

# Trends in Prescribing Antibiotic Therapy for Hospitalized Patients with Community-Acquired Pneumonia in Vietnam

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## Abstract

**Background:** Community-acquired pneumonia (CAP) is a serious and common infectious disease with a high rate of morbidity and mortality among adults. Appropriate antibiotic treatment is therefore vital for reducing the disease incidence. **Objective:** This study aimed at determining the trends in antibiotic use in hospitalized patients with CAP. **Methods:** A retrospective study involving 479 medical records of hospitalized adults with CAP was undertaken at Tien Giang Central General Hospital in southern Vietnam during 2018–2019. Collected data included patient socio-demographic characteristics and administered antibiotic therapy. **Results:** Of the 479 CAP cases, 53.8% were female and more than half were aged 65 and above (average age 66.4±18.3 years). Cardiovascular diseases, gastrointestinal disorders, and pulmonary diseases were the most common morbidity of patients with CAP. Overall, 43% of the patients had used antibiotics before hospital admission. In the initial treatment, the most frequent single prescribed antibiotics were amoxicillin/clavulanic acid, ceftriaxone, and levofloxacin. Double combinations of the antibiotics in the initial treatment were used in 75.8% of the cases. Overall, 78.6% of the patients had good responses to the first-choice antibiotics. A negative association was noted between the pneumonia severity and antibiotic effectiveness ( $P<0.05$ ). **Conclusions:** Although the initial treatment was successful in the majority of hospitalized patients with CAP, the severity of pneumonia still required attention from healthcare professionals to improve the effectiveness of the treatment.

**Keywords:** Antibiotic, community, pneumonia, prescribing, therapy, Vietnam.

## INTRODUCTION

Community-acquired pneumonia (CAP) is considered one of the major causes of mortality and morbidity in adults worldwide. The disease comprises acute symptoms and the presence of signs of lower respiratory tract infection (LRTI) without other apparent causes, but the presence of a new pulmonary infiltrate on a chest radiograph is needed for the diagnosis. <sup>[1]</sup> CAP usually refers to pneumonia acquired outside the hospital or that develops within 48h after hospital admission. <sup>[2]</sup> Common clinical symptoms of CAP are cough, fever, rapid shallow breathing, shortness of breath, fatigue, and night sweats. <sup>[3]</sup> The criteria for the diagnosis of pneumonia depend on different guidelines, such as the presence of dense areas of the lung on a chest X-ray or other imaging technique<sup>[4]</sup> and the presence of respiratory signs (abnormal breath sounds, such as localized crackles) or only clinical symptoms. <sup>[5]</sup>

CAP can be triggered by separate microorganisms, with common infective organisms including *Haemophilus influenzae*, *Mycoplasma pneumoniae*, *Chlamydomphila pneumoniae*, *Streptococcus pneumoniae*, and viruses, bacteria, parasites, and fungi. In fact, the causative agent of the disease often cannot be found in most cases. As a result,

the treatment for CAP is mostly empirical, making the risk of failure difficult to predict. Over the last few decades, the overuse of antibiotics, their inappropriate use, and unreasonable antibiotic combinations have resulted in an increasing rate of antibiotic resistance and reduced treatment effectiveness. A study by Mauldin et al. <sup>[6]</sup> in the United States showed that 29% of the healthcare-associated infections (HAIs) from 2000 to 2008 were caused by resistant gram-negative pathogens, and almost 16% involved a

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multidrug-resistant gram-negative pathogen. The cost and length of hospital stay attributable to antibiotic-resistant HAIs were higher for those caused by gram-negative pathogens than by antibiotic-susceptible gram-negative pathogens.<sup>[6]</sup> Several factors are associated with an increased risk of CAP, including smoking behaviors, drinking behaviors, underlying medical conditions, nursing home residency, and regular contact with children.<sup>[4, 7]</sup>

