

Original Research

# Assessment of pneumonia management in a tertiary care teaching hospital in the United Arab Emirates: A Retrospective study

Snaa AlOmar , Juny Sebastian\* 

Received (first version): 11-Jul-2025

Accepted: 01-Sep-2025

Published online: 10-Jan-2026

## Abstract

**Introduction:** Pneumonia remains a significant health concern, contributing to substantial morbidity, mortality and economic burden globally. Pneumonia is one of the leading cause of premature death, with hospitalization rates reaching alarming levels. Effective management relies on timely diagnosis and appropriate antibiotic therapy. However, deviations from clinical guidelines, the rise of antimicrobial resistance and inappropriate treatment practices pose ongoing challenges in optimizing treatment outcomes. **Objective:** This study aims to assess the management of pneumonia in a tertiary care teaching hospital. **Methods:** The study utilized a structured data collection form to extract relevant information from electronic health records of patients aged 18 and above, diagnosed with pneumonia at Tertiary care teaching hospital from January 2022 to December 2023. The World Health Organization's prescribing indicators and adherence to Infectious Disease Society of America (IDSA) guidelines were assessed. Drug-related problems were classified using Hepler and Strand's categorization. Descriptive statistics and regression models were employed for data analysis. **Results:** Out of 109 patients enrolled, 57.79% were males, and the mean age was 45.44 years. Drug-related problems were identified in 60.55% of patients, with potential drug interactions being the most common (60.75%). Age, gender, length of hospital stays, number of prescribed drugs, and comorbidities along with Pneumonia were not statistically significant predictors of drug-related problems. **Conclusion:** The study highlighted suboptimal adherence to clinical practice guidelines, the prevalence of drug-related problems, and the need for targeted interventions to improve pneumonia management and optimize patient outcomes in the UAE. Strengthening antimicrobial stewardship programs, enhancing guideline adherence, and implementing strategies to reduce medication-related issues were recommended to address these challenges.

**Keywords:** Antimicrobial stewardship, Drug-related problems, IDSA Guideline adherence, Pneumonia management, United Arab Emirates.

## INTRODUCTION

Pneumonia remains a formidable global health threat, accounting for a substantial burden of illness worldwide. As an acute respiratory infection commonly caused by viruses or bacteria, pneumonia inflicts significant morbidity and mortality across all age groups<sup>1,2</sup>. Community-acquired pneumonia (CAP), which develops outside of healthcare settings, represents a particularly prevalent and concerning form of this condition<sup>2</sup>. The burden of pneumonia is staggering, affecting individuals of all ages and demographics worldwide. In low and middle-income countries, pneumonia is the single largest cause of death among children under five years old, accounting for 15% of all childhood deaths<sup>3</sup>. However, the impact extends far beyond pediatric populations, as pneumonia is also a major cause of morbidity and mortality among adults, particularly the elderly and those with underlying comorbidities or compromised immune systems<sup>4</sup>. Pneumonia places a substantial economic strain on healthcare systems and societies. Direct medical costs associated with pneumonia hospitalizations, treatments,

and management of complications are immense<sup>5</sup>. Additionally, indirect costs related to lost productivity, absenteeism, and premature mortality further exacerbate the economic toll<sup>6</sup>. In the United States alone, the annual economic burden of pneumonia is estimated to exceed \$17 billion<sup>7</sup>. In the United Arab Emirates (UAE), the impact of pneumonia is especially pronounced<sup>8</sup>. Recent reports indicate that lower respiratory infections, including pneumonia, rank among the top 10 leading causes of premature death in the nation<sup>9,10</sup>. Alarming, hospital admission rates for pneumonia in the UAE approach 760 cases per million people yearly. Furthermore, pneumonia-associated mortality rates in this region range from 13% to an alarming 24<sup>8</sup>.

