Hospital.

MEDICAL OFFICERS

Dr. Suha Abdul Shakoor
Medical Officer, B. Atoll Hospital

Dr. Aishath Maurisha
Medical Officer, Gan Regional Hospital

Dr. Mohamed Hishaam
Medical Officer, Shaviyani Atoll Hospital

Dr. Aishath Shurooq Waheed
Medical Officer, Shaviyani Atoll Hospital

DSPRUD contributors

ENDOCRINOLOGY

Dr. SV Madhu
Director Professor, Department of Endocrinology, Center for Diabetes, Endocrinology and Metabolism, UCMS & GTB Hospital, New Delhi

NEPHROLOGY

Dr. Anil Yadav
Additional Medical Superintendent (Admin), Department of Medicine, UCMS & GTB Hospital, New Delhi.

Dr. Likhita V
Senior Resident and Postgraduate Nephrology Trainee, CMC Vellore.

PSYCHIATRY

Dr. R.K. Chadda
Former Professor & Head, Department of Psychiatry, AIIMS, New Delhi; Consultant, Amrita Hospital, Faridabad, Haryana.

Dr. Amit Khanna
Associate Professor, Department of Psychiatry, IHBAS, New Delhi.

NEUROLOGY

Dr. Suman Kushwaha
Professor, Department of Neurology, IHBAS, New Delhi.

Dr. Mridula Rastogi
Assistant Professor, Department of Neurology, IHBAS, New Delhi.

Dr. Manoj Kumar Sharma
Professor, Department of Hepatology, Institute of Liver and Biliary Sciences (ILBS), New Delhi.

Dr. Monika Jain
Head, Gastroenterology, Balaji Action Hospital, New Delhi.

Dr. Ekta Gupta
Professor, Dept of Clinical Virology, Nodal Officer WHO CC, ILBS, New Delhi

PULMONOLOGY

Dr. Anup R Warrier
Senior Consultant, Infectious Disease Specialist, Aster Medicity, Kochi, Kerala, India.

Dr. Amit Mandal
Pulmonologist & ICU Specialist, Senior Director, Paras Hospital, Panchkula, Haryana, India.

Dr. Manvir Bhatia
Founder, Neurology & Sleep Centre; Vice President, Indian Society of Sleep Research

Dr. Ashok Rajput
Chief Consultant & Pulmonologist, Morpheus Lung & Sleep Clinic, CK Birla Hospital, New Delhi.

Dr. Rajendra Prasad
Director Medical Education & Professor, Respiratory Medicine, Era University, Lucknow, Uttar Pradesh, India.

Dr. Nikhil Gupta
Associate Professor, Department of Medicine, Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, Uttar Pradesh, India.

ORTHOPEDICS

Dr. Sumit Sural
Director Professor & Head, Department of Orthopedics, MAMC & LN Hospital, New Delhi.

Dr. N.V. Kamat
Former Director General Health Services, Govt. of NCT Delhi; Executive Vice President, DSPRUD

CARDIOLOGY

Dr. M.S.S. Mukharjee
Senior Interventional Cardiologist, Pulse Heart Center, Hyderabad

Dr. Neeraj Nishchal
Additional Professor, Department of Medicine, AIIMS, New Delhi.

Dr. Prerna Garg
Senior Resident, Cardiology, AIIMS, New Delhi

Dr. R. Krishna Kumar
Pediatric Cardiology, Amrita Hospital, Kochi

Dr. Aashima Dabas
Professor, Pediatrics, LN Hospital, New Delhi

EMERGENCY MEDICINE

Dr. Vanitha Rajagopalan
Assistant Professor, Critical & Intensive Care, Department of Anesthesiology, AIIMS, New Delhi

OBS & GYNAE ONCOLOGY

Dr. Amita Suneja
Former Director Professor, Department of Obstetrics & Gynaecology, UCMS & GTB Hospital, Delhi.

Dr. Poonam Joon
Deputy Medical Superintendent, Head of Department Obstetrics & Gynaecology, Sanjay Gandhi Memorial Hospital; Secretary, DSPRUD, New Delhi

Endorsed by

Uza. Thasleema Usman
Commissioner of Quality Assurance
Ministry of Health, Male', Maldives

Published by

Quality Assurance and Regulations Division
Ministry of Health, Male,
Republic of Maldives

GUIDELINES DEVELOPMENT METHODOLOGY

The development of the Maldives Standard Treatment Guidelines (STGs) followed a structured, evidence-informed, and consensus-driven methodology adapted from internationally accepted guideline-development standards and the Delhi Society for Promotion of Rational Use of Drugs (DSPRUD) model. The process combined systematic evidence retrieval, critical appraisal, contextual adaptation, and multidisciplinary expert review to ensure feasibility, clinical relevance, and national ownership.

1. Determining Scope and Priority Conditions

Priority clinical conditions were identified through consultation with national programme managers, specialty clinicians, and health-system stakeholders. Selection criteria included: (i) major causes of morbidity and mortality, (ii) observed variation in clinical practice or prescribing patterns, (iii) potential to improve patient outcomes, and (iv) the feasibility of implementation across health-facility levels in Maldives. The final list of diseases reflected national epidemiology, service-delivery capacity, and essential-medicine availability.

2. Identification of Existing Evidence and Source Guidelines

A targeted search strategy was used to identify high-quality existing clinical guidelines. Searches were conducted across international guideline repositories (e.g., WHO, NICE, SIGN and other intergovernmental bodies, international and national guideline repositories, specialty societies and professional associations.

3. Quality Appraisal of Source Guidelines

Retrieved guidelines were screened for transparency of development, methodological rigour, clarity of recommendations, applicability to health-system reality, editorial independence. Guidelines were included if they met the Institute of Medicine (IOM) definition of a clinical guideline and addressed treatment or management of priority conditions. Guidelines that did not meet minimum quality standards, review articles, diagnostic criteria, or technical standards were excluded.

4. Adoption, Adaptation, and Contextualization

The guideline-development team employed an adopt–adapt–contextualize model:

- **Adoption**: High-quality recommendations that aligned with Maldivian health-system realities were retained without modification.
- **Adaptation**: Recommendations were modified when local considerations such as diagnostic capacity, medicine availability, workforce skills, referral pathways, or cost constraints affected feasibility.

- **Contextualization**: Where evidence was absent or inconclusive, conditional recommendations were formulated based on expert consensus, with explicit consideration of pragmatism, safety, and local workflows.
  Medicines were selected in alignment with the Maldives National Essential Medicines List (NEML), based on suitability, efficacy, safety, and availability.

5. Expert Consensus and Multidisciplinary Input

Draft recommendations were initially prepared by experts from the DSPRUD, India, providing a strong methodological foundation for the process. Building on this, a collaborative and participatory process brought together clinicians from internal medicine, paediatrics, obstetrics-gynaecology, surgery, emergency medicine, endocrinology, cardiology, general practitioners, and public health representing different levels of healthcare. Consensus was achieved through moderated discussions, iterative revisions, and resolution of divergent views. For topics lacking strong evidence, recommendations were derived from expert clinical judgment grounded in extensive practice experience.

6. Drafting, Peer Review, and Validation

Each guideline section was organized in a standard format including key clinical features, essential investigations, non-pharmacological management, pharmacological therapy (with step-up/step-down options where relevant), referral criteria, paediatric considerations, and follow-up requirements. Drafts were peer-reviewed by senior clinicians and national experts. Reviewer comments were systematically integrated to strengthen clarity, accuracy, and applicability.

7. Addressing Conflicts of Interest

All contributors declared the absence of conflicts of interest. Individuals with potential or perceived conflicts were excluded from authorship or decision-making roles.

8. Updating and Future Revisions

The STGs were conceptualized as a living document. Future updates will incorporate new scientific evidence, changes in essential-medicine availability, national programme priorities, and user feedback from clinicians. Periodic review cycles will ensure the continued relevance and reliability of recommendations.

9. Distinctive Features of the Guidelines

Developed through a collaborative process involving a large group of multidisciplinary experts from different levels of healthcare, the guidelines incorporate the following distinctive features:

- **Diagnostic Assumption and Confirmation**: While assuming that an initial diagnosis has been established by the healthcare provider, the guidelines provide essential information for confirming diagnoses. This includes a comprehensive overview of major signs and symptoms, descriptions of confirmatory tests, and clear guidance on practices that are prohibited, discouraged, or unreliable—promoting evidence-based medicine supported by relevant references.
- **Comprehensive Treatment Approach**: The guidelines offer a systematic, up-to-date framework for managing medical conditions across the continuum of care. They begin at the primary care level and extend to secondary and tertiary care, incorporating protocols for treatment response assessment and referral criteria as integral components.
- **Diverse Treatment Modalities**: Recommendations encompass both non-pharmacological and pharmacological interventions and surgical intervention where applicable, providing flexibility for individualized treatment plans. Cautionary notes are included where necessary to ensure safe and effective use of therapies.
- **Assessment and Referral Criteria**: Clear criteria and goals for evaluating patient response to treatment are provided, along with guidance on when referral to higher levels of care is warranted ensuring continuity and comprehensiveness in patient management.

ACKNOWLEDGEMENTS

The Government of the Republic of Maldives is committed to ensuring universal access to quality health services for all citizens. The Constitution of Maldives mandates the progressive realization of rights, including the right to good standards of health care for the population. In line with this national commitment, standardized quality health services are regarded as the foundation of a strong and equitable healthcare system.

This important work would not have been possible without the cooperation and support of many individuals and institutions. We express our sincere appreciation to the Honourable Minister of Health, Abdullah Nazim Ibrahim, for his leadership, commitment, and continuous guidance throughout the development process. We are grateful to WHO and ADB for their significant contribution, support, and technical assistance.

Our heartfelt gratitude is extended to the technical lead and editor, Dr. Sangeeta Sharma, Professor, Neuropsychopharmacology, IHBAS and President, Delhi Society for Promotion of Rational Use of Drugs (DSPRUD), and her team. We express our deepest appreciation to the Maldivian and DSPRUD experts and contributors who played a pivotal role in this process. Their technical expertise and dedication to adapt the standards to the Maldivian context have been instrumental in the development and finalization of these guidelines. The time, experience, generous sharing of knowledge and insights contributed by all parties have not only enriched the work but also have been invaluable in making these standards practical, locally acceptable, and aligned with the needs of the resident population.

