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# ANALYZE THE COST STRUCTURE OF INJECTABLE ANTIBIOTICS UTILIZATION FOR INPATIENTS AT 11 HOSPITALS IN AN-GIANG PROVINCE, VIETNAM

**Hoang-Thy Nhac-Vu**[1], **Pham Vinh-Thang**[2]
and
**Tran-Thi Ngoc-Van**[3]

[1] *University of Medicine and Pharmacy at Ho Chi Minh City, Vietnam*
*e-mail: hoangthynhacvu@uphcm.edu.vn*

[2] *Department of Health of An-Giang province, Vietnam*
[3] *Medical College of Quang Nam, Vietnam*

**Abstract**

Objective: To investigate the cost structure of injectable antibiotics used for inpatients at 11 hospitals in An-Giang province.

Methods: A health facilities-based retrospective cross-sectional study was conducted through retrieving the inpatients' medical data at 11 district hospitals in An-Giang province over the 01-12/2015 period.

Results: There were 27593 treatment episodes included in the study. The spending for using injectable antibiotics represented 4% of the total drugs expenditure and 24% of the total antibiotic cost at the whole of 11 hospitals over the one-year study period. The spending for Cephalosporins represented 98% of the total injectable antibiotics cost of the sample. 27593 treatment episodes receiving injectable antibiotics related to 16 groups of drug indications, in which treating Gastrointestinal infections, Pneumonia and Cesarean were 3 groups with the largest number of treatment episodes, the largest number of drug units used and the highest costs spent.

Conclusion: In the present study area, this is a very first study which could represent the reality of using injectable antibiotics at hospitals. This information is science-based evidence which enables authorities in

**Key words:** injectable antibiotics, cost, inpatients.

Department of Health of An-Giang province and hospitals to supply efficiently injectable antibiotics on their budget. Thus, this will optimize the effect of medical examination and treatment at hospitals.

# 1. Introduction

Since antibiotic resistance has emerged as a serious threat to global public health recently [1-3], antimicrobial stewardship programs have become a prerequisite committed at all the healthcare centres. 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 utilisation and stewardship at hospitals [4, 5] which provides a standard for hospitals to follow. Sharing the same concern of this issue, recent studies have examined the antibiotic use in the world [2, 6-11] as well as in Vietnam [12-14]. Information about the antibiotic consumption is fundamental to assess the present status of antibacterial use. This is also necessary for medical regulatory authorities in regulating antibiotic use behaviours.

In the south of Vietnam, An-Giang province consits of 11 district hospitals and 4 provincial ones. A dual disease pattern has existed in this province 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 antibiotics expenditure for inpatients at 11 district hospitals in An-Giang accounted for around 10% of the aggregate medicine cost. Although medicine uses in An-Giang's hospitals are reported every year, these statistics are still limited to science research. Indeed, there has been no study which can accurately describe the status of injectable anti-infection agent use as well as itemizing data on the cost structure. This information is essential for medical authorities to assess and have appropriate antibiotic use strategies which can ensure hospitals using these medicines safely and effectively.

With the purpose of providing the very first scientific evidence in Vietnam on the reality and the cost structure of injectable anti-infection agents used, the research was conducted over a 1-year period at 11 district hospitals in An-Giang province, Vietnam.

# 2. Materials and Methods

**Study design:** This descriptive cross-section study looked at injectable antibacterial prescribing data in inpatients admitted to 11 district hospitals in An-Giang province, Vietnam during 12-months (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 centres were excluded from the study; (3) inpatients whose medical data were not stored in the hospital information system. Injectable antibiotic data was 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 were entered in a form and included the following: name, the active ingredient, content, quantity, diagnosis, indication(s). Data were reported for 27593 treatment episodes in 11 hospitals. Drug utilization and cost structure were described through the active ingredient(s) and indication(s). Statistic methods: Descriptive statistics was used to describe the data. For categorical and continuous variables, frequencies and percentages were reported. Descriptive statistical analyses were done using R Statistic Software (version 3.1.3).