Lower respiratory tract infections (LRTIs) including pneumonia are the third highest cause of death in adults, and 1.8 million people aged  $\geq 15$  years annually die from pneumonia.<sup>[8]</sup> Studies have shown that the incidence of CAP increases with age and is greatest among people aged 60 and older, indicating that the burden of this health risk will grow as the global population ages.<sup>[9–11]</sup> In the United States and Canada, CAP remains a leading cause of death due to infectious diseases.<sup>[12]</sup> In Europe, the incidence rates of CAP range from 1.6–11.6 per 1000,<sup>[13]</sup> while the rates in the Asia-Pacific region range from 0.2–0.9 per 1000.<sup>[14]</sup> Special attention should be paid to CAP in Southeast Asia (SEA), as this region is facing a rapid demographic transition.<sup>[15]</sup>

CAP has a negative impact on physical and mental health, but it also creates a financial burden for patients. The costs for CAP inpatient treatment accounted for 80–95% of the total treatment costs, with the average length of the hospital stay about 9–10 working days.<sup>[16]</sup> About 8,500 adults were hospitalized for CAP, at an estimated cost of more than \$40 million per year, in the Canadian province of Alberta.<sup>[17]</sup> A study by File *et al.* in 2010 reported an overall financial burden of CAP of approximately \$9.3 billion among 4 million outpatients in the US.<sup>[8]</sup> In the Philippines, the economic burden associated with CAP was calculated at \$852–\$5,885 per case.<sup>[18]</sup> Nguyen *et al.* emphasized that the average cost of treatment was approximately \$629 for Vietnamese in CAP patients. On average, the largest expenses were those related to direct medical costs, at 76.6% of the total (\$481).<sup>[19]</sup>

The main cause of Community-acquired pneumonia has not been clarified due to the lack of clinical data and limited diagnostic tools. This gap in knowledge poses considerable challenges to the health system in Vietnam. A study of CAP in adults at Khanh Hoa General Hospital revealed 174 episodes of CAP among 367 episodes of lower respiratory tract infections, accounting for 47%. This incidence increased significantly with age and was highest in the elderly. The proportion of CAP patient fatalities was also relatively high, at 9.8%.<sup>[15]</sup> Therefore, an appropriate antibiotic selection is considered a prerequisite for the treatment of CAP.

The need for appropriate use of antibiotics in diagnosis and treatment has become an urgent issue recently, but only a few studies in Vietnam have provided clinical evidence regarding antibiotic therapy for CAP patients. In this study, our aim was to analyze the trend in prescribing antibiotics for hospitalized adults with CAP.

## MATERIALS AND METHODS

### Study site

A retrospective study was conducted by collecting information from the database at Tien Giang Central General Hospital between 2018 and 2019. Tien Giang Center General Hospital is a first-class hospital located in My Tho City, Tien Giang Province, Vietnam. The hospital has 8 functional offices, 26 clinical and para-clinical departments, and a total of 870 healthcare staff (unpublished data).

### Data collection

The study recruited medical records of patients who were diagnosed with CAP and defined as code J10–J18 according to the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD).<sup>[20]</sup> If patients were classified as having hospital-acquired pneumonia or did not develop the disease within 48 hours after admission, they were excluded from the study. We also eliminated pregnant and breastfeeding women, patients who had been moved from other hospitals to the study site, or patients who were arbitrarily discharged from hospital (before full recovery).

Socio-demographic characteristics and antibiotic therapy used in the treatment of Community-acquired pneumonia were collected for each patient. Information about socio-demographic aspects included age, gender, education, occupation, living area, co-morbidity, clinical pneumonia symptoms, laboratory test results, and the severity of pneumonia. Trends in antibiotic use for patients with CAP included data related to types of antibiotics, dosage and regimen, the effectiveness of initial antibiotic treatment, changes in antibiotics, and the overall effectiveness of the entire course of treatment. The effectiveness of treatment was divided into treatment success (when clinical symptoms improved, diminished, or disappeared, patients were instructed to continue the antibiotic injection or oral antibiotics) or treatment failure (when clinical symptoms became worse and more dangerous signs appeared or the patients died).