It is important to acknowledge the immense efforts, involvement, timely coordination, collaboration, and dedication of the Quality Assurance and Regulation Division team who made it possible for these Clinical Treatment Guidelines to come into existence.

Uza. Thasleema Usman

Commissioner of Quality Assurance
Ministry of Health, Male', Maldives

PNEUMONIA

QUICK REFERENCE GUIDE

Pneumonia is a major global health concern, causing about 2.18 million deaths in 2021, with the highest burden in older adults (≥65 years) and those with comorbidities such as COPD, diabetes, and cardiovascular disease. Mortality and severity rise sharply with age and frailty, and outcomes depend on early recognition and guideline-based management. Most mild cases resolve with treatment, but severe cases can lead to respiratory failure, sepsis, or death if not promptly managed.

Definition

Pneumonia is an acute infection of lung parenchyma, presenting with systemic and respiratory symptoms and a new infiltrate on chest imaging. It is classified by where it's acquired: community-acquired pneumonia (CAP), meaning pneumonia acquired outside the hospital setting; hospital-acquired pneumonia (HAP), which develops 48 hours or more after hospital admission and was not incubating at admission; and ventilator-associated pneumonia (VAP), which arises 48 hours or more after endotracheal intubation. Aspiration pneumonia occurs due to inhalation of oropharyngeal/gastric contents (risk with dysphagia, reduced consciousness).

Causes, Risk factors & Triggers

- **Common pathogens (CAP):** Streptococcus pneumoniae, Haemophilus influenzae, atypical (Mycoplasma, Chlamydophila, Legionella), respiratory viruses (influenza, SARS-CoV-2).
- **Risk for Gram-negative bacilli (GNB):** Recent hospitalization/IV antibiotics (≤90 d), bronchiectasis/COPD, structural lung disease.
- **Risk for MRSA (methicillin-resistant Staphylococcus aureus):** Prior MRSA, post-influenza necrotizing pneumonia, recent healthcare exposure, injection drug use.
- **Aspiration risk:** Stroke, dementia, seizures, dysphagia, poor dentition, tube feeding.
- **Host factors worsening outcomes:** Age ≥65, frailty, heart failure, chronic kidney/liver disease, diabetes, immunocompromise, smoking.
- **Triggers:** Viral surges, air pollution peaks, travel to TB or melioidosis-endemic regions.

Evaluation for Diagnosis

- **Clinical features**: New/worsening cough (± sputum), dyspnea/rapid breathing, pleuritic chest pain, fever (or hypothermia in elderly), fatigue/myalgia. In older adults: confusion/delirium.

Tachypnea: Respiratory rate (RR) ≥30/min = severity marker; RR ≥22/min (qSOFA - quick Sequential Organ Failure Assessment) flags sepsis risk.

- **Physical examination**: Crackles/rales, bronchial breath sounds, dullness to percussion, ↑ tactile fremitus, signs of distress (accessory muscle use, cyanosis).
- **Laboratory investigations:** Complete blood count, urea/creatinine, liver enzymes, CRP (C-reactive protein)/PCT (procalcitonin) if available. Blood cultures (get two blood cultures before antibiotics in severe disease); sputum for Gram stain/culture when good quality is available urinary antigens (pneumococcal/Legionella) per severity/epidemiology. Add TB NAAT on sputum/BAL when clinical or radiographic flags exist.

Confirmation of diagnosis

Diagnosis in Adults without Immunocompromising Conditions (IDSA) requires all of the following:

1. New pulmonary infiltrate(s) on chest imaging and
2. ≥1 respiratory symptom and
3. ≥1 other sign/finding from the lists below.

Category	Criteria
Imaging (required)	New infiltrate(s) on chest imaging (CXR preferred)*.
Respiratory symptoms (≥1 required)	New or increased cough; new or increased sputum production; dyspnea; pleuritic chest pain.
Other signs or findings (≥1 required)	Abnormal lung sounds (rhonchi or rales); fever ≥38.0 °C (≥100.4 °F); leukocytosis or unexplained bandemia (above lab normal limits); hypoxia (SpO_2 <90% on room air or significant drop from baseline).

Note: A negative CXR does not rule out pneumonia; false negatives may occur in early disease, neutropenic states, dehydration, or infections such as Pneumocystis jirovecii pneumonia. If suspicion remains high with a negative chest radiograph: obtain CT chest to evaluate for occult infiltrates/complications or if atypical pattern raises melioidosis, TB, abscess, or fungal disease

Immunocompromised (exclude from this pathway): inherited or acquired immune deficiency; drug-induced neutropenia; active cancer chemotherapy; HIV with low CD4 counts; solid-organ or bone-marrow transplant recipients.

Classification / Severity assessment criteria

Severe CAP: ≥1 major (invasive ventilation; septic shock needing vasopressors) or ≥3 minor (e.g., RR ≥30, PaO_2/FiO_2 ≤250, multilobar infiltrates, confusion, BUN ≥20 mg/dL, WBC <4k, platelets <100k, Temp <36°C, hypotension needing fluids).

Site-of-Care Decisions

- **CURB-65:** Confusion, Urea >7 mmol/L, RR ≥30, BP (SBP <90 or DBP ≤60), Age ≥65.
  0-1 outpatient (if safe), 2 admit/ observe, ≥3 severe - consider higher level of care.
- **CRB-65 (no urea):** For primary care/resource-limited settings.
- **PSI (Pneumonia Severity Index):** Detailed risk classes I-V (hospital-based).

Differential Diagnosis

- Viral respiratory infection (including COVID-19), acute bronchitis, COPD/ asthma exacerbation, heart failure with edema, pulmonary embolism/infarct, tuberculosis, lung malignancy, aspiration pneumonitis, pleural effusion/empyema, interstitial lung disease flare, atelectasis.

Management Goals & principles

- Restore oxygenation/ventilation; eradicate pathogen; prevent progression (sepsis/ARDS/empyema); minimize adverse effects; plan safe discharge and follow-up.
- Start empiric antibiotics promptly after cultures are drawn (when feasible). Reassess at 48-72 h and de-escalate based on data and clinical response.

Approach to management

1. **Site of care**: Use CURB-65/CRB-65/PSI + clinical judgment to choose outpatient vs ward vs ICU.
2. **Early bundle (first hours)**: Oxygen to target SpO_2 ≥92% (or baseline), fluids if hypotensive, obtain cultures where indicated, start empiric antibiotics.
3. **Monitoring**: Reassess at 6-12 h, 24-48 h, then daily - vitals, work of breathing, oxygen needs, urine output, labs, complications screen.
4. **Stewardship:** Narrow/stop antibiotics with microbiology/biomarker support; switch IV to PO when stable.

Non-Pharmacological interventions

- Hydration, antipyretics/analgesics, chest physiotherapy if secretions problematic, early mobilization, nutrition, glycemic control (140-180 mg/dL inpatient).
- Infection prevention: Hand hygiene, respiratory etiquette, isolation for influenza/COVID-19; vaccinate (influenza, pneumococcal) before discharge when eligible.
- Smoking cessation counseling and pharmacotherapy where available.

Pharmacological therapy

Outpatient, no comorbidities/no recent antibiotics

- Amoxicillin 1 g PO q8h or Doxycycline 100 mg PO q12h or Macrolide (only if local pneumococcal macrolide resistance ...

<25%): Azithromycin 500 mg day 1, then 250 mg daily for 4 days or Clarithromycin 500 mg PO q12h.

- Duration: Usually 5 days, stop when clinically stable.

Outpatient with comorbidities or recent antibiotics

- Amoxicillin-clavulanate (500/125 mg PO q8h or 875/125 mg PO q12h or 2000/125 mg PO q12h) PLUS Azithromycin/Clarithromycin or Doxycycline;
  Alternative: Respiratory fluoroquinolone monotherapy (e.g., Levofloxacin 750 mg PO daily or Moxifloxacin 400 mg PO daily) if needed (use judiciously).
- Duration is five days, provided the patient is clinically improving and afebrile for at least 48 hours; extending beyond seven days rarely adds benefit.

Inpatient (non-severe CAP)

1. **Oxygen therapy:** Nasal cannula or simple mask; escalate to HFNC (high-flow nasal cannula)/NIV (non-invasive ventilation)/invasive ventilation as needed. In low-resource settings, prioritize pulse oximetry, oxygen concentrators, prone positioning in selected non-intubated hypoxemic patients, and timely referral.
2. Ceftriaxone 1-2 g IV daily plus Azithromycin 500 mg IV/PO daily
   Or β-lactam plus Doxycycline 100 mg q12h
   Or Respiratory fluoroquinolone alone (stewardship caveats).

Severe CAP (ICU) without MRSA/ Pseudomonas risks

- Anti-pneumococcal β-lactam (e.g., Ceftriaxone/Cefotaxime/Piperacillin-tazobactam 4.5 g IV q6h) plus Azithromycin or plus Levofloxacin/ Moxifloxacin.

Add-ons when risk factors present

- **MRSA risk *(prior MRSA in past 12 months, post-influenza necrotizing pneumonia, cavitation/empyema, dialysis/wounds/LTCF, injection drug use, ICU shock)*:** Vancomycin IV (AUC-guided) or Linezolid 600 mg IV/PO q12h.
- **Pseudomonas risk *(prior colonization/ infection, repeated antibiotics, bronchiectasis/advanced structural disease, recent hospitalization), start broad-spectrum anti-pseudomonal therapy:*** Piperacillin-tazobactam 4.5 g IV q6h or Cefepime 2 g IV q8-12h or Meropenem 1 g IV q8h; combine with macrolide or fluoroquinolone initially; de-escalate when susceptibilities return.

Suspected melioidosis (sepsis with diabetes/alcohol/soil-water exposure in endemic travel):

- Start ceftazidime or meropenem pending confirmation; involve ID specialist early.