## 3. Results

**General characteristics of the study sample:** During 12-month collecting data, the study recorded 27593 hospitalized episodes which represented 25% of the total figure for the whole 11 hospitals. Based on the purposes of using antibiotics, the study clustered indications into 16 groups, in which the majority of indications belonged to 3 groups: 'Pneumonia', 'Digestive System Infections' and 'Cesarean Section'. Of 6.76 billion VND spending for injectable antibiotics, 1.133 billion VND (16.8%) were consumed for adjuvant therapies. A total of 10 antimicrobial agents prescribed corresponding to 27 brand-name drugs were divided into 3 main groups: Penicillins, Aminoglycosides, and Cephalosporins. Among 11 hospitals, Cefotaxime was the dominant prescribed agent which presented 74.5% of total drug units used, and 70.5% of total treatment cost of the sample. (Table 1)

**Cost structure of injectable antibiotics:** In 2015, the aggregate expenditure for antibiotics at 11 hospitals was 157.57 billion VND, of which 28.68 billion VND were spent on antibiotics in general and 6.76 billion VND on injectable antibacterial agents in particular. The expenditure for injectable antibiotics represented 4% of total cost of medicine used in one year and accounted for 24% of aggregate antibiotic costs at 11 hospitals. The total cost of injectable Cephalosporin was 6.61 billion VND, representing 98% of the injectable antibacterial cost in 12 months at 11 hospitals. Among injectable antibiotics, Cefotaxime had the highest expenditure which represented 71% of the total. The spending for Aminoglycosides and Penicillins were 79 million VND (1.2%) and 68 million VND (1%), respectively. The percentages of spending for antibiotics at each hospital were different, varied from 0.7% to 22.7%. (Fig. 1)

According to purposes of using antibiotics, the cost of Cefotaxime was always dominant in every indication group. The cost of other Cephalosporins

