Respiratory Investigation 63 (2025) 811–828

Contents lists available at ScienceDirect

Respiratory Investigation

journal homepage: www.elsevier.com/locate/resinv

Guideline

The JRS guideline for the management of pneumonia in adults 2024☆

Hiroshi Mukae [a,b], Naoki Iwanaga [a,*], Nobuyuki Horita [c], Kosaku Komiya [d], Takaya Maruyama [e], Yuichiro Shindo [f], Yoshifumi Imamura [g], Kazuhiro Yatera [h], Yoshihiro Yamamoto [i], Katsunori Yanagihara [j], Nobuaki Shime [k], Kazuyoshi Senda [l], Hiroshi Takahashi [m], Futoshi Higa [n], Tetsuya Matsumoto [o], Makoto Miki [p], Shinji Teramoto [q], Hiroki Tsukada [r], Masahiro Yoshida [s], Naoyuki Miyashita [t], the members of the systematic review team of the Japanese Respiratory Society for the Japanese Clinical Practice Guidelines for Pneumonia in Adults 2024

[a] Department of Respiratory Medicine, Nagasaki University Hospital, Nagasaki, 852-8501, Japan
[b] Department of Respiratory Medicine, Nagasaki University Graduate School of Biomedical Sciences, Nagasaki, 852-8501, Japan
[c] Chemotherapy Center, Yokohama City University Hospital, Yokohama, 236-0004, Japan
[d] Department of Respiratory Medicine and Infectious Diseases, Oita University Faculty of Medicine, Oita, 879-5593, Japan
[e] Mie Prefectural Ichishi Hospital, Mie, 515-3133, Japan
[f] Department of Respiratory Medicine, Nagoya University Graduate School of Medicine, Nagoya, 466-8550, Japan
[g] Medical Education Development Center, Nagasaki University Hospital, Nagasaki, 852-8501, Japan
[h] Department of Respiratory Medicine, University of Occupational and Environmental Health, Japan, Fukuoka, 807-8555, Japan
[i] Department of Clinical Infectious Diseases, Graduate School of Medicine and Pharmaceutical Sciences, Toyama University, Toyama, 930-0194, Japan
[j] Department of Laboratory Medicine, Nagasaki University Hospital, Nagasaki, 852-8501, Japan
[k] Department of Emergency and Critical Care Medicine, Graduate School of Biomedical and Health Science, Hiroshima University, Hiroshima, 734-8551, Japan
[l] Department of Pharmacy, Kinjo Gakuin University, Nagoya, 463-8521, Japan
[m] Department of Respiratory Medicine, Saka General Hospital, Shiogama, 985-8506, Japan
[n] Division of Respiratory Medicine, National Hospital Organization Okinawa National Hospital, Ginowan, 901-2214, Japan
[o] Department of Infectious Diseases, International University of Health and Welfare, Narita, 286-8686, Japan
[p] Department of Respiratory Medicine, Japanese Red Cross Sendai Hospital, Sendai, 982-8501, Japan
[q] Department of Respiratory Medicine, Tokyo Medical University Hachioji Medical Center, Tokyo, 193-0998, Japan
[r] Department of Infection Control, The Jikei University Kashiwa Hospital, Kashiwa, 277-8567, Japan
[s] Department of Hepato-Biliary-Pancreatic and Gastrointestinal Surgery, International University of Health and Welfare, Narita, 286-8686, Japan
[t] First Department of Internal Medicine, Division of Respiratory Medicine, Infectious Disease and Allergology, Kansai Medical University, Hirakata, 573-1010, Japan

ARTICLE INFO

Keywords:
Japanese guidelines
Pneumonia in adults
Antibiotic stewardship
Interdisciplinary collaboration

ABSTRACT

The Japanese Respiratory Society published the Adult Pneumonia Practice Guidelines 2024 in April 2024. In Japan, a super-aged society, the disease burden of pneumonia is significant and is expected to grow in the future. Given this historical context, the most important themes in this revision of the guidelines include the appropriate use of antibiotics and measures against pneumonia in older adults. A large portion of these cases involves aspiration pneumonia, making it challenging to achieve fundamental improvement with antibiotic treatment alone and necessitating a comprehensive approach. Preventing pneumonia and maintaining physical function are

Abbreviations: ACP, advance care planning; AIDS, acquired immunodeficiency syndrome; ATS, American Thoracic Society; BAL, bronchoalveolar lavage; BLNAR, β-lactamase negative ampicillin resistance; CAP, community-acquired pneumonia; CDC, Centers for Disease Control and Prevention; CKD, chronic kidney diseases; CQ, clinical question; HAP, hospital-acquired pneumonia; HCAP, healthcare-associated pneumonia; HR, hazard ratio; IDSA, Infectious Diseases Society of America; IQR, interquartile range; JRS, Japanese Respiratory Society; MRSA, Methicillin-resistant *Staphylococcus aureus*; MSSA, Methicillin-sensitive *Staphylococcus aureus*; NHCAP, nursing and healthcare-associated pneumonia; QOL, quality of life; RCT, randomized controlled trial; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; SR, systematic review; TDM, therapeutic drug monitoring; VAP, ventilator-associated pneumonia.

☆ This is a translated summary of a full Guideline published as a book in Japanese (https://www.jrs.or.jp/publication/jrs_guidelines/20240319125656.html) by The Japanese Respiratory Society: Digest Edition.

* Corresponding author. Department of Respiratory Medicine, Nagasaki University Hospital, 1-7-1 Sakamoto, Nagasaki City, 852-8501, Japan.
E-mail address: niwanaga@nagasaki-u.ac.jp (N. Iwanaga).

https://doi.org/10.1016/j.resinv.2025.06.014
Received 2 May 2025; Received in revised form 12 June 2025; Accepted 15 June 2025
Available online 3 July 2025

essential points for improving the prognosis of pneumonia in older adults, with an emphasis on promoting vaccination, rehabilitation, and oral care.

The treatment of Nursing and Healthcare-Associated Pneumonia (NHCAP), a Japan-specific category adapted from the ATS/IDSA's HCAP guidelines, has been extensively reviewed. Despite international moves away from HCAP due to concerns about the overuse of broad-spectrum antibiotics, Japan has chosen to retain NHCAP for treating pneumonia in older adults while implementing stricter controls on antibiotic use to promote antimicrobial stewardship.

In cases of repeated aspiration pneumonia or in situations where the patient is in a terminal state of age-related decline or the final stage of comorbidities, all pneumonia patients are recommended to undergo a background assessment, occasionally prioritizing palliative care and respecting the patient's outlook on life. The importance of advanced care planning has also been highlighted to underscore the need for interdisciplinary collaboration with medical doctors and other healthcare professionals.

1. Introduction

In Japan, pneumonia is broadly divided into Community-Acquired Pneumonia (CAP), Hospital-Acquired Pneumonia (HAP), and NHCAP from the perspective of the place of onset and the patient's background. According to the Ministry of Health, Labour and Welfare's demographic statistics, pneumonia was the fifth leading cause of death in Japan in 2022; however, when combined with aspiration pneumonia, which is the sixth leading cause of death in Japan, it actually becomes the fourth leading cause. Additionally, since many pneumonia cases are included in the category of death from age-related physical debility (ranked 3rd), the disease burden is significant [1]. More than 98 % of pneumonia deaths in Japan involve older adults aged 65 and over [2], so it can be seen that countermeasures against pneumonia in older adults are an urgent issue in Japan. On the other hand, the age-specific mortality rate of pneumonia in the United States during the same period was relatively low [3], so it is obviously not appropriate to apply the American pneumonia guidelines to Japan as is.

In the guideline, a systematic review (SR) was conducted on 20 clinical questions (CQs). Based on the results of this meta-analysis, the creation committee discussed and determined the recommendation level (Table 1) [4]. For 13 clinical questions, only SRs were conducted

Table 1
Clinical Questions and Recommendations described in the JRS Guideline for Pneumonia in Adults 2024.

CQ	Content	Recommendation	Certainty of Evidence
1	Which of the A-DROP score, CURB-65 score, or PSI score is recommended for assessing the severity of CAP?	We weakly recommend using A-DROP.	C
2	In treating CAP, with improved symptoms and laboratory findings, is a change from injection antibiotics to oral antibiotics (switch therapy) recommended?	We strongly recommend doing switch therapy.	B
3	In treating CAP, is short-term antimicrobial treatment within one week recommended?	We weakly recommend short-term antimicrobial treatment.	B
4	In treating CAP, is it recommended to use β-lactams in combination with macrolides?	i) We weakly recommend using macrolides in severe cases. ii) We weakly recommend not using macrolides in non-severe cases.	C
5	In treating CAP, is the concomitant use of systemic steroids with antibiotics more recommended than treatment with antibiotics alone?	i) We weakly recommend using systemic steroids in severe cases. ii) We weakly recommend not using systemic steroids in non-severe cases.	C
6	In the treatment of NHCAP, are broad-spectrum antibiotics covering *pseudomonas aeruginosa* recommended?	We weakly recommended not using the broad-spectrum antibiotics.	D
7	In treating NHCAP, is short-term antimicrobial treatment within one week recommended?	Recommendation not determined	D
8	In diagnosing NHCAP, is a severity assessment (A-DROP/I-ROAD score) recommended?	We weakly recommend using the severity assessment.	C
9	In the empiric treatment for HAP, is broad-spectrum antibiotic therapy covering *pseudomonas aeruginosa* recommended?	We weakly recommend not using broad-spectrum antibiotics.	C
10	In the empiric treatment for HAP, are anti-MRSA drugs recommended?	We weakly recommend not using anti-MRSA antibiotics.	C
11	In treating HAP, is de-escalation therapy recommended?	We weakly recommend doing de-escalation treatment.	D
12	In the treatment for HAP, is short-term treatment within 7–8 days recommended?	We weakly recommend doing short-term treatment within 7–8 days.	C
13	In diagnosing HAP, is the severity assessment (I-ROAD score) recommended?	We weakly recommend using the severity assessment.	D
14	Is invasive culture sampling using bronchoscopy recommended for VAP?	We weakly recommend not using the invasive diagnostic method with bronchoscopy.	C
15	In the empiric treatment for VAP, is combination or single-antibiotic therapy recommended?	We weakly recommend not using the empirical combination antibiotic therapy.	C
16	In the empiric treatment for VAP, is the use of carbapenems recommended?	We weakly recommend not using the carbapenem antibiotics	C
17	In treating VAP, is a short or long course of antibiotic administration recommended?	We weakly recommend doing the short-course antibiotic treatment	C
18	In treating aspiration pneumonia, are antibiotics recommended to cover anaerobic bacteria?	Recommendation not determined	D
19	In diagnosing pneumonia, is multigene panel testing recommended?	We weakly recommend using multigene panel testing recommended.	C
20	Is oral care recommended to prevent pneumonia?	We weakly recommend doing oral care for preventing pneumonia.	C

Certainty of Evidence; A: Very confident that the true effect is close to the effect estimate, B: Moderate confidence in the effect estimate, C: Limited confidence in the effect estimate, D: Little confidence in the effect estimate.
(The table was modified from the summary of CQs presented on pages vi to vii, as published in the guideline for pneumonia in adults 2024 in Japanese by The Japanese Respiratory Society.).

Table 2
Systematic reviews only described in the JRS Guideline for Pneumonia in Adults 2024.

SR number	Content	Result
1	Procalcitonin measurement in CAP treatment	Antimicrobial treatment under the procalcitonin guide reduces the prescription period of antibiotics, the proportion of antibiotics prescribed, and the length of hospitalization.
2	Microorganisms detected in CAP	Shown in Fig. 2
3	New quinolones as a first-line drug in CAP treatment	The clinical response rate, microbiological response rate, and early clinical response rate improved significantly with the administration of new quinolones. However, we appear to be detecting small differences of clinical significance.
4	What are the resistant bacterial risk factors for NHCAP and medical care-associated pneumonia?	Shown in Table 9
5	What are the resistant bacterial risk factors for CAP (pneumonia group including CAP, medical care-associated pneumonia, and NHCAP)?	In the analysis of the group clinically diagnosed with pneumonia, the resistance bacterial risk factors of CAP drug-resistant pathogens were "COPD, ventilator management by intubation early after hospitalization, history of heart disease, use of inhaled steroids, history of neurological disease, hospitalization history within the past 90 days, history of resistance bacterial detection in the past year, and tracheotomy." The resistant bacterial risk factors in the analysis of bacterial pneumonia obtained from culture tests were "chronic lung disease, CKD, history of heart disease, immunosuppressive status, ADL deficiency, history of resistant bacterial detection in the past year, history of hospitalization in the past 90 days, history of antibiotic use in the past 90 days, admission to a nursing care facility, severe condition, enteral nutrition, use of anti-gastric acid drugs, and bedsores."
6	Microorganisms detected in NHCAP	Shown in Fig. 4
7	Microorganisms detected in HAP (Japan)	Shown in Fig. 6
8	Regarding HAPs + VAPs, are the outcomes different for high-risk and low-risk patients with resistant bacteria?	The prognosis of HAPs and related 30-day mortality did not differ between the two groups.
9	Regarding HAPs + VAPs, is the detection of multi-agent resistant bacteria a poor prognostic factor?	There was no difference in the 30-day mortality rate associated with the initial treatment failure rate and the prognosis of HAPs between the two groups.
10	What are the resistant bacterial risk factors in HAPs + VAPs?	Shown in Table 10
11	Covering anaerobic bacteria in the treatment of HAPs	While initial treatment of HAP with antibiotics with antianaerobic activity significantly reduced the treatment failure rate, the effect on mortality was small, suggesting that the frequency of adverse events may increase.
12	Detected microorganisms in VAP	Shown in Supplemental Fig. 3
13	What are the prognostic factors for CAP in older individuals requiring hospitalization?	In the specified domains, several prognostic factors of short-term mortality were identified. The patient background domain included "age and male," the comorbidities domain included "malignancy, neurological disease, chronic kidney disease, COPD, and heart disease," and the severity domain included "altered consciousness, high BUN level, multiple lobes/bilateral infiltrates, pleural effusion, hypoxemia, high PSI level, tachycardia, shock/systolic blood pressure ≤90 mmHg, high CURB-65 score, tachypnea, bacteremia/sepsis, renal dysfunction/failure, and body temperature below 37 °C. In the patient functionality domain, bedridden status was linked to mortality. Conversely, high levels of "serum albumin, Hb, and BMI" were associated with a reduced risk of death.

(The table was modified from the summary of SRs presented on pages viii to ix in the guideline for pneumonia in adults 2024 in Japanese by The Japanese Respiratory Society.).

without determining the level of recommendation (Table 2). This paper briefly summarizes the "Adult Pneumonia Practice Guidelines 2024″ to disseminate the Adult Pneumonia Practice Guidelines in Japan overseas.

2. Patient background assessment

First, it is recommended in the flowchart to assess whether it falls under the category of "repeated aspiration pneumonia" or "terminal disease or age-related decline," and if applicable, to consider whether or not to emphasize the quality of life (QOL) rather than invasive treatment of pneumonia (Fig. 1). Healthcare, nursing, and welfare professionals will provide patients, their families, and representatives with an explanation of the adequate prognosis and treatment options, and support decision-making through interdisciplinary collaboration in Advance Care Planning (ACP). This involves medical and long-term care pursuing to relieve symptoms based on the consensus of the team.