When TB is suspected

- Do **NOT** start empiric anti-TB alongside broad CAP cover unless the patient is crashing and TB is overwhelmingly likely. Prioritize specimen collection...

(sputum/BAL for NAAT and culture), airborne precautions when indicated, and reassess at 24–48 h.

Duration

- Usually 5 to 7 days, provided the patient is clinically improving and has been afebrile for at least 48 hours. Adjust dose for renal or hepatic impairment as per standard dosing guidelines. De-escalate based on culture results and clinical response.

Atypical/viral

- **Legionella:** Azithromycin or respiratory fluoroquinolone (total 5-7 days if uncomplicated).
- **Influenza:** Start promptly Oseltamivir 75 mg orally twice daily for 5 days (adjust dose for renal impairment) Or zanamivir 10 mg inhaled (two 5 mg inhalations) twice daily for 5 days).
- **COVID-19:** Manage per contemporaneous national/WHO guidance.

Cautions

- Verify allergies, renal/hepatic dosing; monitor QTc with macrolides/ fluoroquinolones; watch for C. difficile. Avoid duplicate GNB/MRSA coverage.

Assessment of response, Review & adjustment

- **Improving by 48-72 h:** no/decreasing fever, stable vitals (RR ≤24, HR ≤100, SBP ≥90), SpO_2 ≥92% on room air or baseline, declining CRP/PCT able to ... take/absorb PO, reliable follow-up - **Step-down** - narrow/stop antibiotics as appropriate; **IV to PO** when stable; plan total 5-7 days (extend if slow response, complications, resistant organisms).
- **No improvement/worsening at 48-72 h**: Re-examine adherence/diagnosis; check cultures; repeat CXR/CT if indicated; consider complications (effusion/empyema, abscess, PE), alternative/co-infection (TB, fungi, melioidosis regionally); adjust therapy. **Step-up:** Escalate oxygen/ventilation, broaden diagnostics/coverage if shock, ARDS, or rapid radiographic/clinical worsening.

Referral (tiered)

- **Primary care to Hospital:** CURB-65 ≥2; SpO_2 <92% or rising O_2 need; RR ≥30; SBP <90/MAP <65; new confusion; pregnancy; immunocompromise; failure to improve in 48-72 h; suspected complications.
- **Ward to ICU/Tertiary:** ATS/IDSA severe CAP (≥1 major or ≥3 minor); refractory hypoxemia despite oxygen/HFNC; shock needing vasopressors; ARDS; pneumothorax; rapidly progressive infiltrates; falling ROX index on HFNC.

Complications (screen daily)

- Respiratory/ARDS, pleural effusion/ empyema, lung abscess, sepsis/shock, pneumothorax, cardiac (arrhythmias, myocarditis, HF decompensation), bacteremia/metastatic infection (endocarditis, osteomyelitis, septic arthritis), residual fibrosis.

Patient education & Instructions

Objectives: Early recognition of warning signs (worsening breathlessness, persistent high fever, new confusion), medication/oxygen adherence, infection prevention, and follow-up compliance.

Do's

- Take antibiotics exactly as prescribed; set reminders.
- Monitor breathing; use a home oximeter if available; record SpO_2.
- **Seek urgent care now if:** Red flag signs - SpO_2 <92% (or falling from baseline), RR ≥30/min, severe breathlessness, cyanosis, SBP <90/ MAP <65, new confusion, hemoptysis, persistent fever beyond 48-72 h on antibiotics.
- Use prescribed oxygen at set flow; keep equipment clean and away from flames.
- Hydrate, rest, practice hand hygiene/respiratory etiquette; keep vaccines up to date.
- Attend follow-up; bring medication list and home readings.

Don'ts

- Don't stop antibiotics early or take leftover/OTC antibiotics.
- Don't change oxygen flow without advice; don't smoke near oxygen.
- Don't ignore new chest pain, hemoptysis, confusion, or inability to drink.

INTRODUCTION

Pneumonia is an acute infection of lung parenchyma, most often seen as community-acquired (CAP), healthcare-associated, hospital-acquired (HAP), or ventilator-associated (VAP), each with distinct risks. Lower respiratory infections caused about 2.18 million deaths in 2021, with Streptococcus pneumoniae a key pathogen; severity and mortality rise sharply after 65 years and with comorbidities such as COPD, diabetes, cardiovascular disease, and immunosuppression. South-East Asia bears a high burden, and rising obesity, diabetes, and prehypertension likely add to risk; country-specific adult data are limited but the burden is expected to be substantial. Its presentation spans a spectrum: mild disease with fever and productive cough to severe cases with respiratory failure, shock, or sepsis. Because its signs overlap with many respiratory conditions, CAP must be considered in almost every lower respiratory tract differential. Standardized, guideline-concordant care, consistent severity assessment, appropriate site-of-care decisions, and rational antibiotic selection, reduces mortality, complications, length of stay, and unnecessary broad-spectrum use.

SCOPE OF THE GUIDELINES

These guidelines provide guidance on CAP in adults, with emphasis on early recognition and management both in the community and upon hospital presentation. They apply across levels of care: primary/outpatient settings for recognition, severity scoring (CURB-65/CRB-65), basic investigations, initial oral therapy, and referral decisions; and secondary/Atoll/regional hospitals for comprehensive evaluation, imaging, intravenous antibiotics, oxygen support, early sepsis care, and structured escalation.

Limitations: Advanced microbiological diagnostics (e.g., rapid molecular panels), arterial blood gases, ICU-level care (vasopressors, mechanical ventilation) may be limited at primary/low-resource secondary settings; rely more on clinical severity scores and empirical therapy.

The intended users are emergency physicians, hospitalists, and primary care clinicians, with the content also serving as a starting framework for specialists. There is overlap with prior concepts of health care-associated pneumonia; most patients formerly classified under that label should be managed as CAP with individualized assessment of pathogen risk.

Pneumonia in non-ambulatory long-term care residents often mirrors hospital-acquired patterns and may require tailored evaluation, balancing CAP-based management with awareness of specific high-risk organisms.

- **Primary care / outpatient:** initial recognition, severity scoring (e.g., CURB-65/ CRB-65), basic investigations, initiation of first-line oral antibiotics, criteria for referral.
- **Secondary care / atoll/regional hospital:** full clinical evaluation, imaging, intravenous therapy, oxygen support, early sepsis management, and escalation pathways.

DEFINITION

Pneumonia is diagnosed when there is a newly recognized pulmonary infiltrate on chest imaging plus at least one respiratory symptom and at least one additional sign or systemic finding such as abnormal lung sounds (rhonchi or rales); fever ≥38.0 °C (≥100.4 °F); leukocytosis or unexplained bandemia (above lab normal limits); hypoxia (SpO_2 <90% on room air or significant drop from baseline). (IDSA 2019)

Definitions (by site of acquisition):

- **Community-acquired pneumonia (CAP):** Acute infection of the lung parenchyma acquired outside healthcare facilities (or ≤48 hours after hospital admission without prior healthcare exposure).
- **Hospital-acquired pneumonia (HAP):** Pneumonia that develops ≥48 hours after hospital admission and was not incubating at admission.
- **Ventilator-associated pneumonia (VAP):** Pneumonia that occurs ≥48 hours after endotracheal intubation or initiation of mechanical ventilation.

CAUSES, RISK FACTORS & TRIGGERS

Category	Examples	Why it matters / Practice implications
Age & frailty	≥65 years, frailty, poor functional status, malnutrition	Higher risk of atypical presentation, severe disease, aspiration; lower threshold for admission and early antibiotics.
Comorbid lung disease	COPD, bronchiectasis, interstitial lung disease, cystic fibrosis	Increased risk of severe CAP and Gram-negative pathogens; obtain sputum culture; consider broader initial coverage if recent antibiotics/exacerbations.
Cardio-metabolic	Heart failure, diabetes, CKD, cirrhosis	Worse outcomes; consider inpatient care and closer monitoring; adjust dosing for renal/hepatic function.
Neurologic/aspiration risk	Stroke, dementia, Parkinson disease, seizures, dysphagia, poor dentition, reflux; tube feeding	Aspiration pneumonia risk; cover oral anaerobes if clinical/radiographic aspiration; elevate head of bed; speech/swallow eval.

Substance use & lifestyle	Smoking, heavy alcohol use, crowded living, contact sports	Smoking/alcohol worsens outcomes; crowded/ contact sports increased CA-MRSA risk if necrotizing features.
Recent healthcare exposure	Hospitalization or IV antibiotics ≤90 days, hemodialysis, wound care, long-term care residence, prior colonization (MRSA/Pseudomonas)	Consider targeted MRSA/Pseudomonas coverage if severe illness or strong risk; get cultures; de-escalate at 48-72 h.
Prior microbiology	Documented MRSA/Pseudomonas in last 12 months	Strong predictor of recurrence; align empiric therapy with prior susceptibilities; de-escalate when new results return.
Immunization status	Lack of pneumococcal or influenza vaccination	Higher risk for pneumococcal and post-influenza bacterial pneumonia; vaccinate at discharge/follow-up.
Viral triggers	Recent influenza-like illness or SARS-CoV-2	Post-influenza necrotizing pneumonia → think MRSA; test for viruses to guide isolation/antivirals and antibiotic de-escalation.
Environmental/ seasonal	Air pollution peaks, dust storms, cold season	May precipitate exacerbations and secondary infections; anticipate surges and lower threshold for testing in high season.
Travel & regional exposures	Endemic areas for melioidosis (soil/ water exposure; diabetes), TB exposure, recent travel/cruise	Consider Burkholderia pseudomallei or TB in subacute/severe disease; order targeted tests; tailor empiric therapy.
HIV/other immunosuppression (if present)	Low CD4, chemotherapy, transplant meds, high-dose steroids	Broader differential (PCP, fungi); early imaging and specialist input; this table focuses on non-immunocompromised pathway - adjust accordingly.