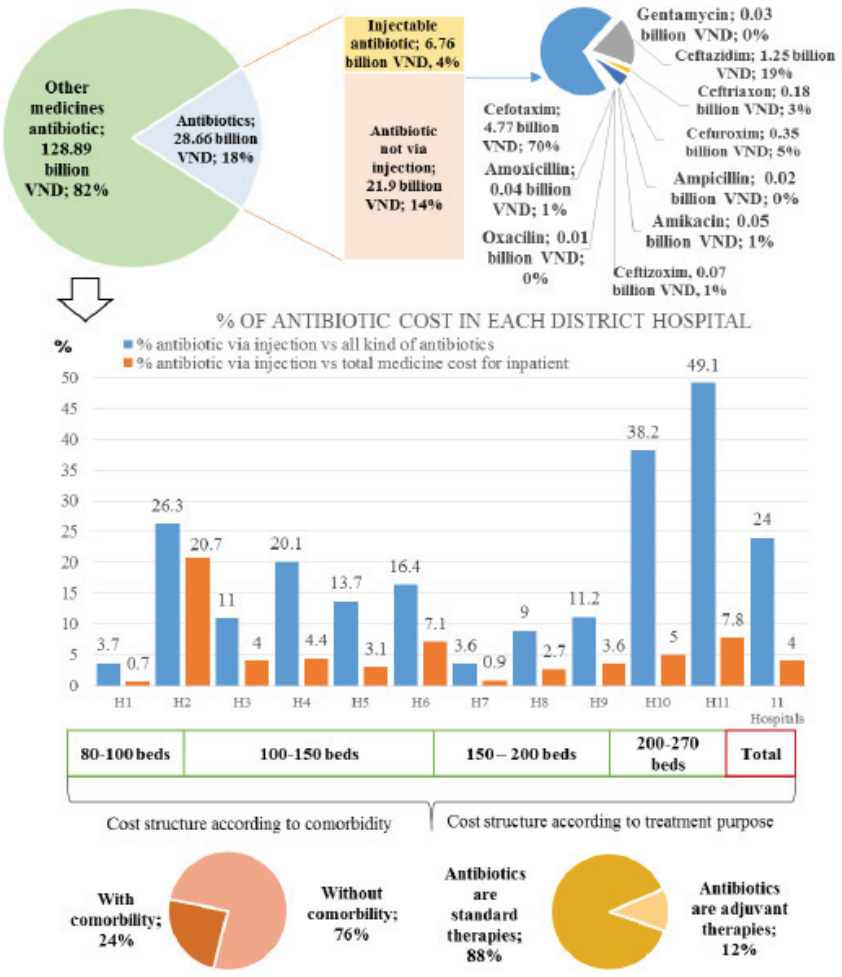


**Fig. 1: Describe the cost structure of injectable antibiotics in the sample**

**Table 1: Describe the status of antibiotic use by active ingredients and treatment purposes**

| | **Total usage in units of injectable antibiotics** | **The cost of injectable antibiotics** |
|---|---|---|
| | n = 330292 units (%) | n = 6.76 billion VND (%) |
| **Indications groups** | | |
| Pneumonia | 77597 (23.5) | 1.7 (25.2) |
| Gastro-Intestinal Infections | 43609 (13.2) | 0.85 (12.5) |
| Cesarean section | 56135 (17.0) | 0.98 (14.5) |
| Hospital-acquired infections | 22484 (6.8) | 0.49 (7.3) |
| Wound infections | 16638 (5.0) | 0.34 (5.0) |
| Ear/Nose/Throat Infections | 10528 (3.2) | 0.16 (2.4) |
| Respiratory Infections | 20045 (6.1) | 0.52 (7.6) |
| Bronchitis | 15724 (4.8) | 0.31 (4.5) |
| Septicemia | 6843 (2.1) | 0.13 (2.0) |
| Skin and Soft Tissue Infection | 12830 (3.9) | 0.27 (4.0) |
| Parasitic Infections | 8386 (2.5) | 0.18 (2.6) |
| Excretory system infection | 8990 (2.7) | 0.18 (2.6) |
| Respiratory Infection (not pneumonia) | 7977 (2.4) | 0.16 (2.3) |
| Infections refer to procedures | 8627 (2.6) | 0.18 (2.7) |
| Superinfection with Pulmonary Tuberculosis | 8826 (2.7) | 0.20 (2.9) |
| Other Infections | 5053 (1.5) | 0.11 (1.6) |
| **Active ingredients** | | |
| Cefotaxim | 246033 (74.5) | 4.77 (70.5) |
| Gentamycin | 30101 (9.1) | 0.03 (0.5) |
| Ceftazidim | 31547 (9.6) | 1.25 (18.5) |
| Ceftriaxon | 6653 (2.0) | 0.18 (2.6) |
| Cefuroxim | 7123 (2.2) | 0.35 (5.2) |
| Ampicillin | 2705 (0.8) | 0.02 (0.2) |
| Amikacin | 2059 (0.6) | 0.05 (0.7) |
| Ceftizoxim | 2584 (0.8) | 0.07 (1.0) |
| Oxacilin | 487 (0.1) | 0.01 (0.1) |
| Amoxicillin | 1000 (0.3) | 0.04 (0.6) |
| **Comorbidities** | | |
| Yes | 82867 (25.1) | 1.83 (27.1) |
| No | 247425 (74.9) | 4.92 (72.9) |
| **Purpose of treatment** | | |
| Antibiotics are standard therapies | 282224 (85.4) | 5.62 (83.2) |
| Antibiotics are adjuvant therapies | 48068 (14.6) | 1.13 (16.8) |

ranked second, while expenditure for Aminoglycosides and Penicillins lagged far behind. Only in treating septicemia, the cost of Cefotaxime was lower than other Cephalosporins. (Table 2)

**Table 2: Describe the cost structure of antibiotics according to 3 antibiotic types prescribed for 16 indications groups of 11 district hospitals in An-Giang province in 2015 (millions VND)**

| Types of injectable antibiotics / Indications groups | Cefotaxime | Other cephalosporins | Aminoglycosides | Penicillins |
|---|---|---|---|---|
| | n = 4770 (%) | n=1842 (%) | n=79 (%) | n=68 (%) |
| Pneumonia | 669.7 (68.4) | 250.1 (25.5) | 13.7 (1.4) | 45.5 (4.7) |
| Digestice system infection | 1126.6 (65.3) | 557.1(33.6) | 8.2 (0.5) | 9.9(0.6) |
| Cesarean section | 664.6 (78.7) | 167.6 (19.9) | 8.1 (1.0) | 4.0 (0.5) |
| Hospital-acquired infection | 394.1 (76.3) | 119.6 (23.2) | 1.9 (0.4) | 0.8 (0.2) |
| Wound infection | 408.9 (82.7) | 77.7 (15.7) | 5.9 (1.2) | 1.7 (0.4) |
| Ear/Nose/Throat Infection | 240.6 (70.7) | 94.4 (27.7) | 4.1 (1.2) | 1.2 (0.3) |
| Respiratory Infection | 188.5 (61.3) | 112.1 (36.5) | 6.6 (2.2) | 0.1 (0.0) |
| Bronchitis | 165.6 (60.6) | 99.5 (36.4) | 5.9 (2.1) | 2.4 (0.9) |
| Skin and Soft Tissue Infection | 119.9 (60.9) | 72.0 (36.6) | 4.7 (2.4) | 0.2 (0.1) |
| Infertilizer | 159.9 (87.0) | 22.5 (12.3) | 0.8 (0.4) | 0.5 (0.3) |
| Septicemia | 114.2 (64.0) | 60.3 (33.8) | 3.8 (2.1) | 0.2 (0.1) |
| Organ Infection | 134.4 (76.2) | 40.9 (23.2) | 0.7 (0.4) | 0.4 (0.2) |
| Respiratory Infection (not pneumonia) | 137.4 (83.3) | 25.5 (15.5) | 1.7 (1.0) | 0.3 (0.2) |
| Technique | 112.9 (71.8) | 43.2 (27.5) | 1.1 (0.7) | 0.1 (0.1) |
| Superinfection in Pneumonia Tuberculosis | 50.7 (38.2) | 70.4 (**53.0**) | 11.3 (8.5) | 0.3 (0.2) |
| Other Infections | 77.6 (71.7) | 29.6 (27.4) | 0.7 (0.6) | 0.3 (0.3) |