Effective treatment of pneumonia hinges on timely and appropriate antibiotic administration, guided by evidence-based clinical practice guidelines. The Infectious Diseases Society of America (IDSA) has developed comprehensive recommendations to improve the quality, appropriateness, and cost-effectiveness of pneumonia care<sup>11</sup>. However, numerous studies have revealed substantial deviations from these guidelines in real-world practice settings across various geographic regions. Common issues identified include inappropriate selection of antibiotic agents, delayed initiation of therapy, problematic drug interactions, excessive treatment durations, and unnecessary use of broad-spectrum agents<sup>12</sup>. The rise of AMR has far-reaching consequences, including increased healthcare costs, prolonged hospital stays, treatment

**Snaa AlOmar.** MCP, Department of Pharmacy Practice, College of Pharmacy, Gulf Medical University, UAE. Sana.salah1@outlook.com

**Juny Sebastian\*.** PhD, Associate Professor and Chair, Department of Pharmacy Practice, College of Pharmacy, Gulf Medical University, UAE. dr.junysebastian@gmu.ac.ae



failures, and higher mortality rates. Pneumonia, as a common infectious disease often treated with antibiotics, is particularly susceptible to the impacts of AMR. The emergence of multidrug-resistant strains of pneumonia-causing pathogens, such as *Streptococcus pneumoniae* and *Klebsiella pneumoniae*, has already complicated treatment efforts and contributed to poorer outcomes in some regions<sup>13,14</sup>.

The UAE lacks comprehensive, high-quality data on pneumonia management practices, hindering efforts to identify specific areas requiring improvement and implement targeted interventions<sup>8</sup>. Drug-related problems (DRPs) are expected to be prevalent in the management of pneumonia due to the complex nature of the disease, polypharmacy, and potential for inappropriate antibiotic use<sup>15</sup>. The most common DRPs are likely to include drug interactions, improper drug selection, and subtherapeutic dosing. Addressing this knowledge gap is essential for optimizing pneumonia management, promoting antimicrobial stewardship, and reducing pneumonia-related morbidity, mortality, and healthcare costs<sup>16</sup>. This study aimed to conduct a comprehensive assessment of pneumonia management practices in a major tertiary teaching hospital, uncover specific areas for improvement, identify predictors of suboptimal care, and inform the development of tailored interventions to enhance the effectiveness and quality of pneumonia management in the UAE. The study utilized a structured data collection form to extract relevant information from electronic health records, assess adherence to guidelines, and classify DRPs.

## METHODS

The study was conducted retrospectively and took place in the Internal Medicine and Pulmonology departments of Tertiary care teaching Hospital in Northern Emirates of the United Arab Emirates (UAE). Conducted from September 2023 to August 2024, the study reviewed medical records of patients 18 years or older diagnosed with pneumonia at admission or during their hospital stay between January 2022 and December 2023. Patients with incomplete records, those diagnosed without radiological findings, those discharged against medical advice, admitted for less than 24 hours, or who received only outpatient care were excluded.

Data collection was conducted using a structured form comprising nine sections, encompassing demographic details, clinical and microbiological data, and specific pneumonia treatment. This included patient vitals at admission, medication history, and details of pneumonia treatment, such as prescribed antibiotics. Additionally, the study recorded radiological findings, microbiological culture results, and clinical outcomes. The collected data were analyzed to identify drug-related problems (DRPs), which were subsequently classified based on the classification. Predictors of DRPs analysis was performed using the odds ratio (OR), considering factors such as age, gender, length of hospital stay, and comorbidities along with pneumonia among the study population.

## RESULTS

A total of 343 medical records were collected during the study period. However, many subjects were excluded based on predefined criteria to ensure the study's focus and validity. Specifically, 178 pediatric patients were omitted from the analysis to maintain adult subjects. Additionally, 43 patients with hospital stays of less than 24 hours were excluded to ensure sufficient observational data. Finally, 13 patients were removed from the study population due to the absence of a confirmed pneumonia diagnosis. These exclusions were implemented to maintain the integrity and relevance of the study about the research objectives, resulting in a final study population of 109 patients, with 63 (57.79%) males and 46 (42.2%) females. The socio-demographic characteristics of the study population are provided in Table 1.