### Statistical analysis

Descriptive statistics were applied to summarize the socio-demographic features and the use of antibiotic therapy for hospitalized patients with CAP. Logistic regression analysis was employed to assess the relationship between socio-demographic characteristics and the effectiveness of the treatment. The  $\chi^2$  test and Fisher's exact tests were used to compare frequencies of categorical variables. A p-value of less than 0.05 was considered statistically significant in all analyses. The collected data were entered into Microsoft Excel 2016 software before being cleaned and exported to SPSS (Statistical Package for Social Sciences) version 16.0 for the performance of the statistical procedures.

### Ethical approval

The study protocol was approved by the Ethics Review Committees of the hospital. All participants agreed to enroll in our study. Personal information was kept confidential and used only for research purpose. Some sensitive information was encrypted.

## RESULTS

**Table 1.** Socio-demographic characteristics of patients

Characteristics	Frequency (n)	Percentage (%)
<i>Gender</i>		
Male	258	53.8
Female	221	46.2
<i>Age groups</i>		
<35	26	5.4
35-44	62	13.0
45-54	49	10.3
55-64	71	14.8
65-74	112	23.3
≥75	159	33.2
Mean (SD)	66.4 (18.3)	
Min-Max	27-89	
<i>Education</i>		
Primary school	64	13.4
Secondary School	138	28.7
High School	170	35.5
College/Technical school	39	8.1
University/Postgraduate	68	14.3
<i>Occupation</i>		
Worker	92	19.2
Businessman	47	9.9
Housewife	32	6.7
Retired	266	55.6
Farmer	24	4.9
Others*	18	3.7
<i>Living area</i>		
Tien Giang Province	380	79.3
Others	99	20.7
<i>Co-morbidity</i>		
Respiratory diseases	190	39.7
Cardiovascular diseases	261	54.5
Endocrine disorders	112	22.5
Gastrointestinal disorders	220	45.9
Others**	64	13.4
<i>Prior pneumonia</i>		
Yes	130	27.1
No	349	72.9

<i>Antibiotic therapy prior to hospital admission</i>		
Yes	206	43.0
From drugstores	87	18.2
Outpatient treatment	54	11.3
Clinics	65	13.5
No	273	57.0
<i>Clinical symptoms</i>		
<i>Fever</i>		
< 39 °C	163	34.0
≥ 39 °C	99	20.7
Cough	302	63.0
Shortness of breath/Rapid shallow breath	221	46.1
Fatigue	298	62.2
Others (Headache, vomiting)	144	30.1
<i>Laboratory test</i>		
<i>White blood cell (n=279)</i>		
Decrease	11	2.3
Normal	267	55.7
Increase	201	42.0
X-ray (n=479)	479	100.0
<i>CRP (n=335)</i>		
Normal	124	37.0
Increase	211	63.0
<i>PCT (n=101)</i>		
Normal	5	5.0
Increase	96	95.0
<i>Microbiological culture (n=293)</i>		
Blood	204	69.6
Phlegm	222	75.8
Bronchial fluids	43	14.7
<i>The severity of pneumonia</i>		
Mild	75	15.7
Moderate	378	78.9
Severe	26	5.4

\*: Freelancers, teachers, accountants,...

\*\* : Chronic kidney disease, benign prostatic hyperplasia,....

Data from 479 patients with CAP who met the research criteria were recorded in our study. The mean age was 66.4 (18.3) years; more than half were male (53.8%), aged 65 and older (56.5%), and retired (55.6%). The proportion of patients who had completed high school was the highest at 35.5%, followed by secondary school at 28.7%. The majority of patients (79.3%) lived in Tien Giang Province, and the other 20.7% lived in other regions. The most common comorbidities were cardiovascular diseases (54.5%), gastrointestinal disorders (45.9%), and respiratory diseases (39.7%). Over 25% of the patients had previously had

pneumonia, whereas 72.9% of the patients had not. Of the 479 patients, 206 (43%) had taken antibiotics before hospital admission. In particular, 18.2% of the patients had bought antibiotics at drugstores without a prescription, and nearly a third of them visited doctors at clinics or underwent outpatient treatment. In terms of clinical symptoms, most patients had fever (55%) and cough (65%). The patients also complained of fatigue because of coughing and difficulty breathing. All patients who were hospitalized with a diagnosis of pneumonia underwent X-rays and white blood cell tests. Approximately 70% of the patients had a C-reactive protein (CRP) test and 61.2% of them had a microbiological culture. The percentage of mild to moderate pneumonia accounted for 94.5%, while that of severe pneumonia was only 5.4% (Table 1).