2.1. Repeated aspiration pneumonia

Aspiration pneumonia is defined as pneumonia that occurs in a host with impaired swallowing function. Since swallowing dysfunction is mainly due to physical weakness associated with aging [5], even if the disease improves once after pneumonia develops, the host's physical functions do not change, so it often recurs. Unlike death due to a common acute disease, the condition gradually progresses toward death through repeated bouts of pneumonia [6]. In fact, it has been shown that people at risk of repeated aspiration are more likely to die within one year, regardless of the cause [7,8].

2.2. Conditions considered to be end-stage disease or age-related frailty

End-stage disease (terminal disease) is defined as "an irreversible process leading to death in which the disease does not respond to appropriate treatment, the pathology is uncontrollable, progression is repeated, and progressive psychosomatic function and QOL are reduced" [9]. The recurrence of aspiration pneumonia may align with terminal-stage disease trajectories such as "dementia/frailty," as described by Lynn et al., which involve a cycle of onset and improvement with gradual decline, leading to death [6]. Frailty is evaluated using the Japanese Cardiovascular Health Study (J-CHS) criteria [10] and the Clinical Frailty Scale (CFS) [11], wherein frailty is defined as a state in which three or more of the five items of walking speed, grip strength, physical activity, fatigue, and weight loss are frail. Decreased activities of daily living (ADLs) and malnutrition have been shown to be significantly associated with the prognosis of CAP [12,13].

2.3. Person-centered care respecting individual wishes and QOL

Respecting individual wishes and maintaining and improving QOL are the essence of medical care. Repeated aspiration pneumonia, senility, and pneumonia in the terminal stage of age-related decline and terminal illness become causes of death, so QOL may not be maintained due to unbearable pain and discomfort. It has been reported that while the life prognosis of patients with advanced dementia improved with

antimicrobial administration, patient QOL deteriorates [14]. ACP is a two-way communication process in which medical and care professionals support decision-making by providing sufficient information to patient surrogate even when patients lose their decision-making capacity, practicing interdisciplinary collaborative medicine and long-term care professionals that forms and shares the consensus of the entire team, including patients and families [15]. If it is agreed that the patient's QOL cannot be maintained even if highly invasive medical treatment is implemented, palliative care should be implemented in alignment with the patient's values and preferences, and the content of the agreement should be recorded in the medical record and updated constantly according to the situation. The recommended timing for ACP is frail patients undergoing pneumonia treatment, repeated cases of aspiration pneumonia, discharge or transfer after the pneumonia condition has stabilized, or when there are changes in the patient's treatment plan or care setting [15]. In a report of 179 cases of pneumonia in long-term care hospitals in Japan, only 16 % of families discussed life extension treatment in advance. The report also found that doctors tended to recall less invasive treatments compared to patients and their families, while families of patients who had lost decision-making capacity often considered more invasive procedures [8]. This highlights a significant gap in the understanding of medical conditions between patients, families, and healthcare professionals. We hope that awareness of ACP will accelerate the spread of " person-centered care respecting individual wishes and QOL ″ for pneumonia.

3. Detection of microorganisms

As shown in the flowchart (Fig. 1), the search for causative microorganisms is important in the treatment of pneumonia.

3.1. Smear, culture, and identification test

In sputum gram staining and culture tests, different microorganisms are detected depending on the staining methods and culture media, so methods suitable for suspected causal microorganisms are used. Sputum gram staining is highly useful when using high-quality samples, with not only the presence or absence of bacteria but also findings such as changes in neutrophils and bacteria capable of being obtained, making it possible to select antibiotics and estimate their effectiveness. In culture and identification testing, while the time required for testing is shortened by introducing a mass spectrometer, it still takes several days to determine drug susceptibility.

3.2. Blood culture

Blood culture tests are important in identifying causal organisms and should be performed on patients who are hospitalized for treatment.

3.3. Antigen detection

Antigen detection targeting pneumonia-causing microorganisms is possible, including pneumococcus, *Legionella pneumophila*, Mycoplasma pneumonia, human metapneumovirus, adenovirus, RS virus, influenza virus, SARS-CoV-2, etc [16–22]. Antigen detection using the immunochromatography method is simple, rapid, and important for diagnosing the microorganisms that cause pneumonia. However, further investigation is required to determine whether viral antigen detection in upper respiratory tract specimens is the causative microorganism of pneumonia.

Urine antigen detection for pneumococcus and *Legionella pneumophila* is widely used in clinical settings. If an antimicrobial agent has already been administered by a former physician or the like, the detection rate of the culture test is likely to decrease; however, the detection rate of the urinary antigen of pneumococcus does not decrease even after initiating treatment with the antimicrobial agent, with cases existing in which antigens are detected in the urine for several months or more after the onset of pneumonia [23]. Therefore, in the case of repeated pneumonia, even if the pneumonia is caused by other causal microorganisms, it should be noted that the urinary antigen may be positive due to previous pneumococcus or Legionella infection.

Regarding antigen testing for viral pneumonia, it is possible to detect SARS-CoV-2 either qualitatively or quantitatively. Since qualitative testing by immunochromatography can be used as a simple and rapid point-of-care device, it is useful for screening symptomatic patients at outpatient clinics and bedside. Chemiluminescent enzyme immunoassay testing requires a measuring instrument, but is more sensitive than immunochromatography.

3.4. Genetic testing

Genetic testing, centered on PCR and LAMP methods, is generally a test method with excellent accuracy. In recent years, fully automated genetic testing systems that can detect major microorganisms in a short time after simple pretreatment have been developed and are becoming popular. There are also systems that can detect the main causative microorganisms and drug resistance genes of bacterial pneumonia, atypical pneumonia, and viral pneumonia in a single comprehensive assay [24], and which are weakly recommended in CQ19.

3.5. Serum diagnosis

Diagnosis by serum antibody titers has been used for mycoplasma pneumonia, pneumonia chlamydia, viruses, and other pathogens that are difficult to test for by culturing. Generally, paired serums at the beginning of infection and 2 weeks later are used, wherein, if the antibody titer has increased by 4-fold or more, it is deemed positive. In Japan, pneumonia chlamydia infection is often diagnosed by measuring anti-*Chlamydia pneumoniae* antibodies. Three antibody titers, IgM, IgG, and IgA, can be measured, with the bacteria causing the infection determined based on the cut-off index value or a significant increase in the antibody titer for IgG and IgA. IgM antibodies begin to rise 2 or 3 weeks after onset, peak after 4 or 5 weeks, and become negative after 3–5 months. In addition, IgG antibodies rise after 30 days and peak after 3–4 months, so tests must be carried out at the appropriate timing in light of the changes in antibody titers [25].

3.6. Other inspection methods

In addition to normal pathological examinations, obtained biopsy tissues and bronchoalveolar lavage (BAL) solutions may be subjected to immunohistological staining, *in situ* hybridization, antigen detection, and genetic testing methods [26].

4. Community-acquired pneumonia (CAP)

4.1. Detecting microorganisms

The guideline creation committee conducted a meta-analysis of detected bacteria in previously published epidemiological studies in Japan [27]. A meta-analysis of 10 studies of CAP cases, both inpatient and outpatient, showed that pneumococcus, bacillus influenzae, and mycoplasma pneumonia were important strains in Community-acquired pneumonia (Fig. 2).

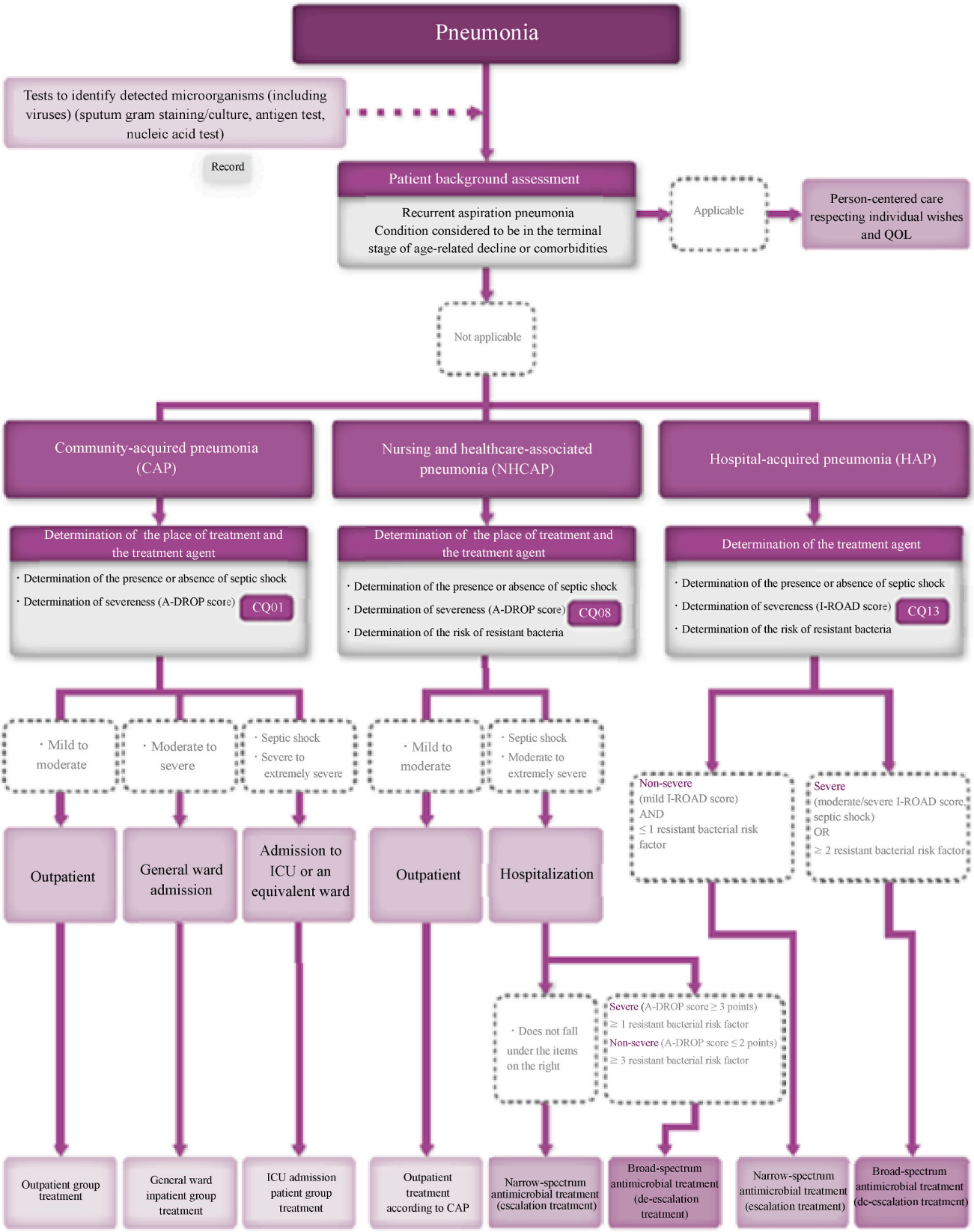

Fig. 1. Diagnosis and treatment guideline for adults with pneumonia 2024 flowchart
After properly assessing the patient's background and detecting causative microorganisms, medical treatment should be conducted under the broad categories of CAP, NHCAP, and HAP. Additionally, for NHCAP and HAP, flowcharts have been developed to identify evidence-based risk factors for bacterial resistance and to appropriately assess the severity of the disease so that appropriate antimicrobial selection can be made.
(The flowchart was modified from the figure on page iv in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society.)

In addition to pneumococcus, *Haemophilus influenza*, and *Mycoplasma pneumonia*, mixed infections of oral streptococci and anaerobic bacteria were often detected in the results of exhaustive bacterial flora analysis using the BAL solution collected from pneumonia lesions as a sample using genetic engineering methods in CAP patients [28].

4.2. Overall flow of CAP treatment

4.2.1. Clinical diagnosis

Check for lower respiratory symptoms (cough, sputum, difficulty breathing, chest pain, etc.) and systemic symptoms (fever, headache, muscle pain, arthralgia, psychiatric symptoms, digestive symptoms, etc.) associated with pneumonia by interview. Imaging should be performed in cases of suspected pneumonia.

4.2.2. Evaluation of severity

The guideline recommends evaluating severity using the A-DROP system, which is an improved version of the UK's CURB-65 (CQ1, Table 3). In pneumonia treatment, the presence or absence of sepsis is also evaluated using screening methods such as quick SOFA (qSOFA). For cases in which sepsis is suspected, sepsis is diagnosed if the SOFA score increases by 2 or more points from the baseline [29].

4.2.3. Differentiating between bacterial pneumonia and mycoplasma pneumonia

It is recommended to differentiate between bacterial pneumonia and mycoplasma pneumonia using the items shown in Table 4 and decide a treatment policy based on the results.

4.2.4. Clinical diagnosis of Legionella pneumonia

Although the frequency of Legionella pneumonia is not high, it tends to rapidly become more severe, so early diagnosis and treatment are necessary. We therefore propose a scoring model for suspected Legionella pneumonia (Table 5) [30].

4.3. Basic concepts of empiric treatment option in CAP

The empiric treatment of CAP recommended by the guidelines is shown in Fig. 3. In addition, the items to be considered for empiric treatment of mild and moderate community-acquired pneumonia are summarized in Table 6. In particular, the points to consider are: (1) the frequency and age of onset of the causative microorganisms; (2) understanding the drug resistance status; (3) understanding the characteristics of respiratory quinolone; and (4) confirming the presence of tuberculosis. Because many respiratory quinolones are susceptible to mycobacterium tuberculosis, administering them in cases complicated by pulmonary tuberculosis carries risks such as delaying diagnosis [31–33], contributing to a poor prognosis [32,34,35], and increasing the

Table 3
A-DROP score.

	Item	Contents
A	Age	Males 70+, Females 75+
D	Dehydration	BUN ≥21 mg/dL or dehydrated
R	Respiration	SpO_2 90 % or less (PaO_2 60 torr or less)
O	Orientation	Change in consciousness present
P	Blood Pressure	Blood pressure (systolic) ≤ 90 mmHg

Mild: None of the above five items apply.
Moderate: One or two of the above items apply.
Severe: Three of the above items apply.
Extremely severe: Four or five of the above items apply.
However, if there is shock, even a single item will be considered extremely severe.
(The table was modified from Table 3 on page 31 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society Society.).

Table 4
Differentiation between bacterial pneumonia and mycoplasma pneumonia.

	Contents
1)	Age <60
2)	No or minor underlying disease
3)	Have a stubborn cough
4)	Poor thoracic auscultation findings
5)	Causal bacteria cannot be proven with rapid diagnosis methods[a]
6)	Peripheral white blood cell count is less than 10,000/uL

If 5 or more of the 6 items match, mycoplasma pneumonia is suspected, while if 2 or fewer items match, bacterial pneumonia is suspected. If 3 or 4 items match, the possibility of difficult differentiation or mixed infection of both pathogens is considered.
(The table was modified from Table 4 on page 32 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society Society.).
[a] Excluding positive results for mycoplasma antigens or genetic tests.