Shifting Trends in CAP Etiology, Resistance pattern & Implications

- **Overall shift:** Streptococcus pneumoniae remains a key pathogen but its incidence has declined with pneumococcal vaccination and herd immunity. Contribution varies by coverage and region; lower where uptake of vaccination is high. Keep pneumococcal cover in empiric regimens yet check local penicillin/ceftriaxone non-susceptibility before banking on standard doses. Use the hospital/region antibiogram to set beta-lactam choice and dose.

- **Regional patterns (South-East Asia):** H. influenzae, Gram-negative bacilli (Klebsiella, Pseudomonas), and Mycobacterium tuberculosis feature more prominently than in many Western settings.

  Add Gram-negative (GNB) cover when risk factors exist (liver disease, diabetes, severe CAP, recent hospitalization/IV antibiotics, bronchiectasis/COPD, structural lung disease). Keep TB in the differential for subacute or non-resolving disease. Macrolide resistance is common; azithromycin failures occur. In adults, pivot to doxycycline or a respiratory fluoroquinolone when atypical pneumonia is likely or if there's no response to a macrolide.

Burkholderia pseudomallei (Melioidosis) is important in parts of Thailand/Malaysia and neighboring tropical belts. Consider in severe sepsis or pneumonia with diabetes or soil/water exposure; alcohol use - send targeted cultures/serology; and cover early with ceftazidime or meropenem while awaiting results.

Tuberculosis: TB can present acutely. Any patient taken for bronchoalveolar lavage (BAL) should have TB testing on the same specimen. Suspect TB diagnosis in case of subacute, non-resolving, or upper-lobe-predominant disease.

In settings where comprehensive CAP surveillance is limited, tropical climate, inter-island/travel exposures, and frequent viral illnesses may yield atypical presentations and broader pathogen diversity. Local bacterial/viral testing data should guide empiric choices when available.

- **Viral etiologies and COVID-19 impact:** Post-COVID era: SARS-CoV-2 is a major cause; multiplex PCRs detect respiratory viruses in a sizeable share of adult CAP, yet many cases remain pathogen-negative.
- **Host-microbiome considerations:** Emerging data on the lung microbiome suggests that resident microbes may influence susceptibility and immune responses; these insights do not yet change frontline management but reinforce prudent antibiotic use.
- **Antimicrobial Resistance Patterns:** Refer to local antibiograms and base empiric choices on the latest hospital/atoll/regional antibiogram when possible. If unavailable, broader surveillance data can be accessed through platforms like WHO's GLASS system, One HealthTrust, and national AMR reports for regional context. Recheck resistance patterns at least annually or sooner after outbreaks/formulary changes.
- **Methicillin Resistant Staph aureus (MRSA) and Pseudomonas Considerations:** Do not cover MRSA or Pseudomonas by default. Add coverage only when risk factors or severity warrant it. Suspect MRSA in CAP when there is prior MRSA colonization or infection within the past 12 months; recent intravenous antibiotics or healthcare exposure such as dialysis, wound care, or residence in long-term care; post-influenza pneumonia or rapidly progressive disease with necrotizing infiltrates, cavitation, or empyema; severe CAP requiring ICU admission or presenting with shock; or community risk factors for CA-MRSA, including recurrent skin and soft-tissue infections, contact sports, crowded living conditions, or injection drug use.

Pseudomonas aeruginosa is infrequent in CAP but more likely in patients with structural lung disease, prior colonization, hospitalization, or recent antibiotic exposure. Resistance is common; empiric coverage may require combination therapy in moderate to severe cases.

EVALUATION FOR DIAGNOSIS

Domain	Key findings	Notes for practice
Pulmonary symptoms	New/worsening cough (± sputum), dyspnea/rapid breathing, pleuritic chest pain, change in sputum	~80% have fever; older adults may present atypically (confusion, delirium).
Systemic symptoms	Fever or hypothermia, fatigue, myalgia	Absence of fever does not exclude CAP, especially in older adults.
Tachypnea (severity/ risk)	≥30/min = severe CAP criterion (ATS/IDSA, BTS). ≥22/min = bedside trigger for sepsis risk (qSOFA)	In elders, tachypnea may precede fever/ leukocytosis; compared with baseline.
Physical examination	Crackles/rales, bronchial breath sounds, dullness to percussion, ↑ tactile fremitus; distress (accessory muscles, cyanosis)	Supports diagnosis; helps gauge extent/ severity.
Oxygenation	SpO_2 <92% (or drop from baseline); hypoxemia on ABG	Guides site-of-care and O_2/ventilatory support.
Laboratory tests	Leukocytosis or leukopenia; CRP/Procalcitonin to aid severity and stewardship	Use biomarkers to support, not replace, clinical judgment.
Imaging	Chest radiograph first-line - New infiltrate compatible with infection	If high suspicion but CXR negative/ indeterminate, consider CT chest.
Special populations - Older adults; immunocompromised	New confusion without fever or leukocytosis (older); plain films may miss infiltrates in immunocompromised	Lower threshold for imaging/escalation; consider atypical/opportunistic pathogens (melioidosis, TB, abscess, or fungal disease)

CONFIRMATION OF DIAGNOSIS & SEVERITY ASSESSMENT

Diagnosis in Adults without Immunocompromising Conditions (IDSA) requires all of the following:

1. New pulmonary infiltrate(s) on chest imaging and
2. ≥1 respiratory symptom and
3. ≥1 other sign/finding from the lists below.

Category	Criteria
Imaging (required)	New infiltrate(s) on chest imaging (CXR preferred)*.
Respiratory symptoms (≥1 required)	New or increased cough; new or increased sputum production; dyspnea; pleuritic chest pain.
Other signs or findings (≥1 required)	Abnormal lung sounds (rhonchi or rales); fever ≥38.0 °C (≥100.4 °F); leukocytosis or unexplained bandemia (above lab normal limits); hypoxia (SpO_2 <90% on room air or significant drop from baseline).

** A negative CXR does not rule out pneumonia; false negatives may occur in early disease, neutropenic states, dehydration, or infections such as Pneumocystis jirovecii pneumonia. If suspicion remains high with a negative chest radiograph: obtain CT chest to evaluate for occult infiltrates.* ***Note:*** *Immunocompromised (exclude from this pathway): inherited or acquired immune deficiency; drug-induced neutropenia; active cancer chemotherapy; HIV with low CD4 counts; solid-organ or bone-marrow transplant recipients.*

- Routine use of CT imaging is not recommended due to cost and limited evidence for clinical benefit and is reserved for situations where the diagnosis is uncertain, when complications are suspected (empyema, abscess, cavitation, bronchiectasis), or when the patient fails to improve as expected despite appropriate therapy.
- In resource-limited settings where imaging may not be immediately available, a strong clinical syndrome (fever, cough, tachypnea, hypoxia, crackles, especially if accompanied by hypoxia or physical signs of consolidation), can justify initiating empirical therapy particularly in settings where delay would worsen outcomes, while arranging referral or awaiting confirmatory imaging.

Severe CAP Criteria (IDSA 2019)

Severe CAP = ≥1 major or ≥3 minor criteria at presentation.		
Major criteria		
Criterion	**Definition / Threshold**	**Notes**
Septic shock	Requires vasopressors to maintain MAP ≥65 mmHg after adequate fluid resuscitation	Persistent hypotension despite fluids
Respiratory failure	Requires invasive mechanical ventilation	Intubation for hypoxemia or ventilatory failure
Minor criteria		
Tachypnea	Respiratory rate ≥30/min	Assess at rest, before bronchodilators
Hypoxemia	PaO_2/FiO_2 ≤250	On supplemental O_2 if used; ABG/venous gas with FiO_2 estimate
Multilobar infiltrates	≥2 lobes involved on CXR/CT	Extent of consolidation matters
Confusion/disorientation	Acute altered mental status	New from baseline
Uremia	BUN ≥20 mg/dL (≥7.14 mmol/L)	Check renal function and hydration
Leukopenia	WBC <4,000/mm^3 (not due to chemotherapy)	Consider marrow suppression/infection severity
Thrombocytopenia	Platelets <100,000/mm^3	Exclude chronic thrombocytopenia
Hypothermia	Temperature <36°C (96.8°F)	In older/frail patients may be prominent
Hypotension requiring fluids	Systolic BP low enough to require aggressive fluid resuscitation	If vasopressors needed → meets major criterion

** PaO2 /FiO2 ratio is the ratio of patient's oxygen in arterial blood (PaO2) to the fraction of the oxygen in the inspired air (FiO2).3 † Due to infection alone (i.e., not chemotherapy)*

Reassess after initial fluids/oxygen. Document count of major/minor criteria to guide site-of-care and empiric therapy.

Microbiologic tests for etiology by Disease Severity

Routine sputum Gram stain and culture are not indicated for adult outpatients with CAP.

Category	Test	Non-severe CAP	Severe CAP
Blood	*Blood culture	Not routine; consider only in select situations where rapid pathogen identification would change management.†	Yes (pretreatment)
	Procalcitonin	Consider if available and endorsed by institutional guidance	Yes, if available and endorsed by institutional guidance
Respiratory	Respiratory secretion culture	Not routine unless any of the following: recent hospitalization with parenteral antibiotics (past 90 days), empiric MRSA or P. aeruginosa coverage started, or advanced structural lung disease (bronchiectasis, post-obstructive changes, advanced COPD, or cystic fibrosis).	Yes, if available and endorsed by institutional guidance
	Sputum/BAL	Add TB NAAT when clinical or radiographic flags exist.	Add TB NAAT when clinical or radiographic flags exist.
	Molecular testing for bacterial pathogens	Not routine; selective use if it would alter therapy.†	Yes, if available and endorsed by institutional guidance
	MRSA nasal swab (colonization marker)	If recent hospitalization with parenteral antibiotics (past 90 days) or empiric MRSA coverage started	If recent hospitalization with parenteral antibiotics (past 90 days), history of MRSA colonization/ infection within 1 year, or empiric MRSA coverage started
Viruses	Influenza testing	If influenza is circulating locally, travel risk, or relevant exposure	Same indications
	COVID-19 testing	If circulating, travel risk, or exposure	Same indications
	Multiplex rapid molecular panels (e.g., rhinovirus, enterovirus, RSV)	Consider if available and would impact management†	Yes, if available†
Urine	Legionella urinary antigen	If severe epidemiologic risk (outbreak, recent travel, other exposures)	Yes
	Pneumococcal urinary antigen	Not routine; as per severity/season/ travel	Yes

*Always get two blood cultures before antibiotics in severe CAP; sputum for Gram stain/culture when good quality is available; urine antigens for pneumococcus/Legionella as per severity/season/travel. Add TB NAAT on sputum/BAL when clinical or radiographic flags exist.