Among the antibiotics prescribed, levofloxacin (26.01%), meropenem (23.98%), and ceftriaxone (23.17%) were the most commonly prescribed, collectively accounting for approximately 73% of all prescriptions. Regarding antibiotic classes, Fluoroquinolones (26.01%), Carbapenems (26.01%), and Cephalosporins (23.97%) were the most frequently prescribed classes. The prescribing pattern of antibiotics used among the study population is provided in Table 2. Bronchodilators,

Variable	Category	Frequency (%)
Age in Years	<20	1 (0.91)
	20-29	12 (11)
	30-39	39 (35.77)
	40-49	23 (21.1)
	50-59	14 (12.84)
	≥ 60	20 (18.34)
	Mean, SD	45.44, 16.51
	Range	18 - 87
Gender	Male	63 (57.79)
	Female	46 (42.2)
Body Mass Index	Underweight ≤ 18.4 kg/m <sup>2</sup>	2 (1.83)
	Normal weight 18.5-24.9 kg/m <sup>2</sup>	26 (23.85)
	Overweight 25.0 - 39.9 kg/m <sup>2</sup>	66 (60.55)
	Obese ≥40.0 kg/m <sup>2</sup>	15 (13.76)
	Mean, SD	29.9, 8.05
	Range	6.7 - 69.44
Marital Status	Single	13 (11.9)
	Married	89 (81.65)
	Widow	1 (0.9)
	Unspecified	6 (5.5)
Medical History	Hypertension	31 (28.44)
	Diabetes Mellitus	31 (28.44)
	Hypercholesterolemia	17 (15.59)
	Respiratory Disease	7 (6.42)



**Table 2.** Prescribing pattern of drugs for the management of pneumonia

Antibiotic Class	Antibiotic name	Frequency (%)
Fluoroquinolones	Levofloxacin	64 (26.01)
Carbapenems	Meropenem	59 (23.98)
	Ertapenem	5 (2.03)
Cephalosporins	Ceftriaxone	57 (23.17)
	Cefdinir	1 (0.40)
	Cefuroxime	1 (0.40)
Macrolides	Clarithromycin	19 (7.72)
Glycopeptides	Teicoplanin	19 (7.72)
	Vancomycin	2 (0.81)
Tetracyclines	Doxycycline	6 (2.43)
Nitroimidazoles	Metronidazole	4 (1.62)
Beta-lactamase inhibitor combinations	Piperacillin/Tazobactam	4 (1.62)
	Amoxicillin/Clavulanic acid	2 (0.81)
Lincosamides	Clindamycin	3 (1.21)

inhaled corticosteroids, and Leukotriene receptor antagonists are the major class of drugs used along with antibiotics for the management of pneumonia. The details of drugs used along with antibiotics among the study population are given in Table 3.

The study identified Drug Related Problems (DRPs) in pneumonia treatments, revealing that most patients (66, 60.55%) experienced at least one DRP. Among those affected, 32 patients had a single DRP, while 34 patients experienced multiple issues. A total of 256 DRPs were identified across all cases, averaging 2.348 DRPs per patient. The most frequent issue was potential drug interactions (48 cases) as classified using the Hepler-Strand classification. The DRPs identified among the study participants are described in Table 4.

Culture tests conducted revealed positive results in 31 cases (28.44%). *Mycoplasma pneumoniae* and Gram-positive

cocci were equally prevalent, each identified in 8 cases (7.33%). *Candida albicans* was found in 5 cases (4.58%), and Gram-negative bacilli in 3 cases (2.75%). The distribution of microorganisms in culture tests is presented in Figure 1.