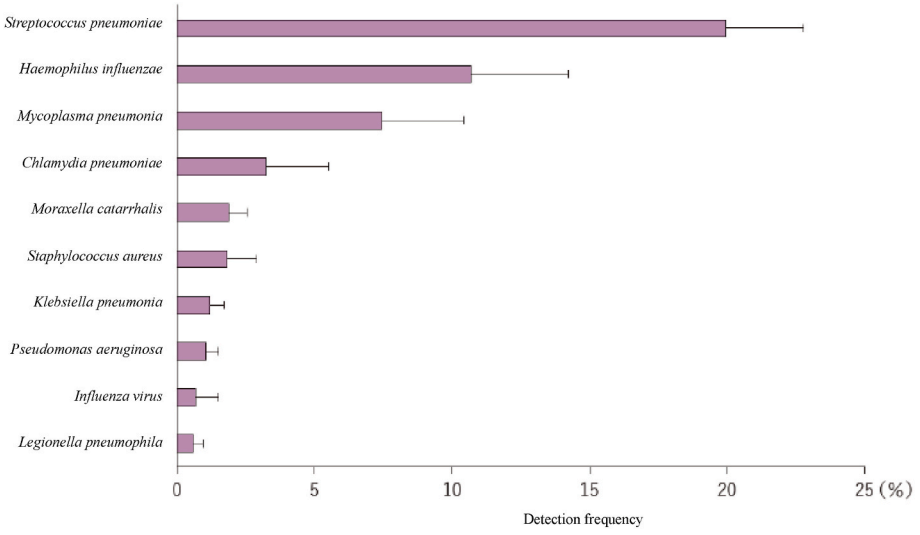

Fig. 2. Top 10 pathogenic microorganisms detected in CAP cases, both inpatient and outpatient, in Japan
Streptococcus pneumoniae was the most frequently isolated organism, followed by *Haemophilus influenzae* and *Mycoplasma pneumoniae*. The results are consistent with previous reports.
(The figure was modified from Fig. 1 on page 29 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society.).

Table 5
Legionella diagnostic prediction score.

	Contents
1)	Male
2)	No coughing
3)	Difficulty breathing
4)	CRP value ≥ 18 mg/dL
5)	Na value < 134 mmol/L
6)	LDH value ≥ 260U/L

Reference Findings: Hypophosphatemia.
If each item applies, assign 1 point to the score. With a score of 3 or higher, suspect Legionella pneumonia.
(The table was modified from Table 5 on page 33 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society Society.).

risk of quinolone resistance [36–38].

In severe cases that require systemic management in the intensive care unit, the use of antibiotics that are anti-*pseudomonas aeruginosa* agents will also be considered. Previous administration of antibiotics, history of *pseudomonas aeruginosa* detection, immunodeficiency status, neutropenia, etc. are risk factors for *pseudomonas aeruginosa* infection.

4.4. Approach to targeted therapy

Targeted therapy is recommended if the causal bacterium is confirmed. While antimicrobial agent selection is based on the antimicrobial susceptibility of the causative bacteria and local drug susceptibility trends, the basic rule is to select an antimicrobial with a narrow spectrum.

4.5. Adjuvant therapy

4.5.1. Macrolides (CQ4)

As a result of a meta-analysis, with severe pneumonia, the effect of improving life prognosis and pneumonia cure rate was clarified when macrolide drugs were combined with β-lactams. Consequently, it was weakly recommended to use macrolides in combination for severe community-acquired pneumonia.

4.5.2. Steroid drugs (CQ5)

SR and meta-analyses revealed a reduction in short-term mortality as well as a reduction in hospitalization duration of approximately 0.7 days in severe CAP cases alone. As a result of the voting by the creation committee, it was weakly recommended not to use systemic steroids in combination with antibiotics for mild to moderate CAPs and weakly recommended to use systemic steroids in combination with antibiotics for severe CAPs.

4.6. Switch therapy and duration of treatment

If initial treatment confirms a clear improvement in symptoms/laboratory findings and oral intake, switch therapy is actively

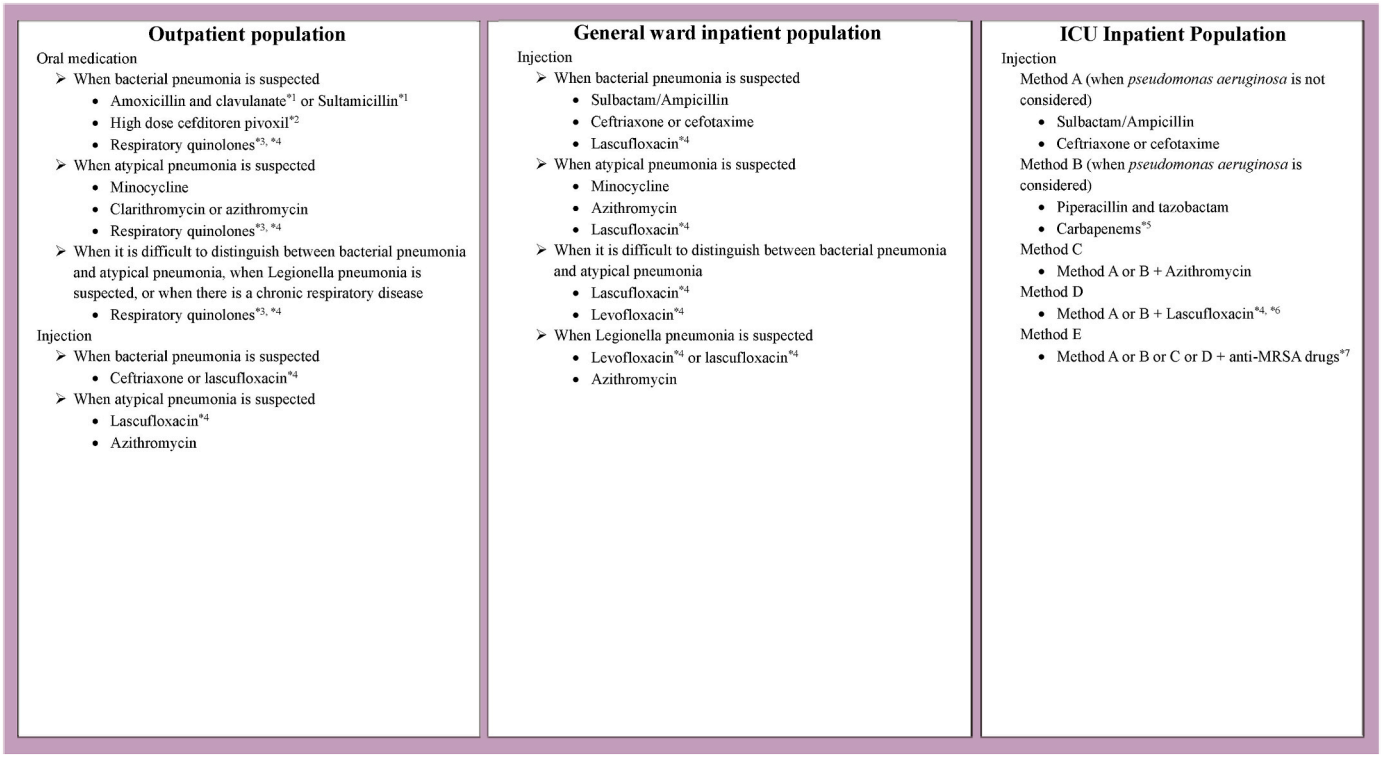

Fig. 3. Recommendation for empiric therapy against CAP
Antimicrobial agents might be selected by differentiating bacteria from *Mycoplasma pneumoniae* or *Legionella* spp. and selecting antimicrobial agents for the suspected microorganisms detected.
*1: High doses are desirable. For specific doses, see "References: Typical Antimicrobial Drug Names and Dosages" at the end of the volume (p.228)
*2: In the event it is necessary to consider haemophilus influenza BLNAR
*3: Lascufloxacin, garenoxacin, moxifloxacin, sitafloxacin, tosufloxacin, levofloxacin
*4: It has antibacterial properties against tuberculosis, so prior to use, carefully diagnose the presence or absence of tuberculosis (excluding tosufloxacin)
*5: Meropenem, doripenem, biapenem, imipenem cilastatin
*6: Alternatives: Levofloxacin*4, ciprofloxacin*4, or pazufloxacin*4
*7: Select in patients at high risk of MRSA pneumonia: linezolid, vancomycin, teicoplanin, arbekacin.
(The figure was modified from Fig. 4 on page 35 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society.).

Table 6
Points to consider in empiric treatment of mild to moderate CAP.

1	Choose antibiotics that take into account pneumococcus and atypical pathogens
2	Understand the status of drug resistance in pneumococcus, haemophilus influenza, and mycoplasma pneumonia
3	Many cases of mycoplasma pneumonia are mild, and although macrolide-resistant strains are present in several tens of percent, the effectiveness of macrolide antibiotics has been demonstrated (however, the clinical effect is inferior compared to tetracycline and respiratory quinolone)
4	For the older patients, consider antibiotics assuming oral bacteria and anaerobic bacteria
5	Although there are six agents of respiratory quinolone, they are not equivalent when taking drug resistance measures into consideration, and new quinolones, garenoxacin and lascufloxacin, have been developed as resistance bacteria measures based on the PK/PD theory
6	Respiratory quinolone is the best drug for oral treatment; however, the presence or absence of tuberculosis should be considered when using it

(The table was modified from Table 6 on page 33 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society Society.).

recommended (CQ2) [39–41]. Regarding the treatment period, if the patient has mild to moderate symptoms and the initial treatment is effective, short-term antibiotic treatment within 1 week does not exacerbate the mortality rate, pneumonia cure rate, or pneumonia relapse rate, and it has the effect of reducing medical costs; therefore, it is weakly recommended (CQ3). For cases in which the causative organisms are severe or difficult-to-treat pathogens such as *Legionella* spp., Methicillin-resistant *Staphylococcus aureus* (MRSA), or *Pseudomonas aeruginosa*, or when the infection has spread beyond the lungs, treatment for 7–14 days (or longer) may be required.

4.7. Approach when antibiotics are ineffective

Regarding the causes of initial treatment failure in community-acquired pneumonia, infectious factors account for 40–60 % of cases, while non-infectious factors account for 15–25 % of cases. With early failure, infectious factors are often involved, while with late failure, the rate of non-infectious factors is high. Heart failure is the most common non-infectious condition and is also of great importance as a factor that inhibits the healing of pneumonia [42–45].

5. Viral pneumonia

5.1. Clinical characteristics

Viral pneumonia can be broadly classified into two types: (1) pneumonia caused by respiratory viruses that primarily target the airways (respiratory system); and (2) pneumonia as a complication of a viral infection that affects not only the respiratory system but also other organs or cells, leading to systemic symptoms. Respiratory tract viruses usually take the form of upper respiratory tract inflammation, which has a good prognosis; however, they may develop into lower respiratory tract infections and be complicated by pneumonia. In the latter case, as a complication of systemic infection, the virus transfer into the lungs and causes pneumonia in a hematologic or lymphatic manner. It often occurs in AIDS patients, patients with malignant tumors such as malignant lymphoma and leukemia, and susceptible hosts such as organ transplant patients.

Respiratory tract viruses include coronavirus, influenza virus, adenovirus, RS virus, parainfluenza virus, human metapneumovirus, etc., while viruses that cause systemic symptoms include cytomegalovirus, varicella/herpes zoster virus, herpes simplex virus, and measles virus. The transmission route of respiratory tract viruses is often droplet transmission, while the transmission route of measles and chickenpox virus is mainly airborne transmission (droplet nuclear transmission), with the onset of cytomegalovirus being the reactivation of the virus from the latent infection state after the initial infection [46,47].

5.2. Epidemiological characteristics

Over the past four years, COVID-19 have been frequently seen as the cause of community-acquired pneumonia, so the involvement of viruses in pneumonia has garnered attention. Viral pneumonia is often seen in children and has been considered a relatively rare condition in adults. With SR, although there are differences in the frequency of virus detection between studies, it has been reported to be approximately 24.5 % [48], in addition to also being strongly associated with adult pneumonia. The results of these studies examined detected viruses, so it is unclear whether the virus itself caused the pneumonia. Table 7 summarizes the reports of attempts to detect viruses as the cause of adult-community-acquired pneumonia prior to the emergence of COVID-19 [49–52].

5.3. Diagnostics

Diagnosis of viral infection depends on isolated cultures, antigen detection, gene detection, or serological diagnosis. Because virus isolation requires cultured cells, the procedure is cumbersome and takes a long time to determine. Serological diagnosis is also poor in terms of swiftness due to the need for paired serums. Therefore, rapid diagnostic kits to detect antigens are widely used for general CAP testing.

5.4. Does viral pneumonia meet the guidelines?

The pneumonia treatment guidelines first assess the severity of the disease and determine the place of treatment. Studies evaluating the severity of COVID-19 pneumonia have reported that the A-DROP system is superior to PSI and CURB-65 [53–56]. Viral pneumonia is classified as atypical pneumonia. When using the differential table of bacterial pneumonia and mycoplasma pneumonia (atypical pneumonia) (Table 4), while the sensitivity of diagnosing atypical pneumonia in community-acquired pneumonia caused by the delta variant was high at 84 %, the diagnostic sensitivity was low at 50–65 % in

Table 7
Frequency of virus detection in community-acquired pneumonia (Before the COVID-19 pandemic).

CQ	United States (Jain S et al., 2015)	United States (Self WH et al., 2016)	United Kingdom (Gadsby NJ et al., 2016)	Japan (Saito A et al., 2006)
Implementation Facility	5 Facilities	CDC	2 Facilities	20 Facilities
Number of Cases	2,259	192	323	232
Age (median value)	57	54	67	60
Detected viruses (%)	589 (26.1)	47 (24.5)	98 (30.3)	38 (16.4)
Virus + bacteria mixed detection (%)[a]	59 (10.0)		80 (81.6)	15 (39.5)
Virus type				
Rhinovirus	194 (8.6)	21 (10.9)	41 (12.7)	0
Influenza virus A or B	132 (5.8)	5 (2.6)	23 (7.1)	31 (13.4)
Human metapneumovirus	88 (3.9)	8 (4.2)	3 (0.9)	0
RS virus	68 (3.0)	3 (1.6)	4 (1.2)	1 (0.4)
Parainfluenza virus	67 (3.0)	3 (1.6)	11 (3.4)	2 (0.9)
Cold coronavirus	53 (2.3)	6 (3.1)	9 (2.8)	0
Adenovirus	32 (1.4)	3 (1.6)	7 (2.2)	3 (1.3)
Chickenpox/shingles virus	0	0	0	1 (0.4)

(The table was modified from Table 1 on page 18 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society Society.).
[a] % of viruses detected as the population number.

community-acquired pneumonia caused by the origin variant, alpha variant, and omicron variant [57–60]. Therefore, it was considered difficult to apply this differential table to COVID-19 pneumonia. However, when limited to young adults under the age of 60, it was possible to distinguish bacterial pneumonia with a diagnostic sensitivity of 90 % or more in community-acquired pneumonia caused by any variant (wave). In addition, using the Legionella core model (Table 5), it was possible to distinguish between Legionella pneumonia and all variants with a median value of 2 points [61].

CT images of viral pneumonia are associated with the pathogenicity of individual viruses and are said to exhibit similar imaging patterns depending on the virus family [62]. The important point is that the shadows vary from phase to phase. On the other hand, if it is a respiratory tract virus, it often exhibits a glassy shadow on both sides, so if it is a typical image, it is possible to distinguish and infer bacterial pneumonia from the image findings. In addition, if classified as atypical pneumonia using the differential table, it can be distinguished from mycoplasma pneumonia [58,59].