† May be used selectively when timely pathogen identification could enable more targeted therapy or allow early discontinuation of unnecessary antibiotics. Order up front in moderate-severe CAP, immunocompromise, treatment failure, or outbreaks.

Inflammatory markers

- Use CRP and procalcitonin (PCT) as adjuncts for severity assessment and antibiotic stewardship; interpret with the clinical picture.
- Trend over time (baseline at presentation, repeat at 48-72 hours): trajectory is more informative than a single value.
- Improving trend: rapid fall in PCT or CRP over 48-72 h supports clinical improvement; consider narrowing spectrum, IV to PO switch, or stopping antibiotics when other stability criteria are met.
- Worsening/plateau: persistently high or rising markers suggest treatment failure, complication (e.g., empyema), alternative diagnosis, or inadequate source control-reassess.
- Etiology aid: low/declining PCT may support a nonbacterial cause and help avoid or shorten antibiotics when clinical risk is low; CRP is less specific but useful for trending inflammation.
- Stewardship application: incorporate a 48-72 h review using vitals, oxygen needs, cultures/PCR, and marker trends to guide de-escalation or cessation. Document planned review/stop date at initiation.
- Limitations/confounders:
  - CRP is nonspecific (elevated in many inflammatory states).
  - PCT may rise with renal dysfunction, major surgery/trauma, severe shock, or certain malignancies.
  - Assay variability, cost/availability (resource-limited settings), and turnaround time can affect utility.
- Operational tips: use the same assay for serial measurements; avoid over-testing (generally every 48-72 h is sufficient); do not delay urgent treatment while awaiting results.
- Key caution: biomarker results must not replace clinical judgment; they are decision-support tools, not stand-alone criteria.

SITE-OF-CARE DECISIONS (AMBULATORY VS. HOSPITAL CARE) USING ILLNESS SCORING AND PROGNOSTIC MODELS

Nearly all key management decisions in CAP - diagnosis, treatment intensity, and resource allocation depend on the initial severity assessment. Common tools for severity assessment help decide the site of care, intensity of monitoring, and initial management include the following:

Choosing Site of Care in Adult CAP

Tool	Components & Scoring	Risk bands & Site of care
CURB-65 (Fast bedside tool for triage in ED/OPD)	1 point each: Confusion; Urea >7 mmol/L; RR ≥30/min; BP systolic <90 or diastolic ≤60 mmHg; Age ≥65. Total 0-5.	**0-1**: usually outpatient (with safety net). **2**: admit or very close observation. **≥3**: severe, inpatient; consider higher monitoring/ intensive support.
CRB-65 **Lab-free;** useful in primary care and low-resource settings.	Same as CURB-65 without Urea (0-4).	0: outpatient if safe. 1-2: hospital evaluation/ admission depending on stability and comorbidity. 3-4: urgent admission, likely inpatient.
PSI (Pneumonia Severity Index) Most validated mortality stratifier; comprehensive.	Demographics, comorbidities, vitals, labs, imaging Classes I-V.	I-II (often III): outpatient if stable and safe. IV-V: inpatient; higher classes need closer monitoring, possible step-up care.
IDSA Severe CAP criteria Directs ICU vs ward decisions; flags need for aggressive support.	Severe CAP = ≥1 major (invasive ventilation, septic shock needing vasopressors) or ≥3 minor (e.g., RR ≥30, PaO_2/FiO_2 ≤250, multilobar infiltrates, confusion, BUN ≥20, WBC <4k, Plt <100k, T <36°C, hypotension requiring fluids).	Meets severe CAP: ICU/HD or early escalation. If not severe but unstable, general ward with close monitoring.

Notes:

- Use these scores to support, not replace, judgment especially in older adults, frail patients, immunocompromised hosts, or when social factors (home support, access to care) affect safety. For example, a patient with a low CURB-65 may still meet three minor severe criteria and therefore need escalation.
- Always layer in red flags not captured by CURB-65/CRB-65 (SpO_2, multilobar disease, rapidly rising oxygen needs, hypothermia).
- Reassess within 4-6 hours if observed in ED/short stay; be ready to upgrade care when trajectory worsens.

Ambulatory care: Patients with CAP who are otherwise healthy, exhibit stable vital signs aside from fever, and show no signs of complications are generally classified as having mild disease and are suitable for outpatient management. These individuals usually correspond to PSI classes I or II, and CURB-65 scores of 0 - occasionally 1 if age exceeds 65 years.

Hospital admission decision: Patients with a CURB-65 score ≥2 need more intensive management, usually hospitalization or, where feasible, enhanced in-home care. Given the increased risk of severe infections and diagnostic complexity in HIV-infected individuals, particularly those with advanced immunosuppression marked by a CD4 count below 200 cells/mm^3, hospitalization may be necessary to ensure timely investigation and appropriate management.

ICU admission decision

- Immediate ICU-level care is required for patients with septic shock needing vasopressors or acute respiratory failure requiring intubation and mechanical ventilation. The major/minor severe CAP criteria(as above) are used to immediate identification of life-threatening severity to trigger ICU-level care or aggressive management, even when their CURB-65 or PSI score is not high.
- The major/minor severe CAP criteria are then used to immediate identification of life-threatening severity to trigger ICU-level care or aggressive management, even when their CURB-65 or PSI score is not high. CAP is considered severe if one major criterion or three or more minor criteria present as below:

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of suspected pneumonia includes several noninfectious and infectious entities with overlapping symptoms as below. Pleural effusion or empyema may coexist or be mistaken for pneumonia on imaging.

Condition	Key clinical clues	Imaging/labs	Initial approach
Viral respiratory infection (incl. COVID-19)	Fever, myalgia, sore throat, dry cough; clusters/contacts	CXR often clear or patchy bilateral opacities; multiplex PCR/SARS-CoV-2 test	Consider antivirals/isolation when indicated; avoid unnecessary antibiotics if bacterial features absent
Acute bronchitis	Cough ± sputum, usually afebrile or low-grade fever; normal vitals	No new infiltrate on CXR	Supportive care; no routine antibiotics
COPD exacerbation	Worsening dyspnea, wheeze, ↑sputum volume/purulence; smoker history	Hyperinflation; no focal consolidation; viral/ bacterial triggers possible	Bronchodilators, steroids; antibiotics only if purulent sputum or severe

Pulmonary embolism / infarction	Pleuritic chest pain, dyspnea, tachycardia; risk factors (immobility, surgery)	Clear CXR or wedge-shaped opacity; ↑D-dimer; CTPA diagnostic	Anticoagulation; avoid delays from mislabeling as pneumonia
Heart failure with pulmonary edema	Orthopnea, PND, edema, S3; history of HF	Cardiomegaly, Kerley B lines, perihilar "bat-wing" opacities; ↑BNP	Diuretics/afterload reduction; antibiotics not primary
Tuberculosis	Subacute/chronic cough, weight loss, night sweats; exposure risk	Upper-lobe cavitation, tree-in-bud; AFB smear/ culture, NAAT	Airborne precautions; RIPE therapy
Lung malignancy	Chronic cough, hemoptysis, weight loss; smoker/age >50	Solitary mass, non-resolving opacity after "pneumonia"; CT, bronchoscopy	Urgent oncologic work-up; avoid recurrent antibiotics
Pleural effusion / empyema	Pleuritic pain, dyspnea; dullness to percussion, ↓breath sounds	Blunted costophrenic angle; US-guided tap: pH, LDH, glucose, Gram stain/ culture	Drain parapneumonic effusions/ empyema; tailor antibiotics
Aspiration pneumonitis/ pneumonia	Dysphagia, impaired consciousness, vomiting, poor dentition	Dependent-lobe infiltrates (posterior upper/superior lower lobes)	Airway protection; anaerobe coverage if classic aspiration
Interstitial lung disease flare	Known ILD; progressive dyspnea, dry cough	HRCT: reticular/ground-glass without focal lobar consolidation	Immunomodulation; exclude infection before steroids
Atelectasis	Post-op, immobility; improved with physiotherapy	Plate-like/subsegmental collapse; volume loss, mediastinal shift	Pulmonary hygiene, mobilization

Note: Pneumonia diagnosis requires a new infiltrate on imaging plus compatible symptoms. If clinical suspicion is high but CXR is negative, consider CT chest and targeted labs.

MANAGEMENT GOALS

- Eradicate the pathogen, restore oxygenation/ventilation, and prevent progression to severe disease or sepsis.
- Minimize adverse effects and plan safe discharge with clear follow-up.

MANAGEMENT PRINCIPLES

- Assess severity early to choose site of care (outpatient, ward, ICU).
- Start empiric antibiotics promptly: tailor to severity, local resistance, and patient-specific risk for resistant pathogens.

- Outpatients with mild disease, no risks: use narrow-spectrum regimens.
- Hospitalized/severe CAP: begin broader coverage; narrow once data return.
- Support oxygenation (supplemental O_2 as needed) and provide supportive care (hydration, antipyretics, VTE prophylaxis when indicated).
- Monitor vitals, clinical symptoms, urine output closely for deterioration and complications (e.g., sepsis, empyema).
- De-escalate/stop antibiotics based on cultures, viral testing, biomarkers, and clinical response.
- Plan transitions of care: clinical stability, IV→PO switch, discharge education, and follow-up arrangements.