# 4. Discussion

The study depicted detailed information about the use of injectable antibiotics for 12 consecutive months at 11 district hospitals in An-Giang province. 27 injectable antibacterials used, corresponding to 10 active ingredients and 3 different antibiotic groups. Most of them were third generation cephalosporins, with dominance of Cefotaxime in terms of drug quantity and this result was similar to previous studies conducted in Vietnam [1-3] and in the world [11]. The aggregate expenditure for Aminoglycosides and Penicillins contributed just 2% of the total figure for all of antibiotics. Analysing antibiotics spending structure according to treatment purposes demonstrated contrasts in the percentage. This may result from the assorted qualities of regimens applied at each hospital; physicians' medicine determination propensities; as well as the health status of each patient. As a consequence, these led to differences in the quantity, type and dose of antibiotics indicated. When reviewing the quantity of 10 active ingredients, the study revealed that high spending did not mean the medicine was prescribed for a large number of patients. It depended on the drug's dosage and price instead.

Since there was a vast gap between usage rate of cefotaxime and other antibiotics in this study, drug price's impact on Cefotaxime's spending was

unclear. However, as focusing on types of antibiotics that their usage rates were not much different, the impact of drug price showed evidently. In particular, the quantity of Gentamycin consumed was quite close to this figure for Ceftazidime (30,101 units vs 31,547 units). Since their prices were distinctive, this resulted in contrasts in their spending. The spending for Ceftazidim was 40 times higher than that for Gentamycin.

The results showed that the value and rate of injectable antibiotic cost at each hospital were different, and were not related to hospital size. Among 11 hospitals, some smaller size hospitals spent for antibiotics more than bigger size ones. 13% of patients in this study receiving at least two antibiotics, most of them were given two antibiotics. The most common antibiotics combinations were Cephalosporins and Gentamycin; and two antibiotics belonging to Cephalosporin group (Cefotaxime and Ceftazidim). Due to numerous risks and adverse effects of experiencing antibiotic therapies, it would take into consideration to replace appropriately from the injectable antibiotics to the oral ones. According to the "Guideline for the Antibiotic Stewardship in Hospitals" issued by Vietnamese Ministry of Health [5], 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.

Numerous studies in Vietnam investigated the use of cephalosporins, however, there was a shortage of results about selecting medicine and spending on drugs according to diagnosis. Consequently, the comparison of results between our study and previous ones still limited. All the data were available as electronic sources, which support us speedily and accurately collect a huge sample size. Another advantage is the one - year data period gathering, therefore, our results are out of the seasonal errors. On the other hand, due to the big data we accessed, the results of this research represent the reality as well as cost structure of injectable antibiotics used at 11 hospitals in particular and in An-Giang Province in general.

Together with the changes in The List of Drug winning the bid and the disease patterns of each hospital, the results of analysing the cost structure in our study are for reference only. The study still limits in exploring the use of different forms of antibiotics with the same active ingredients. Further studies may continue analyzing the use characteristics of injecting antibiotics with deeper information, taking the patient's medical records into account, in order to assess the antibiotic cost structure more totally.

## 5. Conclusion

The study particularly examined the cost structure of injectable antibiotics for a great number of inpatients which could represent the real situation. Results of the study complement the information about the antibiotics use cost in

An-Giang province in general and at the district level hospitals in particular. This information is useful science evidence for An-Giang Health Department in estimating budget for drugs in general and antibiotics in particular, thereby, optimizing the management of antibiotic use in health facilities.

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