© 2023 Journal of Pharmacy & Pharmacognosy Research, 11 (5), 787-796, 2023
ISSN 0719-4250
https://jppres.com

DOI: https://doi.org/10.56499/jppres23.1663_11.5.787

Original Article

Assessment of the results of clinical pharmacists' interventions on the use of antibiotics at a medical center in Vietnam between 2021 and 2022

[Evaluación de los resultados de las intervenciones de los farmacéuticos clínicos sobre el uso de antibióticos en un centro médico de Vietnam entre 2021 y 2022]

Duyen Thi My Huynh[1], Chat Luong Luong[2], Quang Loc Duyen Vo[3], Ba Kien Tran[4], Van De Tran[5]*

[1]Department of Pharmaceutical and Pharmaceutical Technology, Faculty of Pharmacy, Can Tho University of Medicine and Pharmacy, Can Tho 900000, Vietnam.
[2]Gia Rai Medical Center, Tran Van Son, Gia Rai, Bac Lieu, Vietnam.
[3]Department of Chemistry, College of Natural Sciences, Can Tho University, Campus II, 3/2 Street, Can Tho 900000, Vietnam.
[4]Department of Pharmaceutical Administration, Hai Duong Central College of Pharmacy, 324 Nguyen Luong Bang, Hai Duong 170000, Vietnam.
[5]Department of Health Organization and Management, Can Tho University of Medicine and Pharmacy, 179 Nguyen Van Cu, Can Tho 900000, Vietnam.
*E-mail: tvde@ctump.edu.vn

Abstract

Context: The rational use of antibiotics is a priority when antibiotic resistance has become severe. Clinical pharmacists' interventions can help increase the rate of rational antibiotic use.

Aims: To determine the effect of clinical pharmacists' interventions on the use of antibiotics and factors related to inappropriate antibiotic use in inpatients at the Department of Surgery, Gia Rai Town Medical Center, Vietnam.

Methods: An interventional and cross-sectional descriptive study was conducted from January 1, 2021, to June 30, 2022, at the Department of Surgery, Gia Rai Town Medical Center, Vietnam.

Results: There were 710 patients (355 patients in pre-intervention and 355 patients in post-intervention) included in this study. The group of antibiotics used the most was beta-lactam (pre- and post-intervention rates were 60.2% and 61.0%, respectively). The parenteral route was the most commonly used (63.9% in pre-intervention and 60.7% in post-intervention). The rationality of the indication increased after the intervention (from 85.7% to 96.2%); the rationality of the dose increased after the intervention (from 90.5% to 95.2%); the rationality of the number of times of use increased after the intervention (from 90.4% to 98.4%); the rationality of the time increased after the intervention (from 94.8% to 95.1%); the general rationality increased after the intervention (from 66.5% to 85.6%). Infections were associated with inappropriate antibiotic use ($p<0.05$).

Conclusions: Effective clinical pharmacists' interventions helped raise the rate of rational use of antibiotics. Besides, inappropriate antibiotic use was found to be associated with infections, emphasizing the need for targeted interventions in this field.

Keywords: antibiotics; clinical pharmacist; patients; treatment.

Resumen

Contexto: El uso racional de los antibióticos es una prioridad cuando la resistencia a los antibióticos se ha agravado. Las intervenciones de los farmacéuticos clínicos pueden ayudar a aumentar la tasa de uso racional de antibióticos.

Objetivos: Determinar el efecto de las intervenciones de los farmacéuticos clínicos sobre el uso de antibióticos y los factores relacionados con el uso inadecuado de antibióticos en pacientes hospitalizados en el Departamento de Cirugía, Centro Médico de la Ciudad de Gia Rai, Vietnam.

Métodos: Se realizó un estudio descriptivo intervencionista y transversal del 1 de enero de 2021 al 30 de junio de 2022 en el Departamento de Cirugía, Gia Rai Town Medical Center, Vietnam.