PHARMACOLOGICAL THERAPY

Outpatient, otherwise healthy adults (no comorbidities, no recent antibiotic use) - IDSA 2023; NICE 2025

Amoxicillin 1 g PO three times daily Or Doxycycline 100 mg PO twice daily Or, if local pneumococcal macrolide resistance <25%, a macrolide (azithromycin 500 mg day 1 then 250 mg daily for 4 days or clarithromycin 500 mg twice daily).

Duration: 5 days depending on response.

Outpatient with comorbidities or recent antibiotic use

Amoxicillin-clavulanate (500/125 mg thrice daily or 875/125 mg twice daily) OR cephalosporin (cefuroxime, cefpodoxime) plus macrolide or doxycycline.

Special considerations / cautions

- Doxycycline contraindicated in pregnancy (alternative: beta-lactam plus macrolide).
- Fluoroquinolones: tendon risk, QT prolongation, avoid unless necessary.
- Adjust dosing for renal/hepatic impairment.
- Allergy: use alternative class (e.g., macrolide + respiratory fluoroquinolone if beta-lactam allergy, guided by severity).
- During the influenza season, high-risk patients may also need antiviral therapy.

- Duration is five days, provided the patient is clinically improving and afebrile for at least 48 hours; extending beyond seven days rarely adds benefit.

Inpatient - non-ICU, no risk factors for MRSA or P aeruginosa

Beta-lactam plus macrolide:

1. Ceftriaxone 1-2 g IV once daily or ampicillin-sulbactam 1.5-3 g IV every 6 hours
2. Azithromycin 500 mg IV/PO once daily or clarithromycin 500 mg PO twice daily

Or

Beta-lactam plus respiratory fluoroquinolone (if macrolide is contraindicated):

1. Same beta-lactam as above. In beta-lactam allergy: respiratory FQ monotherapy with close review at 48–72 h.
2. Levofloxacin 750 mg IV/PO once daily or moxifloxacin 400 mg IV/PO once daily

Duration: 5 to 7 days, provided the patient is clinically improving and has been afebrile for at least 48 hours. Adjust dose for renal or hepatic impairment as per standard dosing guidelines. De-escalate based on culture results and clinical response.

Inpatient ICU or severe CAP

Beta-lactam plus either azithromycin or a respiratory fluoroquinolone. Consider coverage for MRSA or Pseudomonas if risk factors present.

For suspected Pseudomonas aeruginosa pneumonia (prior colonization/infection, repeated antibiotics, bronchiectasis/advanced structural disease, recent hospitalization), start broad-spectrum anti-pseudomonal therapy:

Any of the anti-pneumococcal, anti-pseudomonal β-lactam such as:

1. Piperacillin-tazobactam 4.5 g IV every 6 hours Or Cefepime 2 g IV every 8 hours Or Imipenem-cilastatin 500 mg IV every 6 hours Or Meropenem 1 g IV every 8 hours **plus**
2. Ciprofloxacin 400 mg IV every 12 hours or 750 mg PO/IV once daily (if oral absorption reliable) Or Levofloxacin 750 mg IV/PO once daily

Alternative regimen, combine the above beta-lactam with an aminoglycoside (e.g., tobramycin 5-7 mg/kg IV once daily or gentamicin 5-7 mg/kg IV once daily) **and** either: Azithromycin (500 mg IV/PO on day 1, then 250 mg daily) **Or**
An anti-pneumococcal fluoroquinolone such as moxifloxacin 400 mg IV/PO once daily (especially in penicillin-allergic patients when using aztreonam in place of the β-lactam).

For penicillin allergy where β-lactam cannot be used, substitute aztreonam (2 g IV every 8 hours) in combination with the above partners.

For suspected community-acquired methicillin-resistant Staphylococcus aureus (MRSA) pneumonia (prior MRSA in past 12 months, post-influenza necrotizing pneumonia, cavitation/empyema, dialysis/wounds/LTCF, injection drug use, ICU shock), add:

Vancomycin, weight-based (15 mg/kg IV every 12 hours, adjusted to target troughs of 15-20 µg/mL in serious infections) Or Linezolid 600 mg IV/PO every 12 hours.

Duration: initial therapy for Pseudomonas or MRSA-associated CAP is generally 7 to 10 days, extended to 10-14 days if there is slow clinical response, complications (e.g., empyema), or immunocompromise. De-escalate using results.

Suspected melioidosis (sepsis with diabetes/alcohol/soil-water exposure in endemic travel):

- Start ceftazidime or meropenem pending confirmation; involve ID early.

When TB is on the table:

- Do **NOT** start empiric anti-TB alongside broad CAP cover unless the patient is crashing and TB is overwhelmingly likely. Prioritize specimen collection (sputum/BAL for NAAT and culture), airborne precautions when indicated, and reassess at 24-48 h.

INTEGRATED MONITORING IN SEVERE PNEUMONIA & ANTIMICROBIAL STEWARDSHIP (AMS) PATHWAY

Integrated Monitoring in Severe Pneumonia & Antimicrobial Stewardship (AMS) Pathway

Reassess at ~6-12 h, 24-48 h, then daily

1. **Vitals and clinical status**

   RR (trend down; red flag ≥30/min), SpO_2 (target ≥92% or baseline for COPD), HR, BP (SBP ≥90; MAP ≥65 if septic), Temp, mental status (if new confusion - escalate).
   Work of breathing: accessory muscle use, dyspnea scale, ability to speak full sentences.
   Urine output: ≥0.5 mL/kg/h (perfusion marker).

2. **Oxygenation and respiratory support**

   Document device/settings (nasal cannula, mask, **HFNC, NIV**, invasive ventilation).
   ROX index (HFNC) = SpO_2/FiO_2 ÷ RR; falling trend suggests failure.
   ABG/VBG if worsening hypoxemia/hypercapnia or on NIV/ventilator.
   Consider **PaO_2/FiO_2 ≤250** as a severity signal.

3. **Labs and biomarkers (trend, don't chase single values)**

   CBC (WBC, platelets); renal/hepatic (creatinine, urea, AST/ALT, bilirubin) for dosing/toxicity.
   CRP / Procalcitonin at baseline and 48-72 h to support de-escalation or trigger re-evaluation.
   Lactate if sepsis suspected; follow clearance.

4. **Microbiology and diagnostics**

   Before first antibiotic dose: obtain appropriate samples (blood cultures, sputum/endotracheal sample when indicated).
   Review results at 48-72 h to narrow/stop therapy.
   Viral testing (e.g., influenza, SARS-CoV-2) when it changes isolation, antivirals, or stewardship.
   Imaging: no routine repeat CXR if improving; repeat for no improvement/worsening or suspected complications (effusion/empyema/abscess).

5. **Antimicrobial management**

   Start empiric antibiotics promptly after cultures are drawn; tailor to severity, local resistance, and patient-specific risks.
   IV to PO switch when hemodynamically stable, improving, tolerating/absorbing orally.
   Pathogen-directed therapy:
   S. pneumoniae (susceptible): de-escalate to narrow β-lactam (e.g., high-dose amoxicillin/penicillin G) and complete 5-7 days if uncomplicated.
   Legionella: azithromycin or a respiratory fluoroquinolone; usual 5-7 days if uncomplicated.
   MRSA: vancomycin (AUC-guided) or linezolid; 7-10 days (longer for necrotizing/bacteremia).
   Pseudomonas: tailor to susceptibilities (e.g., cefepime, piperacillin-tazobactam, meropenem); de-escalate combination therapy once sensitivities allow.
   Viral pneumonia (e.g., influenza/COVID-19): follow antiviral protocols; reserve/stop antibiotics unless bacterial coinfection is confirmed or strongly suspected.
   Stop or narrow broad/MRSA/Pseudomonas coverage promptly if report don't support and the patient is improving.
   Recheck allergies, organ function, drug interactions with every change.

6. **Complications screen (daily)**

Respiratory: rising oxygen needs, acute respiratory distress syndrome (ARDS), pneumothorax.
Pleural: new effusion/empyema (ultrasound if suspected).
Sepsis: hypotension, rising lactate, organ dysfunction.
Thromboembolism: unexplained hypoxemia/pleuritic pain - consider PE.
Treatment failure: fever >72 h, progressive infiltrates - reconsider TB, atypicals, melioidosis (endemic exposure), noninfectious mimics.

7. **Therapy monitoring and adverse effects**

Macrolides/fluoroquinolones (FQ): QTc (ECG if risk); FQ - dysglycemia, tendinopathy, neuropsychiatric effects.
β-lactams: hypersensitivity; co-amoxicillin - cholestasis; neurotoxicity with renal impairment/high levels.
Vancomycin: AUC/MIC or trough per protocol; nephrotoxicity.
Linezolid: weekly CBC; serotonin syndrome risk; neuropathy if prolonged.
Aminoglycosides (if used): levels; nephro/ototoxicity.
Oxygen/NIV: skin breakdown, gastric distension (NIV), barotrauma if escalating pressures.
VTE prophylaxis: dose/bleeding checks.
GI: monitor for C. *difficile diarrhea.*

8. **Supportive care and function**

Fluids: avoid both hypovolemia and fluid overload (HF/CKD).
Nutrition and glycemic control (inpatient target 140-180 mg/dL).
Mobility: early ambulation, incentive spirometry, chest physiotherapy if indicated.
Education: inhaler/nebulizer technique, antibiotic course, red flags.
Vaccination plan before discharge (pneumococcal, influenza).

9. **De-escalation checkpoint (at 48-72 h)**

If afebrile or improving, hemodynamically stable, RR falling, SpO_2 stable/improved, cultures negative or viral positive, and CRP/PCT declining - narrow or stop antibiotics and switch IV to PO when absorbing.

10. **Discharge readiness**

Afebrile ≥48 h; HR ≤100, RR ≤24, SBP ≥90, SpO_2 ≥92% on room air (or at baseline/O_2 plan).
Tolerating oral meds/fluids; pain controlled; mental status at baseline.
Home support and follow-up arranged; provide meds, safety-net advice, and vaccination plan.

