

**Original Article**

**INJECTABLE CEPHALOSPORINS USE IN VIETNAMESE HOSPITALS: A DESCRIPTIVE CROSS-SECTIONAL MULTICENTER STUDY**

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**ABSTRACT**

**Objective:** The objective of this research was to investigate the use of injectable cephalosporins for inpatients at eleven hospitals in An-Giang province, Vietnam.

**Methods:** This cross-sectional multicenter study was conducted through retrieving the medical inpatient data at eleven hospitals in An-Giang province over the 01-12/2015 period.

**Results:** The sample included 23155 treatment episodes with cephalosporins. Among them, 86% were used only one agent of cephalosporins, mainly cefotaxime. Among cases administered concurrently different antibiotic classes, combinations of cephalosporins and gentamycin were the majority. All treatment episodes correlated with sixteen indication groups of infection treatment, in which the leading groups were "pneumonia", "gastrointestinal infections" and "cesarean" according to the numbers of treatment episodes and the costs of cephalosporins used. 6.61 billion VND was spent for cephalosporins which accounted for 98 % of the total injectable antibiotic cost over the twelve-month period at eleven hospitals in An-Giang.

**Conclusion:** Analysis of injectable cephalosporins consumption, and multicenter approach, has a crucial importance for further survey of antibiotic de-escalation protocol in hospitals in An-Giang.

**Keywords:** Cephalosporins, Injectable antibiotics, Cost, Inpatients

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**INTRODUCTION**

Cephalosporins are a significant class of antibacterial agents in use and are endorsed for use for penicillin-allergic inpatients [1]. Studies, which investigated the use of antibiotics, recent years revealed that cephalosporins were prescribed more frequently in the treatment of infections in the world [2-7] and in Vietnam as well [8-15]. However, in the current context of antibiotic resistance crisis, particularly the burgeoning resistance to cephalosporins [16], antimicrobial stewardship programs have become a prerequisite committed at all the healthcare centers. Being aware of complicated drug resistance status, the Vietnam's government has taken urgent action to deal with this issue. Specifically, in two years 2015 and 2016, the Vietnam's Ministry of Health has addressed guidelines for the antibiotic utilization and stewardship at hospitals [17, 18] which provided a standard for practitioners to follow.

In the south of Vietnam, An-Giang province consists of eleven district hospitals and four provincial ones. A dual disease pattern has existed in this province in recent years and witnessed an increase in the prevalence rates of infectious diseases, particularly respiratory tract infections, gastrointestinal infections, dengue fever, and influenza. The annual injectable antibiotic expenditure for inpatients at eleven district hospitals in An-Giang accounted for around 10% of the aggregate drug cost. In this province, cephalosporins were documented as the most regularly prescribed antibiotics for inpatients compared to other injectable antibacterial agents.

Although medicine consumption in An-Giang's hospitals is reported every year, these statistics are still limited to scientific studies. Indeed, there has been no study which can accurately describe the status of injectable cephalosporin utilization. Information about the consumption of injectable cephalosporins is an indispensable part of An-Giang Health Department's comprehensive antibacterial utilization assessment. This is also vital for medicinal regulatory authorities in regulating behaviours of antibiotic use. With the purpose of providing the very first scientific evidence in Vietnam on the reality of injectable cephalosporin utilization, the research was conducted over a one-year period at eleven district hospitals in An-Giang province, Vietnam.

**MATERIALS AND METHODS**

**Study design**

This cross-sectional multi-centre study looked at injectable cephalosporins prescribing data in inpatients admitted to eleven district hospitals in An-Giang, Vietnam over a twelve-month period (January-December 2015). Exclusion criteria for this study were: (1) inpatients hospitalized in 2015 and discharged in 2016; (2) inpatients who were referred to higher centers; (3) inpatients whose medical data were not stored in the hospital information system.

**Data collection and analysis**

Injectable antibiotics data were retrieved from the hospital information system by reviewing the electronic records of discharged patients. Each treatment episode was recorded as a single variable. These data of injectable antibiotics consumption were entered in a form and included the following: brand name, generic name (antimicrobial agent), content, quantity, and indication(s). Cephalosporin utilization was described by the antimicrobial agent(s), indication(s) and treatment episode(s).

These data were reported for 23155 treatment episodes with injectable cephalosporins. According to the World Health Organization, a treatment episode is a patient contact which required a standard course of drug treatment [19]. In our study, a single inpatient contact might be counted as more than one treatment episode if he or she was re-admitted in hospitals and received another standard course of drug treatment during the period of sampling. There were exactly 20760 inpatients related to 23155 treatment episodes with injectable cephalosporins.

**Statistic methods**

Descriptive statistical analysis was done by calculating the frequency and the percentage for all the parameters. The data obtained were entered in Microsoft Excel 2010 spreadsheet and the analysis was done using the R Statistic Software (version 3.1.3).