Analysis of potential predictors of DRPs using odds-ratio tests determined statistical significance. The study investigated various demographic and clinical factors to understand drug-related problem occurrences. Age categories demonstrated notable variations, with the 30-39 group exhibiting the highest drug-related problem rates. Notably, all p-values exceeded the conventional statistical significance threshold ( $p > 0.05$ ), suggesting no statistically significant associations were found between demographic factors and DRP development. Multiple variables were assessed to identify potential predictive characteristics of drug-related problems. The predictor analysis DRPs are provided in Table 5.

**Table 3.** Distribution of medication other than antibiotics used in Pneumonia Management

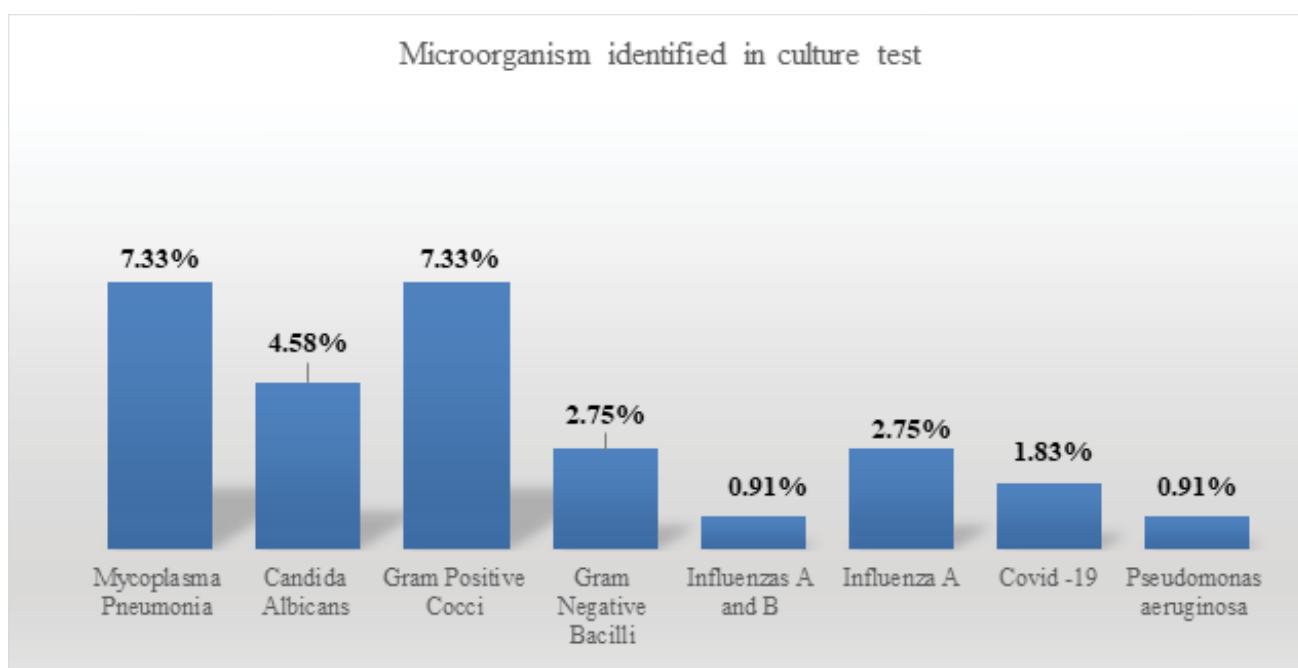
Drug Class	Drug Names	Frequency (%)
Bronchodilators	Ipratropium/Salbutamol	30 (27.52)
	Ipratropium/Levosalbutamol	9 (8.25)
	Ipratropium/Albuterol	10 (9.17)
	Salbutamol	5 (4.58)
Inhaled Corticosteroid/Combinations	Budesonide	66 (60.55)
	Formoterol/Beclomethasone	2 (1.83)
	Formoterol/Budesonide	1 (0.91)
Leukotriene Receptor Antagonists	Montelukast	6 (5.50)
Corticosteroids	Methylprednisolone	6 (5.50)
	Prednisolone	3 (2.75)
	Hydrocortisone	4 (3.66)
	Dexamethasone	2 (1.83)