6. Nursing and Healthcare Associated Pneumonia (NHCAP)

6.1. Clinical characteristics

The concept of NHCAP was based on HCAP of the HAP/VAP/HCAP in 2005, jointly announced by ATS and IDSA [63]. The definition of NHCAP was created in 2011 taking into account the medical and nursing care system and treatment status in Japan based on this definition of HCAP (Table 8). Currently, it has become an important concept in Japan against the backdrop of a super-aged society.

Patients with NHCAP (Nursing and Healthcare-associated Pneumonia) tend to be older, have poorer activities of daily living (ADL), and often have underlying health conditions compared to those with CAP (Community-acquired Pneumonia) [64–68]. In many cases, aspiration is involved in the disease process, and the prognosis is generally worse than that of CAP. In addition, in the case of so-called terminal pneumonia, the abovementioned patient background assessment is important for treatment decisions taking into account individual will and QOL.

6.2. Detecting microorganisms

Meta-analysis of detected microorganisms was performed on 23 previously reported articles of epidemiological studies in Japan [67, 69–87] and 6,417 cases of NHCAP, both inpatient and outpatient (SR6). As a result, similar to CAP, pneumococcus was isolated the most (12.4 %), followed by Klebsiella (7.4 %), MRSA (5.9 %), *Pseudomonas aeruginosa* (5.0 %), *Haemophilus influenza* (4.9 %), methicillin-susceptible *Staphylococcus aureus* (MSSA) (4.8 %), *Streptococcus* spp. (4.1 %), *Escherichia coli* (3.0 %), *Chlamydia pneumoniae* (2.5 %), and *Moraxella catarrhalis* (2.1 %) (Fig. 4). In the comprehensive bacterial flora analysis method targeting the 16S ribosomal ribonucleic acid gene of bacteria using bronchoalveolar lavage solution in HCAP patients, many anaerobic bacteria such as oral *streptococci* and *Prevotella* were detected [83], so careful judgment is required as to whether the bacteria detected from sputum are the causative bacteria.

Table 8
Definition of Nursing and healthcare-associated pneumonia: NHCAP
It is a community-onset pneumonia that meets any of the following four criteria.

1)	Admitted to a long-term hospital bed group[a] or nursing care facility
2)	Discharged from hospital within 90 days
3)	Older adults and persons with disabilities requiring care[b]
4)	Undergoing continuous endovascular treatment (treatment with dialysis, antibiotics, chemotherapy, immunosuppressive drugs, etc.) at the hospital

(The table was modified from Table 1 on page 49 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society Society.).

[a] Including psychiatric beds.

[b] PS 3: Can only handle a limited amount of personal matters. Spend 50 % of the day in bed.Use the above as a guideline.

6.3. management flow

6.3.1. Severity assessment

An SR was conducted of the CQ "Is severity assessment (A-DROP/I-ROAD score) recommended in NHCAP diagnosis?"; however, although the death prediction accuracy of the existing scoring system in NHCAP is not high, we believe that evaluating severity and predicting the prognosis itself is important in clinical practice. In addition, the severity evaluation by A-DROP was weakly recommended because there were no disadvantages such as cost, effort, and invasion (CQ8).

6.3.2. Assessment of drug resistance risk factors

With NHCAP, approximately 7–15 % of cases are caused by resistant bacteria that are not targeted by standard CAP treatments [69,76,79, 87]. It is important to identify which characteristics of NHCAP patients are susceptible to detecting resistant bacteria at the time of initial antibiotic selection [88–90].

An SR was conducted for the question, “What are the resistant bacterial risk factors in NHCAP patients?” and a meta-analysis of resistant bacterial risk factors was performed focusing on factors reported in two or more studies out of six previously reported [79,91–95]. Multivariate analyses of resistant bacterial risk factors in patients with NHCAP, HCAP, and Nursing home-acquired pneumonia (NHAP) (SR4). With NHCAP, six factors were found to be significant risk factors for resistant bacteria (Table 9). In addition to the above, "history of chronic respiratory disease" was also a significant risk factor for *Pseudomonas aeruginosa*.

6.3.3. Empiric therapy

With empiric treatment, in order to properly evaluate the risk of resistant bacteria, upon classification as NHCAP, the presence or absence of significant resistant bacterial risk factors in NHCAP patients shown in Table 9 is evaluated again and empiric treatment is selected (Fig. 5).

6.3.3.1. Empiric therapy for outpatients. When selecting initial antibiotics for outpatient treatment of NHCAP patients, it is generally recommended to approach it in the same way as CAP. However, since aspiration is more commonly involved in NHCAP, it is important to consider the increased likelihood of the involvement of oral cavity flora and anaerobic bacteria, which should be taken into account when choosing the initial antibiotics. Furthermore, it is necessary to carefully determine the presence or absence of tuberculosis when selecting a respiratory quinolone medication.

6.3.3.2. Empiric therapy for inpatients. In NHCAP patients, broad-spectrum antibiotic administration should be limited to patients with the risk factor "past* history of resistant bacteria detection" (*roughly the past one year) and the risk factors for the resistant bacteria shown in Table 9. We also consider the existence of a "history of chronic respiratory disease” to be a risk factor for *Pseudomonas aeruginosa*. In non-serious cases, broad-spectrum antibiotic administration is acceptable when there are three or more resistant bacterial risk factors, and in severe cases, it is acceptable when there are one or more resistant bacterial risk factors.

There is also evidence from Japan that the prognosis worsens with the administration of broad-spectrum antibiotic in groups with a low risk of resistant bacteria [87,96]. In the resistant bacteria low-risk group, it is better to initially treat with narrow-spectrum antibiotics (standard CAP treatment regimen) rather than broad-spectrum antibiotics covering *Pseudomonas aeruginosa* and MRSA (CQ6).

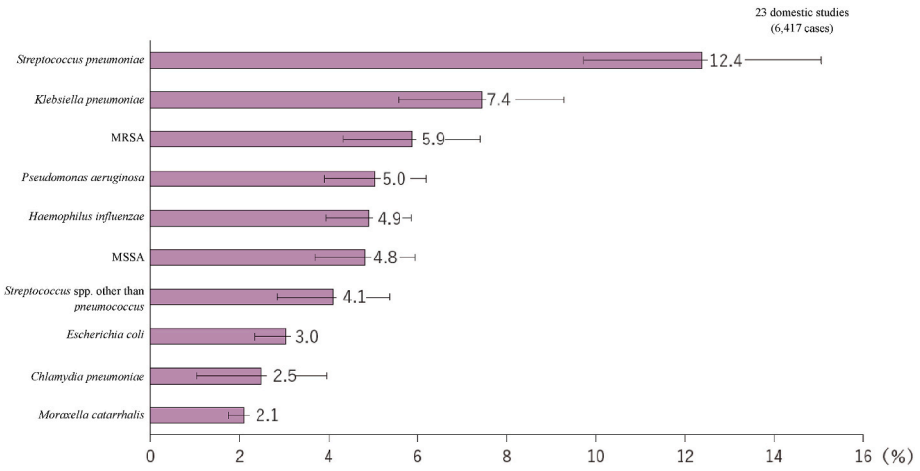

Fig. 4. Detected bacteria in NHCAP (integrated values and 95 % confidence intervals for each study are shown)
Streptococcus pneumoniae was the most frequently isolated, followed by *Klebsiella pneumoniae* (7.4 %), methicillin-resistant *Staphylococcus aureus* (MRSA) (5.9 %), *Pseudomonas aeruginosa* (5.0 %), *Haemophilus influenzae* (4.9 %), methicillin-susceptible *Staphylococcus aureus* (MSSA) (4.8 %), Streptococcus spp. methicillin-susceptible *Staphylococcus aureus* (MSSA) (4.8 %), Streptococcus spp. (4.1 %), *Escherichia coli* (3.0 %), *Chlamydia pneumoniae* (2.5 %), and *Moraxella catarrhalis* (2.1 %).
(The figure was modified from Fig. 1 on page 50 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society.).

Table 9
Risk factors for resistant bacteria and the magnitudes in NHCAP/HCAP/NHAP.

Significant resistance to bacterial risk factors	CAP drug-resistant bacteria	
	Number of bibliographies (editions)	OR [lower, upper]
Enteral nutrition	2	2.29[1.31, 4.01]
Hypoalbuminemia	3	1.80[1.16, 2.81]
Antimicrobial use in the last 90 days	4	2.50[1.39, 4.49]
Requires ventilator management through early intubation after admission	3	3.22[2.05, 5.05]
Hospitalization history within the last 90 days	2	1.28[1.07, 1.53]
Immunosuppressive state	2	1.39[1.23, 1.59]

Although not significant, "a history of detection of resistant bacteria in the past year" with a high OR is also a risk factor that should be considered. In addition to the above, "history of chronic respiratory disease" is also a significant risk factor for *pseudomonas aeruginosa*.
(The table was modified from Table 2 on page 52 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society Society.).

7. Aspiration pneumonia

7.1. Clinical characteristics

Aspiration pneumonia is defined as “pneumonia that occurs in a host at risk of aspiration [97,98].” The risk of aspiration is broadly classified into decreased swallowing function and gastroesophageal dysfunction (Table 1) [5], with many of the causes thereof related to systemic weakness associated with aging. Aspiration pneumonia is known to have a poor prognosis compared to pneumonia other than aspiration pneumonia in community-acquired pneumonia [12]. Furthermore, the risk of aspiration is related to the onset of aspiration pneumonia and subsequent poor prognosis. At the same time, this suggests that there is an aspect of so-called senility in which even if people recover from pneumonia, they die from various causes [99]. In addition, the disease name "aspiration pneumonia" is a disease concept that reflects the onset mechanism and is included in CAP, NHCAP, and HAP, respectively, which are classified based on the main site of onset [5,100]. Most NHCAPs are considered to be aspiration pneumonia; however, although the associations between aspiration pneumonia, NHCAP, and senility are similar concepts, it is necessary to use them while keeping in mind the differences therebetween (Supplemental Fig. 1).

7.2. Epidemiological characteristics of aspiration pneumonia

7.2.1. Number of patients and prevalence

Since 2017, the Ministry of Health, Labour and Welfare has separated aspiration pneumonia from pneumonia in vital statistics. As a result, there is a tendency for deaths due to aspiration pneumonia to be seen as increasing and deaths due to pneumonia to be seen as decreasing.

7.2.2. Causing microorganisms

Reports from the 19 [101]s to the 1980s found a high frequency of anaerobic bacteria in patients with aspiration pneumonia [102]. On the other hand, a 1999 report suggested that the involvement of anaerobic bacteria was small [103] and the involvement of anaerobic bacteria in aspiration pneumonia is debated. Bacterial flora analysis using the 16S ribosomal RNA gene using bronchoalveolar lavage solution as a sample in CAP cases found that streptococci and anaerobic bacteria constituting the oral persistent flora were predominantly detected [104].

7.3. Overall flow of treatment

7.3.1. Diagnosis

Aspiration pneumonia is defined as “pneumonia that occurs in a host at risk of aspiration,” so pneumonia is diagnosed as aspiration pneumonia when it occurs in a host at risk of aspiration as previously described. However, in the diagnosis of aspiration pneumonia, it is difficult to set objective indicators other than confirming the risk of aspiration. While swallowing contrast tests and swallowing endoscopy are considered the gold standard methods for evaluating swallowing function, the reality is that even if these tests show no abnormalities, they cannot be ruled out.

7.3.2. Treatment

The microorganisms detected in patients with aspiration pneumonia are somewhat different from common CAP and are characterized by a lower frequency of pneumococcus and an increased rate of *Klebsiella*,

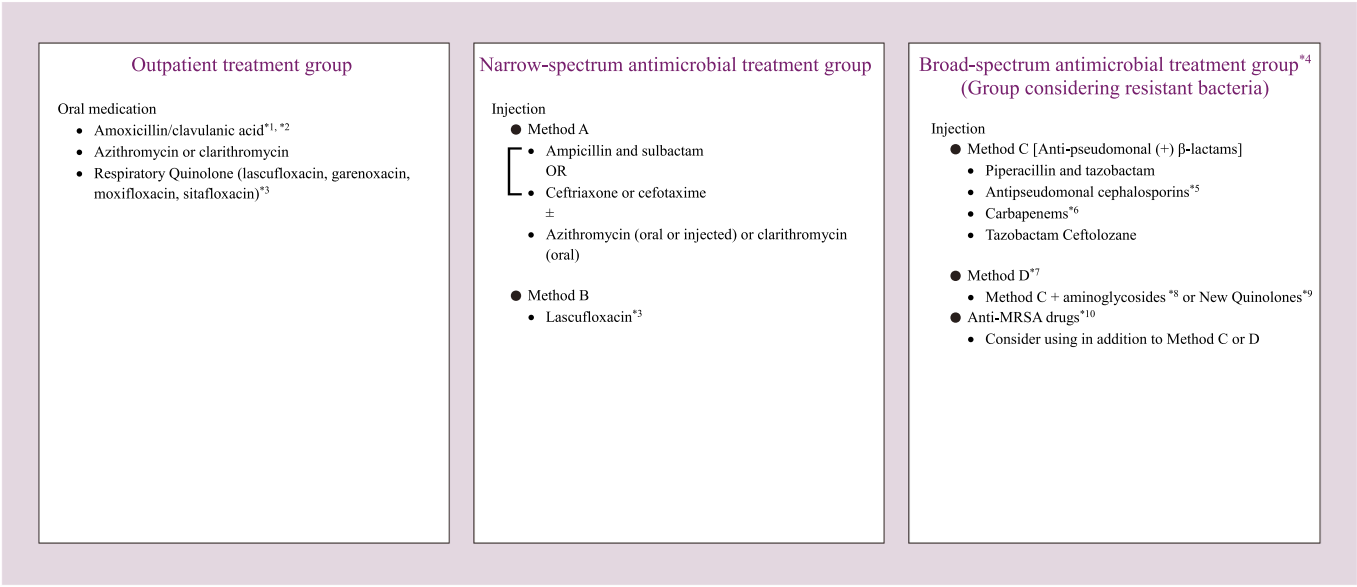

Fig. 5. Recommendation for empiric therapy against NHCAP
Empiric therapy for NHCAP should be initiated based on the severity of the disease and the patient's risk factors for resistant bacteria. The initial selection of antibiotics should reflect the higher frequency of oral commensal and anaerobic bacteria involved in NHCAP compared to CAP.
*1: High doses are desirable. For specific doses, see "References: Typical Antimicrobial Drug Names and Dosages" at the end of the volume (p.228)
*2: Note that sulbactam ampicillin and amoxicillin clavulanic acid are not effective against certain haemophilus influenza strains.
*3: It has antibacterial properties against tuberculosis, so prior to use, carefully diagnose the presence or absence of tuberculosis Since aspiration is often involved in the pathophysiology of NHCAP, antibiotics with activity against anaerobic bacteria are selected.
*4: When selecting this treatment, de-escalation treatment should be considered after confirming the culture results.
If a patient with a "history of detection of resistant bacteria in the past year" uses a broad-spectrum antibiotic, the susceptibility test results when detected in the past should be used as a reference. Note that there is also a possibility of fixation when MRSA is detected. Anti-MRSA drugs will be considered in severe cases.
*5: Ceftazidime, cefepime, cefozopran
*6: Meropenem, doripenem, biapenem, imipenem cilastatin
*7: When taking this method, refer to the antibiogram of each facility for drugs in the method C. Consider in serious cases.
*8: Amikacin, tobramycin, gentamicin
*9: Ciprofloxacin, pazufloxacin, levofloxacin
*10: Linezolid, vancomycin, teicoplanin When applying method D, arbekacin can be used as an aminoglycoside.
(The figure was modified from Fig. 4 on page 55 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society.).