**RESULTS**

**General characteristics of the study sample**

During 12-month collecting data, the episodes of injectable cephalosporin treatment contributed 84% of the aggregate figure for injectable antibiotics. The expense of injectable cephalosporins was 6.61 billion VND, representing 98% of the total expense of injectable antibacterial agents. Injectable cephalosporins were presented through different concentrations, including 125 mg; 750 mg; 1 g; 1.5 g; and 2 g. The most common strength was 1 g. All of the cephalosporins prescribed in this study were the third generation. Active ingredients included cefotaxime, ceftazidime, ceftriaxone, cefuroxime, ceftizoxime in the descending order of consumption level (fig. 1).

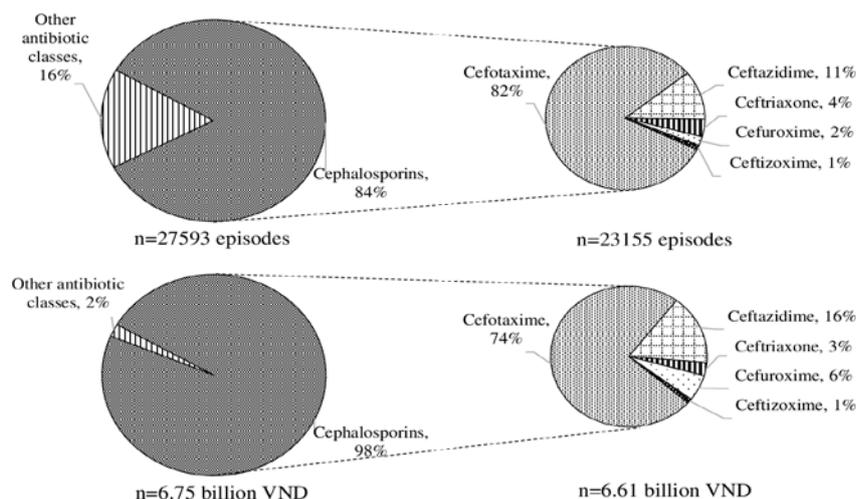
**Characteristics of combining antibiotics**

Among 20760 inpatients injected cephalosporin, there were 17953 inpatients receiving one antibacterial agent, accounted for

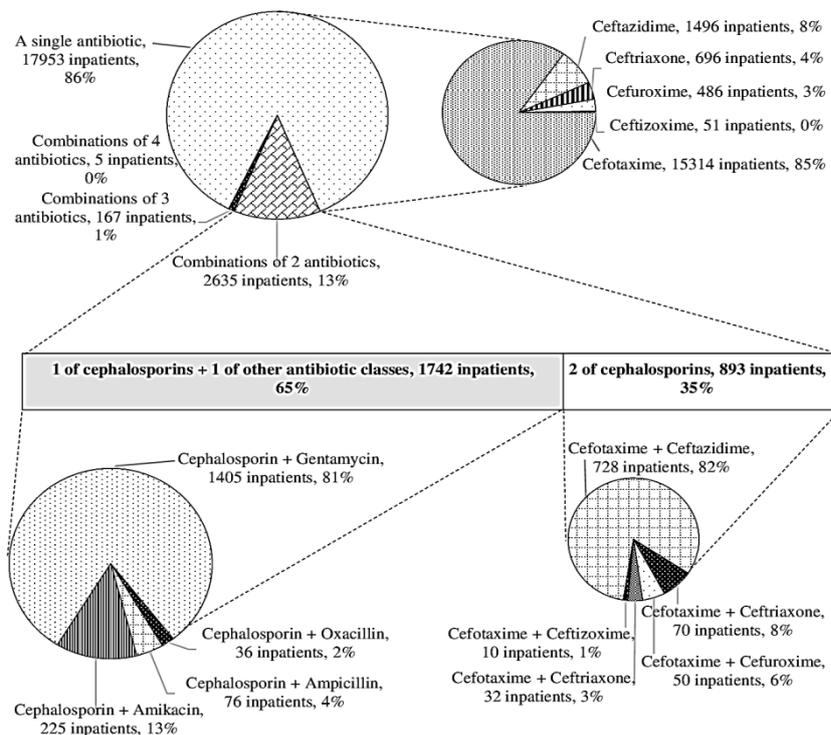
86%. 2635 inpatients have administrated combinations of two antibacterial agents. Among them, 65% received simultaneously one of the cephalosporins and one of the other antibiotic classes (in which, 81% were combinations with gentamycin) while the remaining 35% received concurrently two of the cephalosporins (in which, 81% were combinations of cefotaxime and ceftazidime) (fig. 2).

**Characteristics of the cephalosporin utilization according to the indications**

In accord with the purposes of treatment, the study clustered indications into sixteen groups, in which the majority of treatment episodes belonged to three groups: "pneumonia", "digestive system infections" and "cesarean section". In cases of injectable cephalosporins, the leading indications group was "pneumonia" according to the number of treatment episodes, and the cost of cephalosporins used (table 1).