Analgesics/Antipyretics	Paracetamol	84 (77.06)
	Dexketoprofen	13 (11.92)
	Diclofenac	6 (5.50)
	Loxoprofen	13 (11.92)
Mucolytics	Ambroxol	4 (3.66)
	Acetylcysteine	2 (1.83)
Antitussives	Butamirate citrate	8 (7.33)
Antihistamines	Loratadine	30 (27.52)
	Desloratadine	2 (1.83)
	Cetirizine	2 (1.83)
Proton Pump Inhibitors	Pantoprazole	91 (83.48)
Antivirals	Oseltamivir	14 (12.84)
	Remdesivir	7 (6.42)

**Table 4.** Drug-related problems among the study population

Variable	Category	Number of patients
Patients with DRP - Total	Yes	66
	No	43
Number of DRPs	One	32
	More than one	34
Type of DRP (Hepler - Strand classification)	Potential Drug interactions	48
	Improper drug selection	23
	Drug use without indication	8
	Untreated indication	3
	Adverse drug reaction	1



**Figure 1.** Distribution of Microorganisms in Culture Tests

**Table 5.** Predictors of drug-related problems associated with the management of pneumonia.

Predictors	DRPs observed		Odds Ratio	P-value
	Yes	No		
<b>Age</b>				
<20	1	0	NA	NA
20-29	2	10	-	-
30-39	15	24	0.333	0.191
40-49	8	15	0.375	0.27
50-59	3	11	0.733	0.759
60≤	6	14	0.446	0.405
<b>Gender</b>				
Male	21	42	0.875	0.749
Female	14	32	-	-
<b>Length of hospital stay</b>				
1-5 days	26	52	1.23	0.408
5-10 days	8	13	-	-
10-15 days	0	6	8.185	0.169
>15	1	3	1.846	0.495
<b>Number of Drugs</b>				
<5 drug	10	27	-	-
5-10 drug	7	14	0.74	0.612
10-15 drugs	8	17	0.787	0.672
>15 drugs	10	15	0.556	0.286
<b>Comorbidities along with Pneumonia</b>				
Patients with only Pneumonia	25	57	-	-
Patients with Pneumonia and other Comorbid Infection	10	17	0.746	0.631

## DISCUSSION

This study aimed to evaluate the management practices of pneumonia, including antibiotic prescribing patterns, in a major tertiary teaching hospital in the UAE. Additionally, it aimed to assess adherence to evidence-based guidelines and identify drug-related problems. This comprehensive assessment was conducted to address the knowledge gap in local pneumonia management data and inform the development of tailored interventions to enhance the quality and effectiveness of pneumonia care in the UAE. Out of 109 pneumonia patient records, 63 were males (57.79%), similar to Jin-liang Liu et al.'s<sup>17</sup> Chinese study where males formed 59.6% of 1640 patients.

Furthermore, levofloxacin emerges as a preferred antibiotic for pneumonia management. Noreddin et al.'s US study present levofloxacin as an effective CAP treatment, citing broad spectrum activity, low resistance rates, and flexible dosing<sup>18</sup>. Our study found levofloxacin was most frequently prescribed (26.01%, n=64), followed by meropenem (23.98%, n=59) and ceftriaxone (23.17%, n=57). Other antibiotics included clarithromycin and teicoplanin (7.72%, n=19 each), doxycycline (2.43%, n=6), ertapenem (2.03%, n=5), metronidazole and piperacillin/tazobactam (1.62%, n=4 each), clindamycin (1.21%, n=3), vancomycin and amoxicillin/clavulanic acid

(0.81%, n=2 each), and cefdinir and cefuroxime (0.40%, n=1 each). The most common classes were Fluoroquinolones and Carbapenems (26.01% each) and Cephalosporins (23.97%). This differs from Mustafa S. Saeed et al.'s<sup>19</sup> Saudi Arabian study showing Fluoroquinolones (48.7%), Macrolides (40.2%), and Ceftriaxone (34.2%) as most frequent, with Amoxicillin/clavulanate (23.1%), Carbapenems (5.1%), Aminoglycosides (6%), Cefuroxime (1.7%) and other antibiotics (6%) also being used. Most patients received dual therapy (66.97%, n=73), while 18.34% (n=20) had monotherapy, and 14.67% (n=16) received triple therapy, highlighting regional prescribing variations and pneumonia management complexity.