MRSA, *Pseudomonas aeruginosa*, and anaerobic bacteria. In addition, it should be noted that even if these resistant bacteria are detected, there are also many cases of colonization only. The basic choice of antibiotics in the treatment of pneumonia is to use penicillin, with sulbactam ampicillin being the first choice for aspiration pneumonia when administered as an injection. However, when the causative microbe is resistant to sulbactam ampicillin due to β-lactamase negative ampicillin resistance (BLNAR), ceftriaxone-based antibiotics (third generation or later) are effective. Furthermore, it was not possible to provide a certain level of recommendation regarding the coverage of anaerobic bacteria in the treatment of aspiration pneumonia (CQ18) [105]. Although MRSA is often detected, most are well-established, with domestic and international studies having shown that combining anti-MRSA drugs does not improve the prognosis [106–108]. *Pseudomonas aeruginosa* is often an established bacterium and there is no clear evidence that the selection of antibiotics with anti-*pseudomonas aeruginosa* activity improves prognosis [109]. In principle, penicillin-based antibiotics (high doses) are also used as oral medications. If ineffective, consider the high-dose administration of respiratory quinolone and third-generation cephem or switch to injectable drugs, taking into account BLNAR and their ability to penetrate the lungs, as previously described. However, when using quinolone-based antibiotics, caution must be observed regarding the possibility of tuberculosis [110].

Furthermore, the need for not only physical rehabilitation but also respiratory rehabilitation and swallowing rehabilitation has been proposed for patients hospitalized with aspiration pneumonia [111]. However, in the case of refractory aspiration pneumonia, it is important to consider the overall condition of the patient while involving the patient, family, and healthcare providers in making decisions, including considering palliative care.

8. Hospital-Acquired Pneumonia (HAP)

8.1. Basic characteristics of HAP

Among HAPs, there are two types of pneumonia: ventilated HAP (V-HAP), in which the respiratory status worsens and requires ventilator management, and non-ventilated HAP (NV-HAP), which does not require ventilator management. At present, it has been reported that the 28-day mortality rate for V-HAP is high at 27.8 %, a prognosis that is clearly poor compared to NV-HAP at 14.5 % and VAP at 18 % [112,113].

8.2. Epidemiological characteristics

HAP is often accompanied by malnutrition, weakness, and a deterioration of the general condition as a result of advanced medical care. Such patients are often exposed to bacteria residing in hospital environments, and because they have previously been treated with antibiotics, drug-resistant bacteria are often the cause of their illness.

8.2.1. Life prognosis

In a recent report on Japanese people, the mortality rate within 30

days of HAP [114]alone was 13.6 %, while the mortality rate within 30 days of HAP and VAP combined was 12.4 % [115]. From the United States, the mortality rate within 30 days of HAP is reportedly approximately 15–20 %, while the mortality rate of HAP is generally considered to be approximately 15 % [116,117].

8.2.2. Bacteria detection

A meta-analysis was performed on the microorganisms detected in HAP (SR7). The microorganisms detected in 1,872 cases were analyzed, with the frequencies thereof found to be high at 21.2 % for *S. aureus* (MRSA 14.4 %, MSSA 6.8 %) and *11.3 % for P. aeruginosa*. This was followed by *K. pneumoniae at* 5.0 % and *S. maltophilia at* 2.9 % (Fig. 6). In a report that examined BAL fluid from Japanese HAP patients using a comprehensive microbiota analysis method targeting the 16S rRNA gene, while oral bacteria accounted for more than half, *the frequency was high at 23.3 % for Corynebacterium* sp., 13.7 % for *S. aureus*, 13.7 % *for Haemophilus* sp., and 11.0 % for *P. aeruginosa* [28].

8.3. Treatment of HAP

The treatment of HAP is divided into three groups based on 1. the presence or absence of septic shock, 2. the severity thereof, and 3. the risk of resistant bacteria: 1) initiating treatment with narrow-spectrum antibiotics; 2) initiating treatment with broad-spectrum antibiotics (single-agent); and 3) initiating treatment with broad-spectrum antibiotics (multiple agents) (Fig. 1).

Upon conducting a meta-analysis in order to identify resistant bacterial risk factors, five factors were extracted, with two or more thereof considered to be at high risk of resistant bacteria (Table 10) (SR8): (1) onset in the ICU; (2) sepsis/septic shock; (3) recent history of antibiotic use; (4) decreased activity (PS $\geq$ 3, basal index <50, inability to walk, tube nutrition or central venous nutrition; and (5) chronic kidney disease (including dialysis): GFR <60 mL/min/1.73 m^2. Applying these risk factors to 2 epidemiological studies conducted in Japan [114,115], the detection rates of resistant bacteria were 40.1 % and 47.1 % respectively when defining high risk as having $\geq$2 risk factors for resistant bacteria, and 19 % and 27.7 % with <2 risk factors. Hence, HAP patients with $\geq$2 risk factors are classified as high risk for resistant bacteria.

8.3.1. Narrow-spectrum antimicrobial therapy

Although HAP has a higher risk of resistant bacteria than CAP, it is not necessary to administer broad-spectrum antibiotics targeting resistant bacteria in all cases (CQ9, CQ10), with the suitability thereof dependent on the risk of resistant bacteria and the severity of pneumonia. The severity of HAP is determined by I-ROAD (Supplemental Fig. 2) (CQ13), while the risk of resistant bacteria is determined by (Table 10). If the severity is not high (mild in I-ROAD (Group A)) and the risk of resistant bacteria is low, initial treatment with narrow-spectrum antibiotic therapy is recommended (Fig. 1).

Table 10
Risk factors for resistant bacteria in HAP
High risk of resistant bacteria when two or more items apply.

1	Onset in ICU
2	Sepsis/septic shock
3	History of antimicrobial use within the last 90 days
4	Decreased activity, unable to walk: PS $\geq$ 3, basel index[a] <50, unable to walk, enteral nutrition or central venous nutrition
5	CKD (including dialysis): eGFR <60 mL/min/1.73 m^2

(The table was modified from Table 3 on page 67 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society Society.).
[a] Basel index: Evaluate 1. meals, 2. travel, 3. personal grooming, 4. toilet activity, 5. bathing, 6. walking, 7. climbing up and down stairs, 8. changing clothes, 9. defecation, and 10. urination on a scale of 0–15 points, and score on a scale of 0–100 points.

8.3.2. Broad-spectrum antimicrobial (single-agent) treatment

Broad-spectrum antimicrobial (single-agent) treatment should be considered for groups that have been diagnosed with HAP and are severe (moderate in I-ROAD (group B) or higher or is in septic shock) or groups deemed to be at high risk of resistant bacteria (Figs. 1 and 7).

8.3.3. Broad-spectrum antimicrobial (multi-agent) therapy

In particular, regarding septic shock or V-HAP, broad-spectrum antibiotic (multi-agent) therapy will also be considered. Considering the anti-biogram of each facility, it is desirable to consider whether it is a broad-spectrum antimicrobial (single agent) or a broad-spectrum antimicrobial (multi-agent). Antimicrobial agents are based on β-lactams that have antibacterial activity against *Pseudomonas aeruginosa* and are used in combination with quinolones or aminoglycosides. If the risk of MRSA infection is determined to be high, combined use with anti-MRSA drugs is considered (Fig. 7). In addition, when treatment is initiated with a broad-spectrum antibiotic and the causative microorganism later

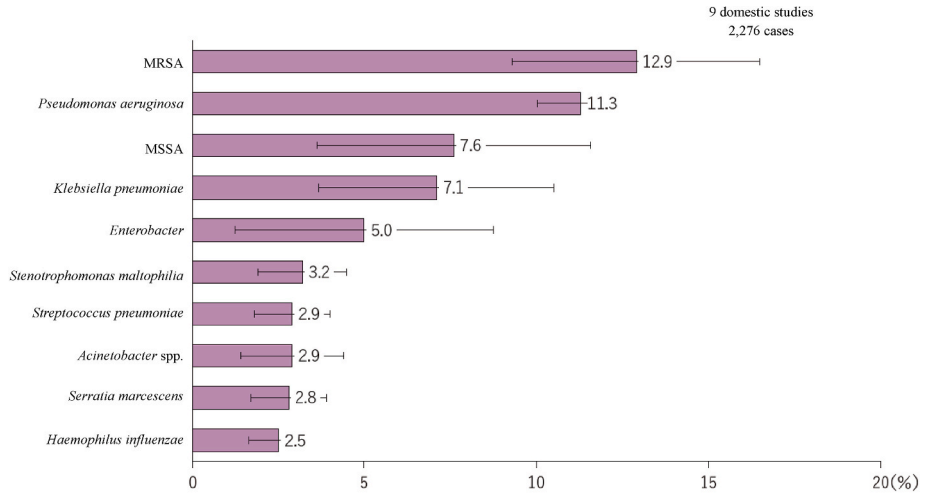

Fig. 6. Detected bacteria in HAP (integrated values and 95 % confidence intervals for each study are shown)
The detected microorganisms in 2,276 cases were analyzed, with a high frequency of *Staphylococcus aureus* (20.5 %) [methicillin-resistant *Staphylococcus aureus* (MRSA) 12.9 %, methicillin-susceptible *Staphylococcus aureus* (MSSA) 7.6 %] and *Pseudomonas aeruginosa* (11.3 %). The detection of *Klebsiella pneumoniae* (7.1 %), *Enterobacter* spp. (5.0 %), and *Stenotrophomonas maltophilia* (3.2 %) were followed.
(The figure was modified from Fig. 1 on page 63 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society.).

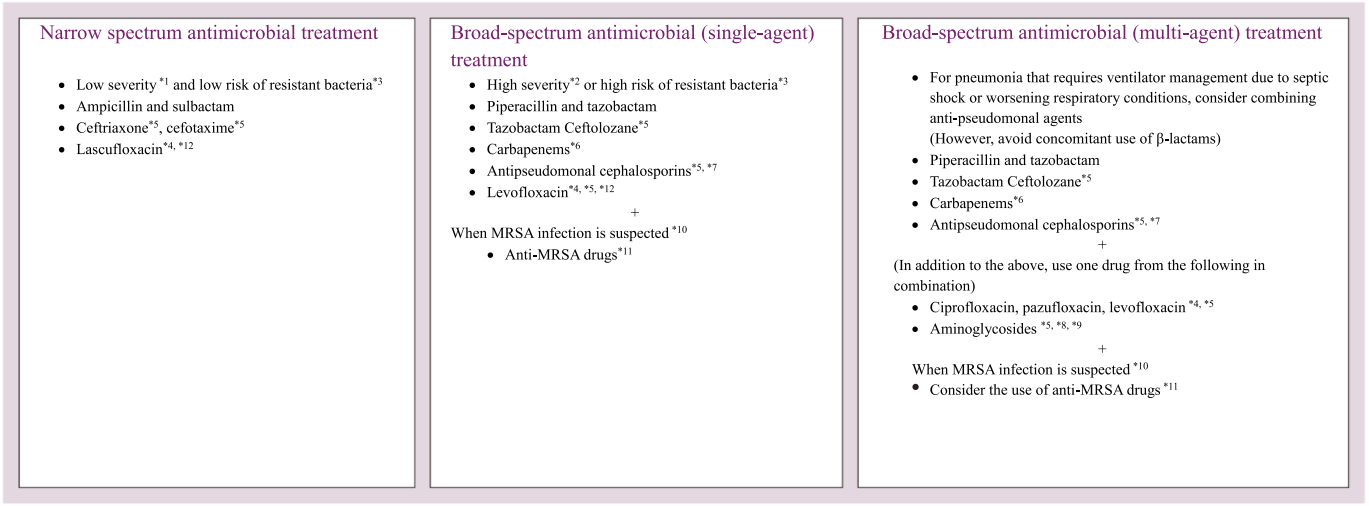

Fig. 7. Recommendation for empiric therapy against HAP
Consider using sulvactam-ampicillin, ceftriaxone, cefotaxime, or lascufloxacin against the cases with mild severity and low risk of resistance. Unless mentioned above, broad-spectrum antimicrobials with anti-*Pseudomonas aeruginosa* activity are recommended.
*1: I-ROAD score shows mild symptoms (group A)
*2: I-ROAD score shows moderate or higher symptoms (group B) or septic shock
*3: Refer to Table 1
*4: It has antibacterial properties against tuberculosis, so prior to use, carefully diagnose the presence or absence of tuberculosis
*5: In the case of a condition with a high probability of anaerobic bacterial infection (pulmonary abscess/pulmonary suppuration, etc.), consider combining clindamycin or metronidazole
*6: Meropenem, doripenem, biapenem, imipenem cilastatin
*7: Cefozopran, cefepime
*8: Amikacin, tobramycin, gentamicin
*9: Not recommended for patients with impaired renal function, the older adults, or those suspected of having Legionella pneumonia
*10: History of MRSA isolation or use of intravenous antibiotics within the past 90 days. Note that MRSA also has a possibility of fixation
*11: Linezolid, vancomycin, teicoplanin, arbekacin
*12: History of allergy to β-lactams.
(The figure was modified from Fig. 5 on page 68 in the 2024 guideline for pneumonia in adults in Japan by The Japanese Respiratory Society.).

becomes known, it is recommended to switch to a narrower target treatment (de-escalation) (CQ11) after this discovery.

8.3.4. *HAP antimicrobial administration period*

Based on the results of SR and meta-analysis, short-term antibiotic treatment (within 7–8 days) was weakly recommended by the creation committee for the administration period of antibiotics (CQ12). However, if it is caused by glucose non-fermenting bacteria, the recurrence rate tends to be high after antibiotics are stopped, so caution is required.

8.3.5. *Targeted therapy for carbapenem-resistant gram-negative bacteria*

Carbapenem-resistant gram-negative bacteria is the generic term for *Enterobacteriaceae*, *P. aeruginosa*, and *Acinetobacter* that are resistant to carbapenem-based antibiotics and broad-spectrum β-lactam-based antibiotics. When these are determined to be causative microorganisms, administration of relevactam/imipenem/cilastatin or siderophore cefalosporin is considered as a targeted therapy.

9. Ventilator-Associated Pneumonia (VAP)

VAP occurs in 5–40 % of all intubated patients, with attributable mortality rate of approximately 10 % [118,119]. The detected microorganisms had a high proportion of *P. aeruginosa* (29.2 %) and MRSA (12.0 %) (Supplemental Fig. 3) [120].

9.1. *Diagnosis*

When treatment is initiated upon a clinical diagnosis alone, the administration of antibiotics can be started earlier. However, clinicians should consider pitfalls associated with antimicrobial overuse; the possibility of inappropriate treatment, the prolonged duration of treatment, and the selection of resistant bacteria [121]. VAP can be diagnosed clinically as shown in Table 11. It is weakly recommended not to perform invasive sampling using bronchoscopy (CQ14).

9.2. *Treatment*

Appropriateness of empirical antibiotics affects the mortality rate, while excessive use of antibiotics also needs caution [122]. Antimicrobial agents to cover the gram-negative bacilli group should be selected with consideration of the possibility of antibiotic-resistant strains, particularly if a patient received antibiotics within the past 90 days, had colonization with resistant bacteria or was mechanically ventilated for more than 4 days. However, it is recommended not to routinely administer multiple antibiotic therapy with antipseudomonal activity (CQ15). It is also recommended not to use carbapenems (CQ16). Once the culture results are obtained, the antibiotics should be changed to one with the narrowest spectrum possible, and if infection is negative, the antibiotics should be discontinued (de-escalation). The duration of antimicrobial therapy is recommended to be relatively short (7–8 days) (CQ17).