**Table 2.** Antibiotics used for patients with Community-acquired pneumonia (N =479)

Antibiotics	Frequency (n)	Percentage (%)
Ampicillin + Sulbactam	36	7.5
Amoxicillin + Clavulanic Acid	82	17.1
Ceftriaxone	125	26.1
Cefmetazole	21	4.4
Ceftizoxime	28	5.8
Ceftazidime	63	13.2
Cefotaxime	123	25.7
Cefoperazone +Sulbactam	15	3.1
Cefepime	23	4.8
Imipenem + Cilastatin	62	12.9
Ciprofloxacin	157	32.8
Levofloxacin	261	54.5
Azithromycin	9	1.9
Doxycycline	22	4.6
Gentamicin	19	4.0
Vancomycin	9	1.9

In the present study,  $\beta$ -lactam and quinolone were the most frequently used antibiotics for the treatment of pneumonia in the hospital. In the  $\beta$ -lactam group, cephalosporins were used more frequently than penicillin. Third-generation cephalosporins in common use were ceftriaxone, cefotaxime, ceftazidime, and cefoperazone/sulbactam (a  $\beta$ -lactamase inhibitor). The only fourth-generation cephalosporin prescribed was cefepime. Penicillin was mainly used in combination with a  $\beta$ -lactamase inhibitor (ampicillin/sulbactam and amoxicillin/clavulanic acid). Among the carbapenems, only imipenem and cilastatin were used in the treatment regimen. Ciprofloxacin and levofloxacin are the most popularly prescribed active ingredients in the quinolone group and are indicated in cases of moderate or severe pneumonia in the form of single therapy or double combinations with  $\beta$ -lactams. The remaining antibiotics, such as azithromycin, doxycycline, and

vancomycin, were given to patients in limited quantities because these antibiotics were often used in combinations (azithromycin, doxycycline) or in extremely severe cases (vancomycin) (Table 2).

**Table 3.** Antibiotic regimen used for patients with community-acquired pneumonia (N=479)

Regimen	Frequency (n)	Percentage (%)
Single regime	111	23.3
Double combination regime	363	75.8
Triple combination regime	5	0.9

Antibiotics for the initial treatment of CAP were mainly used in combinations (Table 3). Double antibiotic combinations made up 75.8% of the total cases and consisted of ceftizoxime + ciprofloxacin, ceftriaxone + ciprofloxacin, ampicillin/sulbactam + ciprofloxacin, amoxicillin/clavulanic acid + ciprofloxacin, ceftazidime + levofloxacin, cefmetazole + ciprofloxacin, and cefotaxime + levofloxacin. By contrast, single antibiotic therapy accounted for only 23.3% of the total cases and included amoxicillin/clavulanic acid, ceftriaxone, and levofloxacin. Only 0.9% of the patients were given triple antibiotic combinations.

**Table 4.** Antibiotics therapy according to the effectiveness of treatment after 72 hours (N=479)

Antibiotics	Treatment Success		Treatment Failure	
	n	%	n	%
Amoxicillin/Acid Clavulanic	22	59.5	15	40.5
Ceftriaxone	16	64.0	9	36.0
Levofloxacin	36	73.5	13	26.5
Cefotaxime + Levofloxacin	81	95.3	4	4.7
Ceftriaxone + Ciprofloxacin	34	69.4	15	30.6
Ceftazidime + Levofloxacin	41	87.2	6	12.8
Amoxicillin/ Clavulanic Acid + Ciprofloxacin	39	84.8	7	15.2
Ampicillin/Sulbactam + Ciprofloxacin	26	72.2	10	27.8
Ceftizoxime + Ciprofloxacin	19	67.9	9	32.1
Imipenem/Cilastatin + Levofloxacin	16	66.7	8	33.3
Cefmetazole + Ciprofloxacin	20	95.2	1	4.8
Cefepime + Gentamicin	8	61.5	5	38.5