- Manage viral pneumonias such as influenza or COVID-19 with their respective antiviral protocols, and antibiotics are reserved for confirmed or strongly suspected secondary bacterial infection. Start antiviral therapy (with oseltamivir 75 mg orally twice daily for 5 days (adjust dose for renal impairment) Or zanamivir 10 mg inhaled (two 5 mg inhalations) twice daily for 5 days) as soon as possible, ideally within 48 hours of symptom onset for influenza A.
- In uncomplicated influenza with symptoms for more than 48 hours, routine use of oseltamivir or zanamivir is not recommended. However, these agents may still be given in hospitalized patients, including those with influenza pneumonia or when reducing viral shedding is desirable. In severe or complicated illness, therapy can be extended (for example, oseltamivir for up to 10 days) based on clinical judgment. If inhaled therapy is not feasible (e.g., with respiratory compromise), consider intravenous alternatives such as peramivir 600 mg IV once daily for 5 days.

Oseltamivir Dose Adjustments in Renal Impairment (Adults)

Renal function	Treatment (usual 5 days)	Post-exposure prophylaxis (usual 10 days)	Key notes
Normal to mild impairment (CrCl >60 mL/min	75 mg PO BID	75 mg PO once daily	Standard dosing.
Moderate impairment (CrCl >30-60 mL/min)	30 mg PO BID	30 mg PO once daily	Reduce dose; reassess if kidney function changes.
Severe impairment (CrCl >10-30 mL/min)	30 mg PO once daily	30 mg PO every other day	Further reduction; monitor for accumulation and tolerance.
End Stage Renal Disease (ESRD, not on dialysis) (CrCl ≤10 mL/min)	Not recommended (insufficient data)	Not recommended	Consider alternative antivirals if available.
Intermittent hemodialysis (IHD)	30 mg PO immediately, then 30 mg after each HD session (do not exceed 5 treatment days total)	30 mg PO immediately, then 30 mg after alternate HD sessions	Give after dialysis on HD days. Coordinate with schedule.
Peritoneal dialysis (CAPD/APD)	30 mg PO × 1 dose	30 mg PO once weekly	Dosing may vary by local protocol; confirm per pharmacy guidance.

Note: Dosing assumes adult patients. Pediatric dosing requires weight-based adjustments and separate renal considerations.

Other treatment considerations

- Persistent septic shock despite adequate fluid resuscitation should prompt evaluation for refractory shock causes, including relative adrenal insufficiency; routine use of Drotrecogin alfa (activated protein C) is no longer recommended or available.
- Routine corticosteroid treatment is not recommended in adults with CAP (regardless of severity) or severe influenza pneumonia. If hemodynamics remain unstable and adrenal insufficiency is suspected, consider empiric stress-dose corticosteroids after appropriate assessment - hydrocortisone 50 mg IV every 6 hours (total 200 mg/day) with taper guided by clinical response and endocrine consultation.
- Hypotensive, fluid-resuscitated patients with severe pneumonia should be screened for occult adrenal insufficiency when shock is disproportionate or refractory. A random cortisol or a short cosyntropin stimulation test can help, with empiric hydrocortisone as above in patients with high clinical suspicion while awaiting results.
- Patients with hypoxemia or respiratory distress who do not require immediate intubation (for example, those without profound hypoxemia [PaO_2/FiO_2 ≥150] or impending respiratory failure) may receive a cautious trial of noninvasive ventilation (NIV) such as CPAP or BiPAP- starting with an expiratory pressure of 5 cmH_2O and pressure support of 8-10 cmH_2O, titrated to effect while monitoring for fatigue, worsening gas exchange, or intolerance. NIV should be aborted and invasive mechanical ventilation initiated promptly if there is no improvement, worsening oxygenation, or signs of exhaustion.
- For patients requiring invasive ventilation with diffuse bilateral pneumonia or acute respiratory distress syndrome, use low-tidal-volume ventilation: 6 mL/kg of ideal body weight with plateau pressures kept ≤30 cmH_2O, permissive hypercapnia as tolerated, and appropriate positive end-expiratory pressure to maintain oxygenation while minimizing lung injury.

NON-PHARMACOLOGICAL INTERVENTIONS

Non-pharmacological care is essential alongside antibiotics to support respiratory mechanics, reduce complications, and speed recovery.

- Administer supplemental oxygen to keep SpO_2 ≥92% (or ≥90% in COPD patients, individualized to their baseline).
- Ensure adequate hydration to maintain perfusion and mucus clearance.
- Encourage deep breathing or incentive spirometry when feasible to prevent atelectasis.

- Promote early mobilization as tolerated to reduce deconditioning and thromboembolic risk.
- Provide smoking cessation counseling to improve both short- and long-term lung recovery.
- Assess nutritional status and offer support for frail patients to aid immune function and healing.
- If sputum clearance is impaired, involve physiotherapy for airway clearance techniques.

ASSESSMENT OF RESPONSE

Response to treatment is assessed by clinical improvement:

- Resolution or reduction of fever, cough, and breathlessness; stabilization of vital signs; and better oxygenation (SpO_2).
- If inflammatory markers such as CRP are being trended, a downward trajectory supports recovery.
- Lack of new complications (pleural effusion, signs of sepsis) is reassuring. If there is no clear improvement or if the patient worsens by 48-72 hours, reassess aggressively.
- Initial follow-up should occur within 48-72 hours for hospitalized patients and within 3-5 days for outpatients who are not clearly improving.
- Before escalating therapy, confirm adherence, revisit the diagnosis, repeat imaging if indicated*, consider alternative or coexisting pathogens (such as tuberculosis or fungal infection), assess for complications, and review for drug interactions or adverse effects.
- Step-down from IV to oral therapy is appropriate after 48-72 hours when the patient is clinically stable; total antibiotic duration is usually 5-7 days but may be extended for atypical pathogens, immuno-compromised hosts, or slow responders.

*Follow-up imaging

- Routine follow-up chest imaging is not required for all patients who improve clinically. Repeat imaging is indicated when:
  - Symptoms or signs fail to improve or worsen by 48-72 hours (to evaluate for treatment failure, new complications such as empyema or abscess, or alternative diagnosis)

- Clinical deterioration after initial improvement
- Suspicion of complications (persistent fever, localized chest pain, pleural effusion, respiratory compromise)
- Immunocompromised patients or those with unusual presentations, where resolution may be delayed or atypical causes are more likely
- Recurrent or non-resolving pneumonia (obtain a repeat chest X-ray 4-6 weeks after completion of therapy to exclude underlying structural disease, malignancy, or obstructing lesion)

PROGNOSIS AND PROGRESSION

Most mild to moderate CAP cases resolve with appropriate treatment. Worse outcomes are seen with advanced age, comorbidities, delayed initiation of therapy, and high severity scores. Early adherence to guideline-based care improves survival. Up to 15% of patients may not respond to initial antibiotics. A systematic evaluation should be undertaken in non-responders to identify the cause. Knowing the original microbiologic etiology increases diagnostic accuracy, so risk factors for treatment failure or deterioration justify more aggressive or expanded initial testing.

REFERRAL / SPECIALIST CONSULTATION

Indications for Escalation / Referral in Adult CAP

Care level	Indication	Indications / red flags	Immediate actions
Primary care to Urgent hospital referral	Suspected/confirmed CAP with moderate-high risk	• Curb-65 ≥2 • Spo_2 <92% (or falling from baseline) or rising oxygen need • Rr ≥30/min or severe work of breathing • SBP <90 mmHg / MAP <65 • New confusion • Rising Lactate • Failure to improve after 48-72 h of appropriate therapy; unable to take/absorb orally • Significant comorbidity/frailty • Pregnancy • Immunocompromise	Start O_2, obtain basic labs if available, give first antibiotic dose, arrange monitored transport; notify receiving facility

ED / Secondary care (admit to ward)	Moderate CAP needs IV therapy and monitoring	CRB-65 ≥1-2 (or CURB-65 = 2), SpO_2 <92% on room air but responsive to low-flow O_2, multilobar infiltrates, dehydration/ AKI risk, social barriers to safe outpatient care	IV antibiotics/fluids, cultures before antibiotics when feasible, pulse oximetry, early reassessment at 6-12 h
Escalate to ICU / Tertiary care	Severe CAP or rapid deterioration	ATS/IDSA severe CAP: ≥1 major (invasive ventilation, septic shock needing vasopressors) or ≥3 minor (e.g., RR ≥30, PaO_2/FiO_2 ≤250, multilobar infiltrates, confusion, BUN ≥20, WBC <4k, Plt <100k, T <36°C, hypotension needing fluids). Other red flags: refractory hypoxemia despite O_2/HFNC, rising CO_2, ROX index falling on HFNC, ARDS, pneumothorax, persistent lactate ≥2, oliguria, rapidly expanding opacities, hemoptysis, severe chest pain, suspected MRSA/Pseudomonas necrotizing pneumonia	Escalate oxygen/ventilation (HFNC/NIV - intubation), sepsis bundle (fluids, vasopressors), broad empiric antibiotics per risks, urgent imaging (US for effusion, CT if needed), early specialist involvement (ID, pulmonology, critical care)
Specialist consultation (ID / Pulmonology / Thoracic surgery)	Complexity or uncertainty	No improvement by 48-72 h, unclear/atypical etiology (TB, fungi, melioidosis), treatment-limiting drug reactions or interactions, complications (empyema needing drainage, lung abscess, bronchopleural fistula), recurrent pneumonia, significant structural lung disease, immunocompromised host	Review diagnosis and microbiology, adjust regimen (de-escalate or broaden), procedure planning (thoracostomy/VATS), consider advanced diagnostics (bronchoscopy, CT, PCR panels)
Routine follow-up (outpatient)	Low-risk CAP improving on oral therapy	Afebrile or improving, RR ≤24, HR ≤100, SBP ≥90, SpO_2 ≥92% on room air or baseline; tolerating PO	Reassess 3-5 days (earlier if not improving); reinforce red flags and return precautions; plan vaccination and risk-factor modification

- Primary care role: recognize CAP, start empiric oral antibiotics in low-risk patients, arrange early review, and refer any patient with moderate-high severity or any red flag.
- Secondary care role: admit moderate/severe cases for IV therapy, imaging, and labs; escalate to tertiary/ICU for organ support, advanced diagnostics, or persistent non-response.