9.3. *Prevention*

Some of the following can be applied in combination for the prevention of VAP; hand hygiene, avoiding supine positions, infrequent replacement of the respiratory circuit, avoiding excessive sedation, promoting weaning from the ventilator, use of the tracheal tube with a subglottic suction port, or use of automatic cuff pressure controller.

Table 11
Clinical diagnosis of VAP
Diagnose by combining the following.

Radiology	Two or more serial chest radiographs with at least 1 of the following: New or progressive and persistent infiltrate Consolidation Cavitation
Systemic symptoms	i) Systemic inflammatory response: increases in fever, CRP, procalcitonin, etc. ii) Hypotension or increased demand for inotropes
Respiratory symptoms	i) Worsening gas exchange (desaturations), increased oxygen requirements, or increased ventilation demand ii) New onset of purulent sputum, change in character of sputum, increased respiratory secretions, or increased suctioning requirements iii) New onset of worsening cough, dyspnea, or tachypnea
Microbiological criteria	i) Positive quantitative culture from bronchoalveolar lavage (BAL or min-BAL) (10^4 or more colony-forming units (CFU)/mL) or direct tracheal aspirate of the lower respiratory tract (10^6 or more CFU/ml) ii) Positive semiquantitative culture from bronchoalveolar lavage (2+ or more) or direct tracheal aspirate of the lower respiratory tract (3+ or more) iii) Positive growth in blood culture not related to another source of infection or positive growth in culture of pleural fluid

(The table was generated from the mention on pages 71 to 72 of the 2024 guidelines for pneumonia in adults in Japan by The Japanese Respiratory Society.).

10. Pneumonia prevention

10.1. Pneumococcal vaccine

10.1.1. Introduction

While the retention rate of pneumococcus in adults is not so high at 5–10 %, in children it is high at 20–40 %, with pneumonia often caused by transmission from children to adults. In particular, it is necessary for those in the high-risk group, such as older people aged 65 and over and those with underlying diseases, to be vaccinated with the pneumococcal vaccine to prevent pneumonia. As there is sufficient evidence for the pneumococcal vaccines based on the meta-analysis of the Adult Pneumonia Practice Guidelines 2017, this time it will be expressed as a good practice statement without conducting SR or meta-analysis.

10.1.2. Types and characteristics of pneumococcal vaccines

Pneumococcal vaccines are broadly classified into two types: capsule polysaccharide type and protein-bound type. The capsule polysaccharide type is a 23-valent capsule polysaccharide pneumococcal vaccine (PPSV [pneumococcal polysaccharide vaccine] 23), while the protein-bound type is a 13-valent protein-bound pneumococcal vaccine (PCV [pneumococcal conjugate vaccine] 13) or a 15-valent protein-bound pneumococcal vaccine (PCV [pneumococcal conjugate vaccine] 15) x. PPSV23 can cover 23 types and a wide range of capsule types, while the immune mechanism is B-cell-dependent, so it has a lower immune effect than PCV13. On the other hand, the immune mechanisms of PCV13 and PCV15 can be expected to have a high immune effect in order to mediate T cells, while the capsule type that can be covered is less than PPSV23. Note that all vaccines are inactivated vaccines whose safety has been established, and the side effects are the same.

10.1.3. Clinical trial showing efficacy of pneumococcal vaccine

10.1.3.1. PPSV23. In the Adult Pneumonia Practice Guidelines 2017, SR was performed on the preventive effect of combined influenza vaccines and pneumococcal vaccines. As a result, three RCTs were extracted for Japanese people [101,123,124], wherein a significant inhibitory effect on "hospitalization due to all pneumonia" was observed.

10.1.3.2. PCV13. RCTs on PCV13 were conducted among 84,496 healthy older people in the Netherlands. For the capsular types included in PCV13, a good preventive effect has been reported, reducing non-invasive pneumococcal pneumonia by 45 %, invasive pneumococcal disease (IPD) by 75 %, and overall pneumococcal pneumonia by 30.6 % and IPD by 51.8 % in all capsular types [125].

10.1.3.3. PCV15. In RCTs comparing PCV15 and PCV13 among those aged 50 and older, non-inferiority was shown for the common serotype 13, while superiority was shown for the unique serotype 2. PCV15 showed superiority for Type 3, which is one of the major capsule types in Japan [126].

10.1.3.4. PCV20. The US Immunization Advisory Board has recommended PCV20 as a stand-alone vaccine for seniors 65 and older and those at high risk of pneumococcal infection between the ages of 19 and 64 since 2022 [127]. In an epidemiological study of adult IPD conducted in Japan, it was reported that the capsule type coverage rate of the vaccine in 2022 was equivalent to 47 % for both PCV20 and PPSV23.

10.1.4. Pneumococcus capsule type

Pneumococcal infections in the older adults are affected by children because pneumococcal infections are transmitted from children to the older adults and the frequency of infections is high. In children, the coverage rate of PCV13 was as high as 90.8 % in 2009 prior to the introduction of PCV7; however, the coverage rate has declined rapidly since the introduction of PCV (2010: PCV7, 2014: PCV13). In 2022, 43 cases of pediatric IPD were registered; however, for the PCV13-containing type, there was only one, 19a type, with a coverage rate of 2.3 %. For adults, the coverage rate of IPD in 2014 was PCV 13:45 % and PPSV 23:67 %; however, this decreased to PCV 13:26 % and PPSV 23:47 % in 2022, a drop considered to be influenced by children. The capsule-type coverage rate of PCV15 was almost the same as that of PCV13.

10.1.5. Pneumococcal vaccination method

PPSV23 vaccination is recommended for healthy older people taking advantage of routine vaccination opportunities. PCV13 or PCV15 is recommended for people at high risk of pneumococcal infection (especially immunosuppressed patients), while PPSV23 is recommended after one year (continuous vaccination).

10.2. Oral care

10.2.1. Introduction

Aspiration pneumonia is thought to overlap with CAP, NHCAP, and HAP in the older adults, mainly in older people with reduced activity. In recent years, a comprehensive bacterial flora analysis method using BAL in Japan has identified a priority strain of pneumonia in older adults (HAP, (N)HCAP). Both oral streptococci and anaerobes have been detected in the upper ranks, thus indicating that they are involved in the development of pneumonia [28].

Regarding aspiration pneumonia, oral care can be performed to keep the oral cavity clean and reduce the number of bacteria. In addition, RCTs targeting residents of assisted living facilities in Japan have reported that high-quality oral care reduces the incidence of pneumonia,

the number of days of fever, and even mortality due to pneumonia [128].

10.2.2. Effectiveness of oral care (CQ20)

As a result of performing a meta-analysis on the effectiveness of oral care, the initial onset of pneumonia and deaths due to pneumonia were found to be significantly suppressed in the oral care group. Although the initial onset of pneumonia (VAP) was significantly suppressed in the oral care group, most of the reports cited in the analysis were from overseas studies using chlorhexidine. In Japan, the use of high concentrations of chlorhexidine on the mucosal surface is contraindicated due to concerns about anaphylactic shock, so mouthwashes such as popidone iodide and benzethonium chloride are often used. Going forward, it is necessary to accumulate evidence in line with the actual situation in Japan regarding VAPs. In this committee, there were many opinions that "strongly recommend" the implementation of oral care from the viewpoint of prevention of onset and improvement of life prognosis; however, considering the problem of manpower and the fact that it cannot be implemented in all medical institutions and for all cases, the voting result was "weakly recommend."

11. CQs

The recommended levels determined at the guidelines development meeting are summarized in Table 1. In addition, the meeting was concluded with the attendance of more than 70 % of the creation committee members who have the right to vote. Recommendations were decided based on deliberations and votes by the creation committee, with a consensus reached using the amended Delphy Law. Members, excluding those with economic and academic COIs, voted and decided with more than 70 % of the votes in favor. If a decision had not been reached within three voting sessions, the recommendation level would have been set to "could not be determined." In addition to the "strength of evidence" and "balance of benefits and harms" required in evaluating and integrating the evidence, "diversity of patient values" and "economic perspectives" were also considered and voted on, with matters related to these votes determined before the guidelines preparation meeting.

12. Future perspectives

In this paper, we introduced the JRS Adult Pneumonia Practice Guidelines 2024 as a digest version. As in the previous edition, it complies with the "Guidelines for the Preparation of Minds Practice Guidelines," implements SRs for CQs in each area, and presents them in the form of recommendations based on the results of the vote of the creation committee. In addition, discussion points based on SR alone are presented, so we believe that it has become possible to provide sufficient evidence to answer the clinical questions of local doctors. We hope that the new evidence presented in this revision of the guidelines can be verified at actual clinical sites and new evidence can be disseminated from Japan. In addition, one of the characteristics of this revision is that it presents areas where evidence is lacking as future research questions, so we hope that our readers (doctors) will use this as a topic for their clinical research.

Through the description of this paper, we hope to help overseas respiratory specialists understand pneumonia management in Japan.

Author contributions

HM and NI made substantial contributions to the conception of the work. HM, NI, NH, KK, TM, YS, YI, K. Yatera, YY, K. Yanagihara, NS, KS, HT, FH, TM, MM, ST, HT, MY, and NM made significant contributions to the data analysis and interpretation. HM and NI drafted the original manuscript, and other authors substantially contributed to revising the manuscript drafts. All authors have approved the submitted version of the manuscript and agreed to be accountable for any part of the work.

Funding

Japanese Respiratory Society.

Declaration of competing interest

Dr. Hiroshi Mukae received honoraria from Shionogi & Co., Ltd., KYOLIN Pharmaceutical Co., Ltd., Pfizer Japan Inc., MSD K.K., Nippon Boehringer Ingelheim Co., Ltd., Insmed Incorporated, Chugai Pharmaceutical Co., Ltd., Novartis Pharma K.K., Gilead Sciences Inc., Asahi Kasei Pharma Corporation, AstraZeneca K.K., GlaxoSmithKline K.K., and Taisho Pharma Co., Ltd., a research grant from Nippon Boehringer Ingelheim Co., Ltd., Taiho Pharmaceutical Co., Ltd., Taisho Pharma Co., Ltd., Ltd., KYORIN Pharmaceutical Co., Ltd., Shionogi & Co., Ltd., FUJIFILM Toyama Chemical Co., Ltd., and Otsuka Pharmaceutical Co., Ltd. and subsidies or donations from Taiho Pharmaceutical Co., Ltd. and Taisho Pharma Co., Ltd.; Dr. Katsunori Yanagihara received honoraria from KYORIN Pharmaceutical Co., Ltd., Daiichi Sankyo Co., Ltd., MSD K.K., GlaxoSmithKline K.K., Becton, Dickinson and Company, Shionogi & Co., Ltd., BioMérieux Japan Ltd., a research grant from Fujifilm Toyama Chemical Co., Ltd., KYORIN Pharmaceutical Co., Ltd., Shionogi & Co., Ltd., and subsidies or donations from KYORIN Pharmaceutical Co., Ltd., Taiho Pharmaceutical Co., Ltd., and Sumitomo Dainippon Pharma Co., Ltd.; Dr. Kazuhiro Yatera received honoraria from GlaxoSmithKline K.K., AstraZeneca K.K., Nippon Boehringer Ingelheim Co., Ltd., Novartis Pharma K.K., a research grant from Insmed Inc., Bayer Pharma Japan, KYORIN Pharmaceutical Co., Ltd., Taiho Pharmaceutical Co., Ltd., GlaxoSmithKline K.K., and subsidies or donations from Taiho Pharmaceutical Co., Ltd., Teijin Home Healthcare Ltd., and Teijin Pharma Ltd.; Dr. Kosaku Komiya received honoraria from KYORIN Pharmaceutical Co., Ltd., and Nippon Boehringer Ingelheim Co., Ltd.; Dr. Makoto Miki received honoraria from KYOLIN Pharmaceutical Co., Ltd.; Dr. Naoki Iwanaga received a research grant from MSD K.K. and Fujifilm Toyama Chemical Co., Ltd.; Dr. Naoyuki Miyashita received honoraria from AstraZeneca K.K., KYORIN Pharmaceutical Co., Ltd., Novartis Pharma K.K., Pfizer Japan Inc., Daiichi Sankyo Co., Ltd., Taisho Pharma Co., and Astellas Pharma Inc.; Dr. Nobuaki Shime received honoraria from Beckton Dickinson Japan, and Asahi-kasei Pharma.; Dr. Shinji Teramoto received honoraria from AstraZeneca K.K., KYORIN Pharmaceutical Co., Ltd., Novartis Pharma K.K., and Nippon Boehringer Ingelheim Co., Ltd.; Dr. Tetsuya Matsumoto received honoraria from KYORIN Pharmaceutical Co., Ltd., MSD K.K., and Pfizer Japan Inc.; Dr. Yuichiro Shindo received honoraria from KYORIN Pharmaceutical Co., Ltd., AstraZeneca K.K., Nippon Boehringer Ingelheim Co., Ltd., Gilead Sciences Inc., MSD K.K., GlaxoSmithKline plc., Insmed, Inc., Asahi Kasei Pharma Co., Ltd., and Pfizer Inc., and a research grant from Japan Society for the Promotion of Science. He participated on a Data Safety Monitoring Board or Advisory Board of GlaxoSmithKline BIOLOGICALS SA, Insmed, Inc., and Pfizer Inc.; Drs. Futoshi Higa, Hiroki Tsukada, Hiroshi Takahashi, Kazuyoshi Senda, Masahiro Yoshida, Nobuyuki Horita, Takaya Maruyama, Yoshifumi Imamura, and Yoshihiro Yamamoto have no conflict of interest.

Acknowledgments

We would like to thank Brian Quinn, Editor-in-Chief, Japan Medical Communication (www.japan-mc.co.jp), for editing a draft of this manuscript and the systematic review members of the JRS guidelines committee for their valuable investigations. The systematic review team of the Japanese Respiratory Society for the Japanese Clinical Practice Guidelines for Pneumonia in Adults 2024 is composed of the following members: Nobumasa Aoki, Masaharu Aga, Shotaro Ide, Akihiro Ito, Takashi Ueji, Masahiro Katsurada, Hitoshi Kawasuji, Yosuke Goto, Hisayuki Shuto, Dongjie Zyo, Hiroshi Sugimoto, Kohei Somekawa, Takayuki Takahama, Hao Chen, Kazuya Tone, Natsuki Nakagawa, Itaru Nakamura, Kentaro Nagaoka, Ho Namkoong, Yuka Numata, Shingo

Noguchi, Shusaku Haranaga, Nobuhiko Fukuda, Yosuke Fukuda, Yuji Fujikura, Hiroyuki Matsumoto, Hiroshi Moro, Yuki Yoshimatsu, and Naoki Iwanaga.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.resinv.2025.06.014.