Our study revealed that 60.55% of patients (n=66) developed drug-related problems (DRPs), while only 39.44% (n=43) did not develop DRPs. These findings align with a study conducted in Spain, where nearly half (45.1%) of hospitalized patients suffered from DRPs<sup>19</sup>. The clinical consequences of potential drug-drug interactions (pDDIs) included increased or decreased therapeutic effectiveness, adverse drug reactions (ADRs), and toxicity (nephrotoxicity, hepatotoxicity). A comparable study conducted in Pakistan demonstrated that out of 431 patient profiles, pDDIs were reported in 73.1%, with major pDDIs present in 53.8% of profiles<sup>20</sup>. Our investigation similarly revealed a high prevalence of pDDIs, affecting 60.75% of



patients (n=48).

In pneumonia management, drug-related problems (DRPs) can significantly impact patient outcomes. Two critical aspects of DRPs are adverse drug reactions (ADRs) and failure to receive necessary medications. Understanding these issues is essential for improving treatment efficacy and patient safety. Adverse drug reactions refer to harmful or unintended responses to medications that can complicate treatment and worsen patient health<sup>15</sup>. The present investigation demonstrated that in our study, a single case (1.26%) experienced ADR. Similarly, the study mentioned above was held in Jasa Kartini Hospital in Tasikmalaya City, and no cases of ADRs were reported among pneumonia patients, indicating that either the monitoring for ADRs was insufficient or that the retrospective nature of the study limited the ability to capture such data effectively<sup>15</sup>. Failure to receive appropriate medications is another significant DRP in pneumonia management. The referenced study identified 11 cases (22%) where patients had untreated indications, such as pulmonary tuberculosis and hypertension, which required specific therapies but were not addressed during their pneumonia treatment<sup>15</sup>. While our study identified only 3 cases of untreated indication.

#### Limitations of the study

The retrospective nature of this study limits the ability to capture certain data points, such as the comprehensive documentation

of adverse drug reactions. Additionally, the single-center design and retrospective nature of the study may restrict the generalizability of the findings to other healthcare settings in the UAE. Furthermore, the study's reliance on electronic health records could potentially introduce information bias if the data is incomplete or inaccurate. Despite these limitations, the rich patient data available at the study site, coupled with the comprehensive analysis plan, ensure that the study will provide valuable insights into pneumonia management practices and inform future quality improvement initiatives within the local healthcare context.

#### CONCLUSION

This study provides valuable insights into pneumonia management and antibiotic prescribing at a major UAE tertiary teaching hospital. Levofloxacin emerged as the most prescribed antibiotic for community-acquired pneumonia. However, significant drug-related problems were identified, including inappropriate antibiotic selection, potential drug interactions, and drug use without clear indication. To improve treatment practices, recommendations include implementing comprehensive antimicrobial stewardship programs, educating providers on evidence-based guidelines, establishing routine audits with feedback mechanisms, and enhancing medication management through comprehensive reviews to address drug interactions and adverse reactions.