**Table 4.** Antibiotics therapy according to the effectiveness of treatment after 72 hours (N=479)

Antibiotics	Treatment Success		Treatment Failure	
	n	%	n	%
Ceftriaxone + Doxycycline	4	66.7	2	33.3
Ceftriaxone + Azithromycin	4	100.0	0	0.0
Cefepime + Levofloxacin	2	50.0	2	50.0
Ceftriaxone+ Azithromycin + Vancomycin	5	100.0	0	0.0

Among the three single antibiotic therapies, levofloxacin had the highest success rate, accounting for 73.2%; followed by ceftriaxone at 65.7% and amoxicillin/clavulanic acid at 59.5%. The reason for this trend may be the narrower antibacterial spectrum of amoxicillin/clavulanic acid than cephalosporin and quinolone. The dual antibiotic combination regimens all had success rates of over 60%, except for cefepime + levofloxacin. All the cases prescribed the combination of ceftriaxone/azithromycin were successful. In 24 cases, the combination of cefmetazole + ciprofloxacin had a success rate of 95.2% and only 4.8% of the patients did not respond to treatment after 72 hours. Cefotaxime + levofloxacin was the most common antibiotic combination and had a relatively high success rate of about 95.3% in 85 cases. Ceftazidime + levofloxacin and amoxicillin/clavulanic acid + ciprofloxacin were two antibiotic combinations prescribed in more than 50 cases, with success rates of 87.2% and 84.8%, respectively.

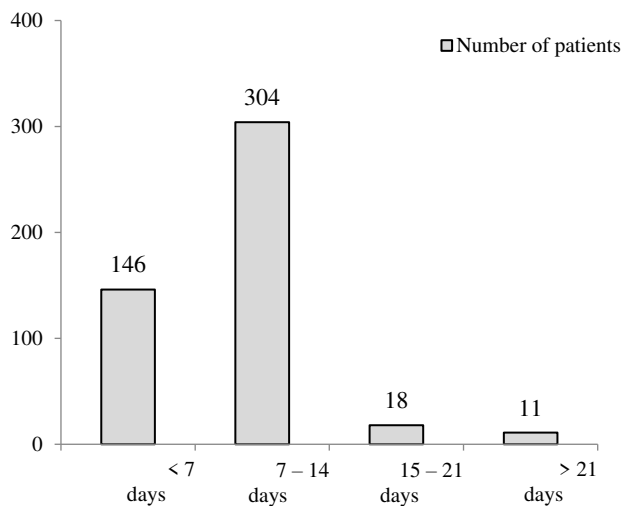
The remaining antibiotic combinations had success rates of 66.7% for imipenem/cilastatin + levofloxacin; 71.4% for ceftriaxon + doxycycline; 69.6% for ceftriaxone + ciprofloxacin; 68.8% for ceftizoxime + ciprofloxacin; 60% for cefixime + gentamicin. Triple antibiotic combinations (ceftriaxone + azithromycin + vancomycin) were administered to 5 cases, with a 100% success rate after 72 hours of treatment (Table 4).