**Fig.1: The proportion of cephalosporins by the number of treatment episodes and drug expense of the study sample**



**Fig.2: Describing the use of cephalosporin antimicrobial agents in the study sample (n=23155 episodes)**

**Table 1: Describing the use of cephalosporins by treatment indications and antimicrobial agents in the study sample**

	Treatment episodes		Cephalosporins units		Spending (billion VND)	
	n=23155	(%)	n=261296	(%)	n=6.72	(%)
<b>Indication groups</b>						
Pneumonia	6171	(26.7)	64359	(24.6)	1.68	(25.5)
Gastro-Intestinal infections	3847	(16.6)	37752	(14.4)	0.83	(12.6)
Cesarean section	2690	(11.6)	34368	(13.2)	0.92	(13.9)
Hospital-acquired infections	1388	(6.0)	18679	(7.1)	0.49	(7.4)
Wound infections	1238	(5.3)	13913	(5.3)	0.34	(5.1)
Ear/Nose/Throat infections	1210	(5.2)	16950	(6.5)	0.51	(7.8)
Respiratory infections	1042	(4.5)	8276	(3.2)	0.16	(2.5)
Bronchitis	940	(4.1)	12178	(4.7)	0.30	(4.5)
Septicemia	742	(3.2)	7430	(2.8)	0.18	(2.7)
Skin and soft tissue infection	733	(3.2)	10678	(4.1)	0.27	(4.0)
Parasitic infections	617	(2.7)	4449	(1.7)	0.12	(1.8)
Excretory system infection	602	(2.6)	7029	(2.7)	0.18	(2.8)
Respiratory Infection (not pneumonia)	568	(2.5)	6968	(2.7)	0.17	(2.6)
Infections refer to procedures	567	(2.4)	6668	(2.6)	0.16	(2.4)
Superinfection with Pulmonary tuberculosis	457	(2.0)	7253	(2.8)	0.19	(2.9)
Other infections	343	(1.5)	4346	(1.7)	0.11	(1.6)
<b>Antimicrobial agents</b>						
Cefotaxime	19090	(82.4)	218704	(83.7)	4.27	(74.5)
Ceftazidime	2426	(10.5)	27958	(10.7)	0.94	(16.4)
Ceftriaxone	941	(4.1)	6009	(2.3)	0.16	(2.8)
Cefuroxime	545	(2.4)	6273	(2.4)	0.33	(5.8)
Ceftizoxime	153	(0.7)	2352	(0.9)	0.03	(0.5)

## DISCUSSION

The study provided detailed information about the use of injectable cephalosporins for twelve consecutive months at eleven district hospitals in An-Giang. Results demonstrated that 84% of the antibiotic-treated cases at the time of sampling in these hospitals were using cephalosporins, mainly cefotaxime, a third-generation cephalosporin antibiotic. This result was similar to previous studies conducted in Vietnam [11-14] and in the world [5, 7]. 14% of inpatients in this study received at least two antibiotics, most of them were given two antibiotics. The most common antibiotic combinations were cephalosporins plus gentamycin, and two antibiotics belonging to the cephalosporin class (cefotaxime and ceftazidime).

Among sixteen groups of indications, "cesarean section" was dominant in terms of the number of units used and the drug costs. This is one of the indications recommended using cephalosporins according to the guideline of prophylactic antibiotics for caesarean section in Vietnam [10]. Due to numerous risks and adverse effects of experiencing antibacterial therapies, it would take into account to replace appropriately from the injectable antibiotics to the oral ones. Among cephalosporins, cefotaxime was prescribed most frequently for inpatients. According to the "Guideline for the Antibiotic Stewardship in Hospitals" issued by Vietnamese Ministry of Health [17], injectable cefotaxime is one of the recommended de-escalate antibiotics, meaning switch over from intravenous to oral therapy when the effect of initial antibiotic treatment was achieved.

All the data were available as electronic sources, which made the process of collecting and analyzing data speedily and accurately. Data were gathered in consecutive twelve months, thus, our results were out of the seasonal errors. Moreover, due to the big data we accessed, the results from this research represented the reality of consuming injectable cephalosporins for their inpatients-the antibacterial class used in superior amounts compared to other classes at eleven hospitals, in particular, and in An-Giang in general.

The comparison of results between our study and previous ones in Vietnamese health facilities was still limited due to the shortage of results about selecting medicines according to treatment indications. Investigating the de-escalation of cephalosporins has not been included in the study's objectives. In addition, this study only initially investigated the combinations of different injectable antibiotics, regardless of other oral antibiotics. This study has not had in-depth evaluations of the timing, dosage, route, and duration

of use of antimicrobial agents in infection treatment. Therefore, this is just an overview description with preliminary assessments.

## CONCLUSION

The study particularly examined the characteristics of injectable cephalosporin utilization for a great number of inpatients, which could represent the real situation. Results of the study complemented the information about the antibiotics used in An-Giang province in general and at the district hospitals in particular. This information is valuable science evidence for An-Giang's Health Department to regulate antibacterial consumption, thereby, optimizing the antibiotic stewardship programs.

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## AUTHOR CONTRIBUTION

Hoang-Thy Nhac-Vu designed the study, directed the entire analysis of research, evaluated the overall research results and redacted the manuscript.

Tran-Thi Ngoc-Van prepared the overview, analyzed data and reviewed the manuscript.

All authors discussed the results and implications and commented on the manuscript at all stages.

## CONFLICTS OF INTERESTS

All authors have none to declare

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