COMPLICATIONS

Complications of pneumonia range from organ-specific failure to systemic spread. Early recognition and management of these complications are essential to prevent deterioration.

Complication	Key clinical clues	Confirmation	Initial management
Respiratory failure / ARDS	Rising O_2 needs, tachypnea, cyanosis; refractory hypoxemia	ABG (low PaO_2), CXR/CT with diffuse bilateral opacities; PaO_2/FiO_2 ≤300 (ARDS)	Escalate O_2 (HFNC/NIV → invasive ventilation if needed), lung-protective ventilation, treat underlying infection, conservative fluids
Sepsis / Septic shock	Hypotension, tachycardia, altered mentation, oliguria; lactate ↑	Sepsis criteria; lactate ≥2 mmol/L; shock = vasopressors to keep MAP ≥65 after fluids	Early IV fluids, blood cultures, prompt antibiotics, vasopressors if needed, source control, organ support
Pleural effusion - Empyema	Pleuritic pain, dyspnea; dullness to percussion; persistent fever	CXR/US → fluid; diagnostic thoracentesis (pH <7.2, low glucose, high LDH, positive Gram/culture)	Drainage (chest tube ± fibrinolytics/VATS), targeted antibiotics; simple effusions may observe if small and improving
Lung abscess	Persistent fever >7-10 d, foul sputum, weight loss; aspiration risk	CXR/CT: cavitary lesion with air-fluid level	Prolonged antibiotics (e.g., β-lactam/β-lactamase inhibitor), ensure anaerobe cover if aspiration; drainage/surgery if refractory
Residual pulmonary fibrosis	Persistent dyspnea/ cough after radiographic "resolution"	PFTs (restrictive pattern, ↓DLCO); HRCT with fibrotic changes	Pulmonary rehab, optimize comorbidities; specialist referral; fibrosis may be permanent
Cardiac complications (myocarditis, arrhythmias, HF decompensation)	Chest pain, palpitations, syncope, edema; troponin/BNP may rise	ECG, troponin, echo as indicated	Treat arrhythmia/HF per guidelines, correct hypoxia/ electrolytes, avoid QT-prolonging drugs if high risk
Bacteremia & metastatic infection (osteomyelitis, endocarditis, septic arthritis)	Recurrent fevers, new focal pain, new murmur, persistent bacteremia	Positive blood cultures; targeted imaging (MRI spine/joint), echo for endocarditis	Prolonged pathogen-directed IV/ PO antibiotics; source control (drainage/debridement); ID/ cardiology/orthopedics input

Note:: reassess at 48-72 hours; rising O_2 needs, persistent fever, or hemodynamic instability should trigger a search for these complications and a change in management.

PREVENTION AND HEALTH PROMOTION

Preventing CAP starts with reducing host susceptibility and interrupting transmission.

- Vaccines: Give influenza (annual, inactivated preferred) and pneumococcal vaccines. Indications: ≥65 yrs, chronic disease (lung/heart/diabetes), pregnancy, immunocompromise, HCWs/long-term care staff, and other high-exposure groups. Offer before discharge or at outpatient visits in season.
- Pneumococcal: Use conjugate/polysaccharide per age/risk schedule; vaccinate ≥65 yrs and younger adults with high-risk comorbidities.
- Check status at admission and update before discharge or at follow-up if incomplete.
- Risk reduction: smoking cessation; optimize diabetes control.
- Infection prevention: hand hygiene, respiratory etiquette, masks when symptomatic; treat upper-respiratory illness early.
- Seek care early for red flags (breathlessness, high fever). Report clusters/unusual severity/notifiable pathogens to public health.
- Outcome: these steps cut CAP incidence, transmission, and complications.

PATIENT EDUCATION

The objectives of patient education are to ensure early recognition of warning signs :

- Recognize warning signs early: difficult or worsening breathing, persistent high fever, new confusion.
- Finish the full antibiotic course; know when and how to escalate care.
- Use home oxygen correctly (flow rate, duration, safety) when prescribed.
- Keep scheduled follow-ups so non-resolving illness is caught early.

Instructions to Patient / Caregiver

Do's	Don'ts
• Take every dose exactly as prescribed; set reminders.	• Don't stop antibiotics early unless your clinician tells you to.
• Check breathing effort and, if available, SpO_2 at rest and with activity; record readings.	• Don't self-start leftover or over-the-counter antibiotics.
• Use oxygen at the prescribed flow rate; keep cannula clean; store cylinders safely away from flames/heat.	• Don't change oxygen flow on your own or sleep without prescribed oxygen if advised to use it continuously.
• Hydrate, rest, and eat small frequent meals if appetite is low.	• Don't smoke or allow smoking near oxygen equipment.
• Practice hand hygiene and respiratory etiquette; keep vaccinations up to date.	• Don't ignore new chest pain, fainting, severe weakness, or inability to drink.
• Avoid smoke, dust, and indoor pollutants; ventilate rooms.	
• Keep your follow-up appointment; bring your medication list and any home readings.	
Red flag signs- Seek urgent care now if any of these occur	
o SpO_2 < 92% on room air (or falling from your usual baseline) or rapidly rising oxygen requirement o Breathing rate ≥ 30/min, severe breathlessness, blue lips/face o Confusion, drowsiness, or new agitation o Chest pain, coughing blood o Fever that persists or returns after 48-72 hours of antibiotics o Inability to keep down fluids or medicines	

REFERENCES

1. Metlay JP, Waterer GW, Long AC, Anzueto A, Brozek J, Crothers K, et al. Diagnosis and treatment of adults with community-acquired pneumonia: an official clinical practice guideline of the American Thoracic Society and Infectious Diseases Society of America. Am J Respir Crit Care Med. 2019;200(7):e45-e67. doi:10.1164/rccm.201908-1581ST.

2. Infectious Diseases Society of America. Community-acquired pneumonia (CAP) clinical pathway-adult. 2023 [cited 2025 Sep 18]. Available from: https://www.idsociety.org/

3. National Institute for Health and Care Excellence (NICE). Pneumonia: diagnosis and management. NICE guideline NG250. London: NICE; 2025 Sep 2 [cited 2025 Sep 17]. Available from: https://www.nice.org.uk/guidance/ng250

4. Kalil AC, Metersky ML, Klompas M, et al. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by IDSA and ATS. Clin Infect Dis. 2016;63(5):e61-e111. doi:10.1093/cid/ciw353.

5. Martin-Loeches I, Torres A, Rinaudo M, et al. ERS/ESICM/ESCMID/ALAT guidelines for the management of severe community-acquired pneumonia. Intensive Care Med. 2023;49(6):615-32. doi:10.1007/s00134-023-07033-8.

6. Peto L, Nadjm B, Horby P, Ta Thi Dieu Ngan, van Doorn R, Nguyen VK, Wertheim HFL. The bacterial aetiology of adult community-acquired pneumonia in Asia: a systematic review. Trans R Soc Trop Med Hyg. 2014;108(6):326-37. doi:10.1093/trstmh/tru058.

7. World Health Organization. Pneumonia: key facts. Geneva: WHO; [cited 2025 Sep 18]. Available from: https://www.who.int/health-topics/pneumonia

8. Bender RG, Sirota SB, Swetschinski LR, Villanueva Dominguez R-M, Novotney A, et al. Global, regional, and national incidence and mortality burden of non-COVID-19 lower respiratory infections and aetiologies, 1990-2021: a systematic analysis from the Global Burden of Disease Study 2021. Lancet Infect Dis. 2024;24(9):974-1002. doi:10.1016/S1473-3099(24)00176-2.

9. BMJ. Antimicrobial resistance in South-East Asia. London: BMJ; [cited 2025 Sep 18]. Available from: https://www.bmj.com/anti-microbial-resistance

10. Institute for Health Metrics and Evaluation (IHME). The burden of antimicrobial resistance (AMR) in the Maldives. Seattle: IHME; 2023 [cited 2025 Sep 18]. Available from: https://www.healthdata.org/sites/default/files/2023-09/Maldives.pdf

11. Ministry of Health, Maldives. National Action Plan on Antimicrobial Resistance (NAP AMR) 2024-2029. Malé: MoH; 2024 [cited 2025 Sep 18]. Available from: https://health.gov.mv/

12. Yu X, Wang H, Ma S, Chen W, Sun L, Zou Z. Estimating the global and regional burden of lower respiratory infections attributable to leading pathogens and the protective effectiveness of immunization programs. Int J Infect Dis. 2024;149:107268. doi:10.1016/j.ijid.2024.107268.

13. Community-acquired pneumonia: an Asia-Pacific perspective. Respirology. 2007;12:162-4. doi:10.1111/j.1440-1843.2006.01013.x.

14. Song J-H, Huh K, Chung DR. Community-acquired pneumonia in the Asia-Pacific region. Semin Respir Crit Care Med. 2016;37:839-54.

15. Ghimire M, Bhattacharya SK, Narain JP. Pneumonia in South-East Asia Region: public health perspective. Indian J Med Res. 2012;135(4):459-68.

16. Cilloniz C, Dela Cruz CS, Curioso WH, Vidal CH. World Pneumonia Day 2023: the rising global threat of pneumonia and what we must do about it. Eur Respir J. 2023;62(5):2301672. doi:10.1183/13993003.01672-2023.

17. Mandell LA, Wunderink RG, Anzueto A, Bartlett JG, Campbell GD, Dean NC, et al. IDSA/ATS consensus guidelines on the management of community-acquired pneumonia in adults. Clin Infect Dis. 2007;44(Suppl 2):S27-72. doi:10.1086/511159.

18. UpToDate. Overview of community-acquired pneumonia in adults. Waltham (MA): UpToDate; [cited 2025 Sep 18]. Available from: https://www.uptodate.com/

19. Medscape. Bacterial pneumonia guidelines: summary. New York (NY): Medscape; [cited 2025 Sep 18]. Available from: https://emedicine.medscape.com/article/300157-guidelines