**Table 5.** The effectiveness of antibiotic therapy after 72 hours by different socio-demographic characteristics (N=479)

Characteristics	The effectiveness of antibiotic therapy after 72 hours [n (%)]		P-value
	Treatment Success	Treatment Failure	
<b>Age groups (years)</b>			
<65	172 (82.4)	37 (17.6)	0.322
≥65	204 (75.6)	66 (24.4)	
<b>Gender</b>			
Male	200 (77.6)	58 (22.4)	0.673

Female	176 (79.8)	45 (20.2)	
<b>Prior pneumonia</b>			
Yes	93 (67.5)	45 (32.5)	0.078
No	283 (83.0)	58 (17.0)	
<b>Antibiotic therapy before hospital admission</b>			
Yes	144 (69.8)	62 (30.2)	0.069
No	232 (85.2)	40 (14.8)	
<b>The severity of pneumonia</b>			
Mild- moderate	362 (80.0)	90 (20.0)	<b>0.012</b>
Severe	14 (53.3)	12 (46.7)	

Table 5 shows the effectiveness of antibiotic therapy after 72 hours in terms of the socio-demographic characteristics of the patients with CAP. No statistically significant differences were detected for the effectiveness of the treatment in terms of age groups, gender, prior pneumonia, and antibiotic therapy prior to hospital admission ( $P > 0.05$ ). The only significant difference in the effectiveness of treatment was noted for distinct severe levels of pneumonia ( $P < 0.05$ ). The failure rate of treatment after 72 hours was 2.34 times higher for patients with severe pneumonia than with mild to moderate pneumonia.



**Figure 1.** Duration of antibiotic treatment at the hospital Respiratory Department

The duration of antibiotic treatment ranged from under 7 days to over 21 days. The duration of treatment depended on the severity of pneumonia and the response to antibiotic therapy. Overall, 63.4% of patients with CAP had a duration of treatment of 7 to 14 days and nearly half of them (30.6%) were those who used antibiotics for under 7 days (Figure 1).



## DISCUSSION

### Socio-demographic characteristics

Male patients accounted for the highest percentage (53.6%) of the 479 patients with CAP at Tien Giang Central General Hospital. This figure was consistent with the results of two different studies conducted in Khanh Hoa General Hospital and Trung Vuong General Hospital, Vietnam in which the proportion of female patients was 52%<sup>[15]</sup> and 58%<sup>[19]</sup>, respectively. This may be explained by the observation that men often have chronic lung disease because of their smoking behavior (a risk factor for lung infections) or drinking behavior (a high risk for pneumonia).<sup>[4]</sup>

The present study illustrated that the incidence of CAP increased with age and the proportion of the elderly was about 10 times higher than that of young adults. Actually, aging can weaken the immune system thereby leading to various comorbidities and impaired organ function. In a study carried out in Germany in 2017, more than half the hospitalized patients with CAP were aged 60 and above.<sup>[21]</sup> This study also found that cardiovascular diseases, gastrointestinal disorders, and respiratory diseases were the most frequent comorbidity in CAP patients. Our results were similar to those of a previous study in Vietnam, which reported that pulmonary and cardiovascular diseases made up the greatest percentage of 69% and 42.4%, respectively<sup>[19]</sup>. This phenomenon was also reported in the Philippines by Azmi *et al.*<sup>[22]</sup>

The severity of pneumonia also varied, with 15.7% of cases identified as a mild level, 78.9% as a moderate level, and 5.4% as a severe level. The CURB-65 scores indicate that patients with mild pneumonia need outpatient treatment while patients with moderate to severe pneumonia should be provided with inpatient care. The guidelines for the treatment of adults with community-acquired pneumonia in Britain or the United States also recommend that a number of other factors, such as age, comorbidities, living conditions, and self-care ability, should be taken into consideration when making a decision about inpatient or outpatient treatments.<sup>[23-25]</sup> Our study showed that 43% of the patients bought antibiotics at private pharmacies without prescriptions before hospital admission because the patients think that self-medication can save time and money compared to visiting a doctor. In our study, all patients suspected of having pneumonia underwent X-rays. A CRP test was also conducted in several cases to check for inflammation in the body. A higher level of CRP may be a sign of more severe pneumonia. In addition, 21.1% of patients underwent a test for procalcitonin (PCT), which has a differential diagnostic value, in order to distinguish bacterial and viral infections.<sup>[26-29]</sup>