References

[1] Ministry of Health LaW. <Summary of vital statistics (fixed number) in 2022.2022.pdf>.
[2] Munyonho FT, Clark RDE, Lin D, Khatun MS, Pungan D, Dai G, et al. Precision-cut lung slices as an ex vivo model to study Pneumocystis murina survival and antimicrobial susceptibility. mBio 2024;15:e0146423.
[3] Timmer KD, Floyd DJ, Scherer AK, Crossen AJ, Atallah J, Viens AL, et al. Multiparametric profiling of neutrophil function via a high-throughput flow cytometry-based assay. Cells 2023;12.
[4] Guideline published as a book in Japanese (https://www.jrs.or.jp/publication/jrs_guidelines/20240319125656.html) [by The Japanese Respiratory Society].
[5] Mandell LA, Niederman MS. Aspiration pneumonia. N Engl J Med 2019;380:651–63.
[6] Lunney JR, Lynn J, Hogan C. Profiles of older medicare decedents. J Am Geriatr Soc 2002;50:1108–12.
[7] Taylor JK, Fleming GB, Singanayagam A, Hill AT, Chalmers JD. Risk factors for aspiration in community-acquired pneumonia: analysis of a hospitalized UK cohort. Am J Med 2013;126:995–1001.
[8] Takazono T, Imamura Y, Kawakami K, Yamasaki N, Shimizu H, Usuki K, et al. Discrepancies in preferences regarding the care of terminal-phase pneumonia in elderly patients among patients, families, and doctors: a multicenter questionnaire survey in nagasaki, Japan. Respir Investig 2020;58:488–94.
[9] Ministry of Health LaW. <Guidelines for the Decision-Making Process for Health and Care in the Last Phase of Life. https://www.mhlw.go.jp/stf/newpage_02783.html.pdf>.
[10] Satake S, Arai H. The revised Japanese version of the Cardiovascular Health Study criteria (revised J-CHS criteria). Geriatr Gerontol Int 2020;20:992–3.
[11] editors GMR. Clinical Frailty Scale [monograph on the Internet] Halifax: Geriatric Medicine Research, Dalhousie University/Nova Scotia Health Authority. [https://www.dal.ca/sites/gmr/our-tools/clinical-frailty-scale.html].
[12] Komiya K, Rubin BK, Kadota JI, Mukae H, Akaba T, Moro H, et al. Prognostic implications of aspiration pneumonia in patients with community acquired pneumonia: a systematic review with meta-analysis. Sci Rep 2016;6:38097.
[13] Ryu S, Oh SK, Cho SU, You Y, Park JS, Min JH, et al. Utility of the blood urea nitrogen to serum albumin ratio as a prognostic factor of mortality in aspiration pneumonia patients. Am J Emerg Med 2021;43:175–9.
[14] Givens JL, Jones RN, Shaffer ML, Kiely DK, Mitchell SL. Survival and comfort after treatment of pneumonia in advanced dementia. Arch Intern Med 2010;170:1102–7.
[15] The Japan Geriatrics Society. <ACP_proposal.https://www.jpn-geriat-soc.or.jp/proposal/acp.html>.
[16] Sinclair A, Xie X, Teltscher M, Dendukuri N. Systematic review and meta-analysis of a urine-based pneumococcal antigen test for diagnosis of community-acquired pneumonia caused by Streptococcus pneumoniae. J Clin Microbiol 2013;51:2303–10.
[17] Izumikawa K, Akamatsu S, Kageyama A, Okada K, Kazuyama Y, Takayanagi N, et al. Evaluation of a rapid immunochromatographic ODK0501 assay for detecting Streptococcus pneumoniae antigen in sputum samples from patients with lower respiratory tract infection. Clin Vaccine Immunol 2009;16:672–8.
[18] Kawasaki T, Nakagawa N, Murata M, Yasuo S, Yoshida T, Ando K, et al. Diagnostic accuracy of urinary antigen tests for legionellosis: a systematic review and meta-analysis. Respir Investig 2022;60:205–14.
[19] Hurt AC, Alexander R, Hibbert J, Deed N, Barr IG. Performance of six influenza rapid tests in detecting human influenza in clinical specimens. J Clin Virol 2007;39:132–5.
[20] Miyashita N, Kawai Y, Kato T, Tanaka T, Akaike H, Teranishi H, et al. Rapid diagnostic method for the identification of Mycoplasma pneumoniae respiratory tract infection. J Infect Chemother 2016;22:327–30.
[21] Dinnes J, Sharma P, Berhane S, van Wyk SS, Nyaaba N, Domen J, et al. Rapid, point-of-care antigen tests for diagnosis of SARS-CoV-2 infection. Cochrane Database Syst Rev 2022;7:CD013705.
[22] National Institute of Infectious Diseases NCfGHaM, National Association of Directors of Public Health Centers. Guideline for the laboratory for pathogenicity of novel coronavirus infections (COVID-19). sixth ed. 2022. https://www.mhlw.go.jp/content/001029252.pdf.
[23] Mukae H, Yatera K, Noguchi S, Kawanami T, Yamasaki K, Tokuyama S, et al. Evaluation of a rapid immunochromatographic ODK0501 assay for detecting Streptococcus pneumoniae antigens in the sputum of pneumonia patients with positive S. pneumoniae urinary antigens. J Infect Chemother 2015;21:176–81.
[24] Kosai K, Akamatsu N, Ota K, Mitsumoto-Kaseida F, Sakamoto K, Hasegawa H, et al. BioFire FilmArray Pneumonia Panel enhances detection of pathogens and antimicrobial resistance in lower respiratory tract specimens. Ann Clin Microbiol Antimicrob 2022;21:24.
[25] Miyashita N, Kawai Y, Tanaka T, Akaike H, Teranishi H, Wakabayashi T, et al. Antibody responses of Chlamydophila pneumoniae pneumonia: why is the diagnosis of C. pneumoniae pneumonia difficult? J Infect Chemother 2015;21:497–501.
[26] Barnes P. The pathology of community-acquired pneumonia. Semin Respir Infect 1994;9:130–9.
[27] Fujikura Y, Somekawa K, Manabe T, Horita N, Takahashi H, Higa F, et al. Aetiological agents of adult community-acquired pneumonia in Japan: systematic review and meta-analysis of published data. BMJ Open Respir Res 2023;10.
[28] Nemoto K, Yatera K, Akata K, Ikegami H, Yamasaki K, Hata R, et al. Comparative study of bacterial flora in bronchoalveolar lavage fluid of pneumonia patients based on their pneumonia subtypes and comorbidities using 16S ribosomal RNA gene analysis. J Infect Chemother 2022.
[29] Guarino M, Perna B, Cesaro AE, Maritati M, Spampinato MD, Contini C, et al. 2023 update on sepsis and septic shock in adult patients: management in the emergency department. J Clin Med 2023;12.
[30] Miyashita N, Horita N, Higa F, Aoki Y, Kikuchi T, Seki M, et al. Validation of a diagnostic score model for the prediction of Legionella pneumophila pneumonia. J Infect Chemother 2019;25:407–12.
[31] Dooley KE, Golub J, Goes FS, Merz WG, Sterling TR. Empiric treatment of community-acquired pneumonia with fluoroquinolones, and delays in the treatment of tuberculosis. Clin Infect Dis 2002;34:1607–12.
[32] Golub JE, Bur S, Cronin WA, Gange S, Sterling TR, Oden B, et al. Impact of empiric antibiotics and chest radiograph on delays in the diagnosis of tuberculosis. Int J Tubercul Lung Dis 2005;9:392–7.
[33] Yoon YS, Lee HJ, Yoon HI, Yoo CG, Kim YW, Han SK, et al. Impact of fluoroquinolones on the diagnosis of pulmonary tuberculosis initially treated as bacterial pneumonia. Int J Tubercul Lung Dis 2005;9:1215–9.
[34] Wang JY, Hsueh PR, Jan IS, Lee LN, Liaw YS, Yang PC, et al. Empirical treatment with a fluoroquinolone delays the treatment for tuberculosis and is associated with a poor prognosis in endemic areas. Thorax 2006;61:903–8.
[35] van der Heijden YF, Maruri F, Blackman A, Holt E, Warkentin JV, Shepherd BE, et al. Fluoroquinolone exposure prior to tuberculosis diagnosis is associated with an increased risk of death. Int J Tubercul Lung Dis 2012;16:1162–7.
[36] Ginsburg AS, Hooper N, Parrish N, Dooley KE, Dorman SE, Booth J, et al. Fluoroquinolone resistance in patients with newly diagnosed tuberculosis. Clin Infect Dis 2003;37:1448–52.
[37] Devasia RA, Blackman A, Gebretsadik T, Griffin M, Shintani A, May C, et al. Fluoroquinolone resistance in Mycobacterium tuberculosis: the effect of duration and timing of fluoroquinolone exposure. Am J Respir Crit Care Med 2009;180:365–70.
[38] Long R, Chong H, Hoeppner V, Shanmuganathan H, Kowalewska-Grochowska K, Shandro C, et al. Empirical treatment of community-acquired pneumonia and the development of fluoroquinolone-resistant tuberculosis. Clin Infect Dis 2009;48:1354–60.
[39] Kohno S, Yanagihara K, Yamamoto Y, Tokimatsu I, Hiramatsu K, Higa F, et al. Early switch therapy from intravenous sulbactam/ampicillin to oral garenoxacin in patients with community-acquired pneumonia: a multicenter, randomized study in Japan. J Infect Chemother 2013;19:1035–41.
[40] Ramirez JA, Vargas S, Ritter GW, Brier ME, Wright A, Smith S, et al. Early switch from intravenous to oral antibiotics and early hospital discharge: a prospective observational study of 200 consecutive patients with community-acquired pneumonia. Arch Intern Med 1999;159:2449–54.
[41] Niederman MS, Mandell LA, Anzueto A, Bass JB, Broughton WA, Campbell GD, et al. Guidelines for the management of adults with community-acquired pneumonia. Diagnosis, assessment of severity, antimicrobial therapy, and prevention. Am J Respir Crit Care Med 2001;163:1730–54.
[42] Menendez R, Torres A, Zalacain R, Aspa J, Martin Villasclaras JJ, Borderias L, et al. Risk factors of treatment failure in community acquired pneumonia: implications for disease outcome. Thorax 2004;59:960–5.
[43] Roson B, Carratala J, Fernandez-Sabe N, Tubau F, Manresa F, Gudiol F. Causes and factors associated with early failure in hospitalized patients with community-acquired pneumonia. Arch Intern Med 2004;164:502–8.
[44] Arancibia F, Ewig S, Martinez JA, Ruiz M, Bauer T, Marcos MA, et al. Antimicrobial treatment failures in patients with community-acquired pneumonia: causes and prognostic implications. Am J Respir Crit Care Med 2000;162:154–60.
[45] Sanyal S, Smith PR, Saha AC, Gupta S, Berkowitz L, Homel P. Initial microbiologic studies did not affect outcome in adults hospitalized with community-acquired pneumonia. Am J Respir Crit Care Med 1999;160:346–8.
[46] Cavallazzi R, Ramirez JA. Influenza and viral pneumonia. Clin Chest Med 2018;39:703–21.
[47] Ruuskanen O, Lahti E, Jennings LC, Murdoch DR. Viral pneumonia. Lancet 2011;377:1264–75.
[48] Burk M, El-Kersh K, Saad M, Wiemken T, Ramirez J, Cavallazzi R. Viral infection in community-acquired pneumonia: a systematic review and meta-analysis. Eur Respir Rev 2016;25:178–88.
[49] Saito A, Kohno S, Matsushima T, Watanabe A, Oizumi K, Yamaguchi K, et al. Prospective multicenter study of the causative organisms of community-acquired pneumonia in adults in Japan. J Infect Chemother 2006;12:63–9.
[50] Self WH, Williams DJ, Zhu Y, Ampofo K, Pavia AT, Chappell JD, et al. Respiratory viral detection in children and adults: comparing asymptomatic controls and patients with community-acquired pneumonia. J Infect Dis 2016;213:584–91.
[51] Jain S, Self WH, Wunderink RG, Fakhran S, Balk R, Bramley AM, et al. Community-acquired pneumonia requiring hospitalization among U.S. Adults. N Engl J Med 2015;373:415–27.