#### References

1. Weiser JN, Ferreira DM, Paton JC. *Streptococcus pneumoniae*: transmission, colonization and invasion. *Nat Rev Microbiol*. 2018;16(6):355-67.
2. Wunderink RG, Waterer GW. Community-acquired pneumonia. *N Engl J Med*. 2014;370(19):1863.
3. McAllister DA, Liu L, Shi T, Chu Y, Reed C, Burrows J, et al. Global, regional, and national estimates of pneumonia morbidity and mortality in children younger than 5 years between 2000 and 2015: a systematic analysis. *Lancet Glob Health*. 2019;7(1):e47-57.
4. Torres A, Cillóniz C, Blasi F, Chalmers JD, Gaillat J, Dartois N, et al. Burden of pneumococcal community-acquired pneumonia in adults across Europe: A literature review. *Respir Med*. 2018;137:6-13.
5. Xu J, Murphy SL, Kochanek KD, Arias E. Mortality in the United States, 2018. *NCHS Data Brief*. 2020;(355):1-8.
6. Nair H, Brooks WA, Katz M, Roca A, Berkley JA, Madhi SA, et al. Global burden of respiratory infections due to seasonal influenza in young children: a modelling study. *Lancet*. 2011;378(9807):1917-30
7. Huang SS, Johnson NJ, Ray GT, Wroe P, Lieu TA, Moore MR. Healthcare utilization and cost of pneumococcal disease in the United States. *Vaccine*. 2011;29(18):3398-412.
8. Al Dallal SAM, Farghaly M, Ghorab A, Elaassar M, Haridy H, Awad N, et al. Real-world evaluation of costs of illness for pneumonia in adult patients in Dubai-A claims database study. *PLoS One*. 2021;16(9):e0256856.
9. Institute for Health Metrics and Evaluation (IHME). Global Burden of Disease (GBD) Results. [internet] 2023 [Cited 2024 Jul 18] Available from: <https://vizhub.healthdata.org/gbd-results/>
10. Mokdad AH, Khalil I, Charara R, Koirala A, Al Mazrouei NA, Tuffaha M, et al. Burden of disease in the United Arab Emirates, 1990-2019: findings from the Global Burden of Disease Study 2019. *Int J Public Health*. 2021;66(Suppl 1):1-13.
11. Metlay JP, Waterer GW, Long AC, Anzueto A, Brozek J, Crothers K, et al. Diagnosis and Treatment of Adults with Community-acquired Pneumonia. *Am J Respir Crit Care Med*. 2019;200(7):e45-67.
12. National Institute for Health and Care Excellence. Pneumonia (community-acquired): antimicrobial prescribing. NICE guideline [NG138]. 2019.
13. World Health Organization (WHO). Antimicrobial resistance [Internet]. Geneva: WHO; [cited 2024 Aug 12]. Available from: <https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance>.
14. Prestinaci F, Pezzotti P, Pantosti A. Antimicrobial resistance: a global multifaceted phenomenon. *Pathog Glob Health*. 2015;109(7):309-18.



15. Rahayuningsih N, Rahayu A, Priatna M. Drug related problems in patients with pneumonia at Jasa Kartini Tasikmalaya city hospital. *Pharm Educ*. 2023;23(2).
16. Bektay MY, Sancar M, Okyaltirik F, Durdu B, Izzettin FV. Investigation of drug-related problems in patients hospitalized in chest disease wards: A randomized controlled trial. *Front Pharmacol*. 2023;13:1049289.
17. Liu JL, Xu F, Zhou H, Wu XJ, Shi LX, Lu RQ, et al. Expanded CURB-65: a new score system predicts severity of community-acquired pneumonia with superior efficiency. *Sci Rep*. 2016;6:22911.
18. Noreddin AM, Elkhatib WF. Levofloxacin in the treatment of community-acquired pneumonia. *Expert Rev Anti Infect Ther*. 2010;8(5):505-14.
19. Garin N, Sole N, Lucas B, Matas L, Moras D, Rodrigo-Troyano A, et al. Drug related problems in clinical practice: a cross-sectional study on their prevalence, risk factors, and associated pharmaceutical interventions. *Sci Rep*. 2021;11(1):883.
20. Noor S, Ismail M, Ali Z. Potential drug-drug interactions among pneumonia patients: do these matter in clinical perspectives? *BMC Pharmacol Toxicol*. 2019;20(1):45.