### Trends in initial antibiotic prescribing for patients with Community-acquired pneumonia

$\beta$ -lactams play an important role in the treatment of CAP. For example, third-generation cephalosporins, such as

cefotaxime, ceftriaxone, and ceftazidime were frequently given to CAP patients. According to the guidelines for the treatment of adults with CAP proposed by the American Thoracic Society (2007) or the British Thoracic Society (2009),  $\beta$ -lactams were the preferred drugs for use in the treatment of CAP.  $\beta$ -lactams were also recommended for use in combinations with macrolide or fluoroquinolones for CAP inpatients or CAP outpatients with comorbidities.<sup>[23, 24, 30-32]</sup> The majority of patients with CAP (87.3%) also received fluoroquinolones as treatment. The American Thoracic Society (2007) has recommended fluoroquinolones in CAP inpatients or outpatients with comorbidity.<sup>[24]</sup> The Antibiotic Guidelines 2015-2016 recommend, in addition to  $\beta$ -lactam, fluoroquinolones as the first-choice antibiotic for hospitalized adults with CAP.<sup>[33]</sup> However, patients should be given respiratory fluoroquinolones, such as levofloxacin and moxifloxacin, as these are effective against *S. pneumonia* and atypical bacteria. Ciprofloxacin would be the most appropriate treatment in cases where *P. aeruginosa* was a suspected pathogen.<sup>[23, 34]</sup>

In this study, only 10 patients with CAP were treated with a macrolide (azithromycin). A study in 2008 conducted in 14 centers in eight Asian countries, including University of Medicine and Pharmacy at Ho Chi Minh City, Vietnam, demonstrated that the most frequently prescribed combination therapy (43.1%) was third-generation cephalosporin + macrolide, while the combination of a third-generation cephalosporin and fluoroquinolones accounted for only 7.7% of the prescriptions<sup>[35]</sup> In the present study, a combination regimen with fluoroquinolones ( $\beta$ -lactams and fluoroquinolones) achieved treatment success after 72 hours in over 65% of the cases. Konstantinos *et al.*<sup>[36]</sup> and Skalsky *et al.*<sup>[37]</sup> emphasized that fluoroquinolones used in single therapy or in combination therapy with  $\beta$ -lactams had better clinical efficacy and fewer adverse gastrointestinal events but had no significant effect on mortality when compared to the combination of a  $\beta$ -lactam and a macrolide. Only two antibiotic combinations with a macrolide were used in the initial treatment for CAP at Tien Giang Central General Hospital, namely ceftriaxone + azithromycin and ceftriaxone + azithromycin + vancomycin. The treatment success rates of these two combinations were 100.0%.

### Limitations

The present study did not investigate the relationship between antibiotic therapy before hospital admission or the effectiveness of inpatient treatment at the hospital. The reason may be that the inpatients were prescribed broad-spectrum antibiotics beginning with their initial treatment, so the effects on the sensitive bacteria were similar. Another possibility is that the sample size of this study was not large enough or sufficiently representative to allow a determination of the association between antibiotic treatment before admission to the hospital and the effectiveness of inpatient treatment. Nevertheless, the use of antibiotics prior to hospitalization in our community has been an urgent issue

that requires careful attention from healthcare professionals. Inappropriate antibiotic therapy may lead to the low effectiveness of outpatient treatment. Furthermore, inappropriate use of antibiotics and antibiotic overuse can potentially cause drug resistance, which is one of the growing challenges in the current treatments.

Further research should be conducted over a longer period and in an expanded study area to allow generalization of the trends in prescribing antibiotics in the region and across the country. Assessment of the antibiotics used in the empirical treatment of CAP, as well as the antibiotic resistance at hospitals, is also crucial.

## CONCLUSIONS

This retrospective study provided information about prescribing antibiotic therapy for patients with CAP at Tien Giang Central General Hospital. Most patients received a combination double therapy as the initial treatment, and a large proportion of the patients had a good response to the initial treatment. The severity of pneumonia was negatively associated with the effectiveness of treatment for CAP patients. Therefore, this feature of the disease should be considered carefully when implementing treatment regimens for CAP patients in order to improve the effectiveness of the treatment.

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## Conflict of interest

The authors declare that they have no conflict of interest.

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