[52] Gadsby NJ, Russell CD, McHugh MP, Mark H, Conway Morris A, Laurenson IF, et al. Comprehensive molecular testing for respiratory pathogens in community-acquired pneumonia. Clin Infect Dis 2016;62:817–23.
[53] Kibar Akilli I, Bilge M, Uslu Guz A, Korkusuz R, Canbolat Unlu E, Kart Yasar K. Comparison of pneumonia severity indices, qCSI, 4C-mortality score and qSOFA in predicting mortality in hospitalized patients with COVID-19 pneumonia. J Personalized Med 2022;12.
[54] Miyashita N, Nakamori Y, Ogata M, Fukuda N, Yamura A, Ishiura Y. Assessment of the pneumonia severity score in community-acquired and nursing and healthcare-associated pneumonia due to COVID-19. J Infect Chemother 2023;29:437–42.
[55] Fan G, Tu C, Zhou F, Liu Z, Wang Y, Song B, et al. Comparison of severity scores for COVID-19 patients with pneumonia: a retrospective study. Eur Respir J 2020;56.
[56] Ucan ES, Ozgen Alpaydin A, Ozuygur SS, Ercan S, Unal B, Sayiner AA, et al. Pneumonia severity indices predict prognosis in coronavirus disease-2019. Respir Med Res 2021;79:100826.
[57] Miyashita N, Nakamori Y, Ogata M, Fukuda N, Yamura A, Ishiura Y, et al. Changes in diagnostic usefulness of the JRS scoring system in COVID-19 pneumonia by SARS-CoV-2 vaccination. J Infect Chemother 2022;28:1375–9.
[58] Miyashita N, Nakamori Y, Ogata M, Fukuda N, Yamura A, Ishiura Y, et al. Early identification of novel coronavirus (COVID-19) pneumonia using clinical and radiographic findings. J Infect Chemother 2022;28:718–21.
[59] Miyashita N, Nakamori Y, Ogata M, Fukuda N, Yamura A, Ishiura Y, et al. Clinical differences between community-acquired mycoplasma pneumoniae pneumonia and COVID-19 pneumonia. J Clin Med 2022;11.
[60] Miyashita N, Nakamori Y, Ogata M, Fukuda N, Yamura A, Ishiura Y, et al. Clinical differentiation of severe acute respiratory syndrome coronavirus 2 pneumonia using the Japanese guidelines. Respirology 2022;27:90–2.
[61] Miyashita N, Higa F, Aoki Y, Kikuchi T, Seki M, Tateda K, et al. Usefulness of the Legionella Score for differentiating from COVID-19 pneumonia to legionella pneumonia. J Infect Chemother 2022;28:1353–7.
[62] Koo HJ, Lim S, Choe J, Choi SH, Sung H, Do KH. Radiographic and CT features of viral pneumonia. Radiographics 2018;38:719–39.
[63] Society AT, Idso America. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. Am J Respir Crit Care Med 2005;171:388–416.
[64] Attridge RT, Frei CR. Health care-associated pneumonia: an evidence-based review. Am J Med 2011;124:689–97.
[65] Carratala J, Mykietiuk A, Fernandez-Sabe N, Suarez C, Dorca J, Verdaguer R, et al. Health care-associated pneumonia requiring hospital admission: epidemiology, antibiotic therapy, and clinical outcomes. Arch Intern Med 2007;167:1393–9.
[66] Maruyama T, Fujisawa T, Okuno M, Toyoshima H, Tsutsui K, Maeda H, et al. A new strategy for healthcare-associated pneumonia: a 2-year prospective multicenter- cohort study using risk factors for multidrug-resistant pathogens to select initial empiric therapy. Clin Infect Dis 2013;57:1373–83.
[67] Shindo Y, Sato S, Maruyama E, Ohashi T, Ogawa M, Hashimoto N, et al. Health-care-associated pneumonia among hospitalized patients in a Japanese community hospital. Chest 2009;135:633–40.
[68] Teramoto S, Kawashima M, Komiya K, Shoji S. Health-care-associated pneumonia is primarily due to aspiration pneumonia. Chest 2009;136:1702–3.
[69] Maruyama T, Fujisawa T, Okuno M, Toyoshima H, Tsutsui K, Maeda H, et al. A new strategy for healthcare-associated pneumonia: a 2-year prospective multicenter cohort study using risk factors for multidrug-resistant pathogens to select initial empiric therapy. Clin Infect Dis 2013;57:1373–83.
[70] Maruyama T, Niederman MS, Kobayashi T, Kobayashi H, Takagi T, D'Alessandro-Gabazza CN, et al. A prospective comparison of nursing home-acquired pneumonia with hospital-acquired pneumonia in non-intubated elderly. Respir Med 2008;102:1287–95.
[71] Kawasaki S, Aoki N, Kikuchi H, Nakayama H, Saito N, Shimada H, et al. Clinical and microbiological evaluation of hemodialysis-associated pneumonia (HDAP): should HDAP be included in healthcare-associated pneumonia? J Infect Chemother 2011;17:640–5.
[72] Umeki K, Tokimatsu I, Yasuda C, Iwata A, Yoshioka D, Ishii H, et al. Clinical features of healthcare-associated pneumonia (HCAP) in a Japanese community hospital: comparisons among nursing home-acquired pneumonia (NHAP), HCAP other than NHAP, and community-acquired pneumonia. Respirology 2011;16:856–61.
[73] Watanabe M, Kato K, Takeda K, Konishi T, Kurai J, Tatsukawa T, et al. Difference of health-care associated pneumonia between large hospitals and small hospitals in Japan. J Med Investig 2011;58:67–74.
[74] Ishida T, Tachibana H, Ito A, Yoshioka H, Arita M, Hashimoto T. Clinical characteristics of nursing and healthcare-associated pneumonia: a Japanese variant of healthcare-associated pneumonia. Intern Med 2012;51:2537–44.
[75] Sugisaki M, Enomoto T, Shibuya Y, Matsumoto A, Saitoh H, Shingu A, et al. Clinical characteristics of healthcare-associated pneumonia in a public hospital in a metropolitan area of Japan. J Infect Chemother 2012;18:352–60.
[76] Fukuyama H, Yamashiro S, Tamaki H, Kishaba T. A prospective comparison of nursing- and healthcare-associated pneumonia (NHCAP) with community-acquired pneumonia (CAP). J Infect Chemother 2013;19:719–26.
[77] Kaku N, Yanagihara K, Morinaga Y, Izumikawa K, Nagashima S, Kakeya H, et al. The definition of healthcare-associated pneumonia (HCAP) is insufficient for the medical environment in Japan: a comparison of HCAP and nursing and healthcare-associated pneumonia (NHCAP). J Infect Chemother 2013;19:70–6.
[78] Oshitani Y, Nagai H, Matsui H, Aoshima M. Reevaluation of the Japanese guideline for healthcare-associated pneumonia in a medium-sized community hospital in Japan. J Infect Chemother 2013;19:579–87.
[79] Shindo Y, Ito R, Kobayashi D, Ando M, Ichikawa M, Shiraki A, et al. Risk factors for drug-resistant pathogens in community-acquired and healthcare-associated pneumonia. Am J Respir Crit Care Med 2013;188:985–95.
[80] Kosai K, Izumikawa K, Imamura Y, Tanaka H, Tsukamoto M, Kurihara S, et al. Importance of functional assessment in the management of community-acquired and healthcare-associated pneumonia. Intern Med 2014;53:1613–20.
[81] Nakagawa N, Saito Y, Sasaki M, Tsuda Y, Mochizuki H, Takahashi H. Comparison of clinical profile in elderly patients with nursing and healthcare-associated pneumonia, and those with community-acquired pneumonia. Geriatr Gerontol Int 2014;14:362–71.
[82] Sakoda Y, Ikegame S, Ikeda-Harada C, Takakura K, Kumazoe H, Wakamatsu K, et al. Retrospective analysis of nursing and healthcare-associated pneumonia: analysis of adverse prognostic factors and validity of the selection criteria. Respir Investig 2014;52:114–20.
[83] Noguchi S, Mukae H, Kawanami T, Yamasaki K, Fukuda K, Akata K, et al. Bacteriological assessment of healthcare-associated pneumonia using a clone library analysis. PLoS One 2015;10:e0124697.
[84] Matsuda S, Ogasawara T, Sugimoto S, Kato S, Umezawa H, Yano T, et al. Prospective open-label randomized comparative, non-inferiority study of two initial antibiotic strategies for patients with nursing- and healthcare-associated pneumonia: guideline-concordant therapy versus empiric therapy. J Infect Chemother 2016;22:400–6.
[85] Parrott G, Nebeya D, Kinjo T, Miyagi K, Haranaga S, Higa F, et al. Etiological analysis and epidemiological comparison among adult CAP and NHCAP patients in Okinawa, Japan. J Infect Chemother 2017;23:452–8.
[86] Yamagata A, Ito A, Nakanishi Y, Ishida T. Prognostic factors in nursing and healthcare-associated pneumonia. J Infect Chemother 2020;26:563–9.
[87] Imamura Y, Miyazaki T, Watanabe A, Tsukada H, Nagai H, Hasegawa Y, et al. Prospective multicenter survey for nursing and healthcare-associated pneumonia in Japan. J Infect Chemother 2022;28:1125–30.
[88] Brito V, Niederman MS. Healthcare-associated pneumonia is a heterogeneous disease, and all patients do not need the same broad-spectrum antibiotic therapy as complex nosocomial pneumonia. Curr Opin Infect Dis 2009;22:316–25.
[89] Wunderink RG. Community-acquired pneumonia versus healthcare-associated pneumonia. The returning pendulum. Am J Respir Crit Care Med 2013;188:896–8.
[90] Wunderink RG, Waterer G. Advances in the causes and management of community acquired pneumonia in adults. BMJ 2017;358:j2471.
[91] Kim NE, Lee JH, Chang JH, Lee SH, Ryu YJ. Clinical characteristics and outcomes among older nursing home residents hospitalized with pneumonia. Arch Gerontol Geriatr 2021;95:104394.
[92] Kirsch N, Ha J, Kang HT, Frisch T, Yoo JW, Grossman C, et al. Factors associated with the appropriate use of ultra-broad spectrum antibiotics, meropenem, for suspected healthcare-associated pneumonia. Medicine (Baltim) 2021;100:e27488.
[93] Lee SH, Kim SJ, Choi YH, Lee JH, Chang JH, Ryu YJ. Clinical outcomes and prognostic factors in patients directly transferred to the intensive care unit from long-term care beds in institutions and hospitals: a retrospective clinical study. BMC Geriatr 2018;18:259.
[94] Wang PH, Wang HC. Risk factors to predict drug-resistant pathogens in hemodialysis-associated pneumonia. BMC Infect Dis 2016;16:377.
[95] Metersky ML, Frei CR, Mortensen EM. Predictors of Pseudomonas and methicillin-resistant Staphylococcus aureus in hospitalized patients with healthcare-associated pneumonia. Respirology 2016;21:157–63.
[96] Kobayashi H, Shindo Y, Kobayashi D, Sakakibara T, Murakami Y, Yagi M, et al. Extended-spectrum antibiotics for community-acquired pneumonia with a low risk for drug-resistant pathogens. Int J Infect Dis 2022;124:124–32.
[97] Kohno S, Imamura Y, Shindo Y, Seki M, Ishida T, Teramoto S, et al. Clinical practice guidelines for nursing- and healthcare-associated pneumonia (NHCAP) [complete translation]. Respir Investig 2013;51:103–26.
[98] Teramoto S. The current definition, epidemiology, animal models and a novel therapeutic strategy for aspiration pneumonia. Respir Investig 2022;60:45–55.
[99] Komiya K, Ishii H, Kushima H, Sato S, Kimura H, Yasuda T, et al. Physicians' attitudes toward the definition of "death from age-related physical debility" in deceased elderly with aspiration pneumonia. Geriatr Gerontol Int 2013;13:586–90.
[100] Komiya K, Ishii H, Kadota J. Healthcare-associated pneumonia and aspiration pneumonia. Aging Dis 2015;6:27–37.
[101] Kawakami K, Ohkusa Y, Kuroki R, Tanaka T, Koyama K, Harada Y, et al. Effectiveness of pneumococcal polysaccharide vaccine against pneumonia and cost analysis for the elderly who receive seasonal influenza vaccine in Japan. Vaccine 2010;28:7063–9.
[102] Bartlett JG. Anaerobic bacterial infections of the lung. Chest 1987;91:901–9.
[103] Marik PE, Careau P. The role of anaerobes in patients with ventilator-associated pneumonia and aspiration pneumonia: a prospective study. Chest 1999;115:178–83.
[104] Yamasaki K, Kawanami T, Yatera K, Fukuda K, Noguchi S, Nagata S, et al. Significance of anaerobes and oral bacteria in community-acquired pneumonia. PLoS One 2013;8:e63103.
[105] Yoshimatsu Y, Aga M, Komiya K, Haranaga S, Numata Y, Miki M, et al. The clinical significance of anaerobic coverage in the antibiotic treatment of aspiration pneumonia: a systematic review and meta-analysis. J Clin Med 2023;12.

[106] Jones BE, Ying J, Stevens V, Haroldsen C, He T, Nevers M, et al. Empirical anti-MRSA vs standard antibiotic therapy and risk of 30-day mortality in patients hospitalized for pneumonia. JAMA Intern Med 2020;180:552–60.
[107] Goto A, Komiya K, Yamasue M, Yoshikawa H, Umeki K, Hiramatsu K, et al. Methicillin-resistant Staphylococcus aureus among elderly patients with community-acquired pneumonia. J Infect Chemother 2022;28:1138–42.
[108] Kawanami T, Yatera K, Yamasaki K, Noguchi S, Fukuda K, Akata K, et al. Clinical impact of methicillin-resistant staphylococcus aureus on bacterial pneumonia: cultivation and 16S ribosomal RNA gene analysis of bronchoalveolar lavage fluid. BMC Infect Dis 2016;16:155.
[109] Goto A, Komiya K, Umeki K, Hiramatsu K, Kadota JI. Impact of Pseudomonas aeruginosa coverage on the prognosis of elderly patients with community-acquired pneumonia. J Infect Chemother 2022.
[110] Wang M, Fitzgerald JM, Richardson K, Marra CA, Cook VJ, Hajek J, et al. Is the delay in diagnosis of pulmonary tuberculosis related to exposure to fluoroquinolones or any antibiotic? Int J Tubercul Lung Dis 2011;15:1062–8.
[111] Momosaki R. Rehabilitative management for aspiration pneumonia in elderly patients. J Gen Fam Med 2017;18:12–5.
[112] Talbot GH, Das A, Cush S, Dane A, Wible M, Echols R, et al. Evidence-based study design for hospital-acquired bacterial pneumonia and ventilator-associated bacterial pneumonia. J Infect Dis 2019;219:1536–44.
[113] Vallecoccia MS, Dominedo C, Cutuli SL, Martin-Loeches I, Torres A, De Pascale G. Is ventilated hospital-acquired pneumonia a worse entity than ventilator-associated pneumonia? Eur Respir Rev 2020;29.
[114] Maruyama T, Fujisawa T, Ishida T, Ito A, Oyamada Y, Fujimoto K, et al. A therapeutic strategy for all pneumonia patients: a 3-year prospective multicenter cohort study using risk factors for multidrug-resistant pathogens to select initial empiric therapy. Clin Infect Dis 2019;68:1080–8.
[115] Sano M, Shindo Y, Takahashi K, Okumura J, Sakakibara T, Murakami Y, et al. Risk factors for antibiotic resistance in hospital-acquired and ventilator-associated pneumonia. J Infect Chemother 2022;28:745–52.
[116] Sopena N, Sabria M, Neunos Study G. Multicenter study of hospital-acquired pneumonia in non-ICU patients. Chest 2005;127:213–9.
[117] Kollef MH, Shorr A, Tabak YP, Gupta V, Liu LZ, Johannes RS. Epidemiology and outcomes of health-care-associated pneumonia: results from a large US database of culture-positive pneumonia. Chest 2005;128:3854–62.
[118] Papazian L, Klompas M, Luyt CE. Ventilator-associated pneumonia in adults: a narrative review. Intensive Care Med 2020;46:888–906.
[119] American Thoracic S, Infectious Diseases Society of A. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. Am J Respir Crit Care Med 2005;171:388–416.
[120] Moro H, Aoki N, Matsumoto H, Tone K, Shuto H, Komiya K, et al. Bacterial profiles detected in ventilator-associated pneumonia in Japan: a systematic review. Respir Investig 2024;62:365–8.
[121] Hranjec T, Rosenberger LH, Swenson B, Metzger R, Flohr TR, Politano AD, et al. Aggressive versus conservative initiation of antimicrobial treatment in critically ill surgical patients with suspected intensive-care-unit-acquired infection: a quasi-experimental, before and after observational cohort study. Lancet Infect Dis 2012;12:774–80.
[122] Barbier F, Bailly S, Schwebel C, Papazian L, Azoulay E, Kallel H, et al. Infection-related ventilator-associated complications in ICU patients colonised with extended-spectrum beta-lactamase-producing Enterobacteriaceae. Intensive Care Med 2018;44:616–26.
[123] Furumoto A, Ohkusa Y, Chen M, Kawakami K, Masaki H, Sueyasu Y, et al. Additive effect of pneumococcal vaccine and influenza vaccine on acute exacerbation in patients with chronic lung disease. Vaccine 2008;26:4284–9.
[124] Maruyama T, Taguchi O, Niederman MS, Morser J, Kobayashi H, Kobayashi T, et al. Efficacy of 23-valent pneumococcal vaccine in preventing pneumonia and improving survival in nursing home residents: double blind, randomised and placebo controlled trial. BMJ 2010;340:c1004.
[125] Bonten MJ, Huijts SM, Bolkenbaas M, Webber C, Patterson S, Gault S, et al. Polysaccharide conjugate vaccine against pneumococcal pneumonia in adults. N Engl J Med 2015;372:1114–25.
[126] Platt HL, Cardona JF, Haranaka M, Schwartz HI, Narejos Perez S, Dowell A, et al. A phase 3 trial of safety, tolerability, and immunogenicity of V114, 15-valent pneumococcal conjugate vaccine, compared with 13-valent pneumococcal conjugate vaccine in adults 50 years of age and older (PNEU-AGE). Vaccine 2022;40:162–72.
[127] Kobayashi M, Farrar JL, Gierke R, Britton A, Childs L, Leidner AJ, et al. Use of 15-valent pneumococcal conjugate vaccine and 20-valent pneumococcal conjugate vaccine among U.S. Adults: updated recommendations of the advisory committee on immunization practices - United States, 2022. MMWR Morb Mortal Wkly Rep 2022;71:109–17.
[128] Yoneyama T, Yoshida M, Ohrui T, Mukaiyama H, Okamoto H, Hoshiba K, et al. Oral care reduces pneumonia in older patients in nursing homes. J Am Geriatr Soc 2002;50:430–3.