Resultados: Hubo 710 pacientes (355 pacientes en preintervención y 355 pacientes en postintervención) incluidos en este estudio. El grupo de antibióticos más utilizado fue el de los betalactámicos (las tasas pre y postintervención fueron del 60,2% y el 61,0%, respectivamente). La vía parenteral fue la más utilizada (63,9% en preintervención y 60,7% en postintervención). La racionalidad de la indicación aumentó tras la intervención (del 85,7% al 96,2%); la racionalidad de la dosis aumentó tras la intervención (del 90,5% al 95,2%); la racionalidad del número de veces de uso aumentó tras la intervención (del 90,4% al 98,4%); la racionalidad del tiempo aumentó tras la intervención (del 94,8% al 95,1%); la racionalidad general aumentó tras la intervención (del 66,5% al 85,6%). Las infecciones se asociaron a un uso inadecuado de antibióticos ($p<0,05$).

Conclusiones: Las intervenciones eficaces de los farmacéuticos clínicos contribuyeron a aumentar la tasa de uso racional de antibióticos. Además, se observó que el uso inadecuado de antibióticos estaba asociado a infecciones, lo que subraya la necesidad de intervenciones específicas en este campo.

Palabras Clave: antibióticos; farmacéutico clínico; pacientes; tratamiento.

ARTICLE INFO
Received: April 11, 2023.
Accepted: July 30, 2023.
Available Online: August 29, 2023.

AUTHOR INFO
ORCID:
0009-0005-0881-5989 (QLDV)
0000-0003-0421-5079 (VDT)

INTRODUCTION

Antibiotics are special drugs because their use affects not only the patients but also the community. This is an important group of drugs in Vietnam because infectious diseases are one of the leading diseases in terms of both morbidity and mortality (Ministry of Health, 2015). Currently, antibiotic resistance is considered a global problem. In the world, there have appeared bacteria resistant to most antibiotics, also known as super-resistant bacteria. According to the World Health Organization (WHO), we are living in an era of antibiotic dependence and should have a responsibility to protect the precious source of antibiotics for the next generation (Ministry of Health, 2013). In Taiwan, the 14-day mortality rate in the bacteremia group due to *E. coli* resistant third-generation cephalosporin was higher than that in the susceptible group (16.0% *vs.* 8.0, p = 0.005) and also had a longer hospital stay (18 days *vs.* 14 days, p<0.001) (Lin et al., 2019). In Ethiopia, the study showed that most of the isolates had a high degree of resistance to ampicillin/amoxicillin (88.3%), penicillin G (79.5%), followed by trimethoprimsulfamethoxazole (73.8%). The bacterial strains identified in this study showed a tendency towards multi-drug resistance. To be more precise, the majority of them (67.0%) were resistant to three or more antibiotics (Gorems et al., 2018). Vietnam was also one of the countries with a high rate of antibiotic resistance in bacterial isolates, with 71.4% of them resistant to penicillin and 92.1% of them resistant to erythromycin (Song et al., 2004).

The inappropriate prescription and irrational use of antibiotics are considered the leading causes of resistance in health facilities. Statistics showed that the average use of antibiotics in Vietnam was 274.7 defined daily doses (DDD) per 100 bed-days. The irrational use of antibiotics can lead to many consequences, such as increasing treatment costs, adversely affecting patients' health, prolonging hospital stays, increasing antibiotic resistance, and threatening global health (Andes and Craig, 2005; Lester et al., 2020; Lin et al., 2019). Patients treated with antibiotics may encounter several drug-related problems. These issues can include adverse reactions, antibiotic resistance, drug interactions, *Clostridioides difficile* infections, superinfections, organ toxicity, misdiagnosis or delayed diagnosis, non-adherence, allergic reactions, and specific concerns in pregnancy and pediatrics. One of the important factors for successful treatment in hospitals is the appropriate and safe use of antibiotics (Ministry of Health, 2015). Therefore, the rational and safe use of antibiotics is the top concern of doctors and is one of the important goals of clinical pharmacists.

The clinical pharmacy department plays an essential role in optimizing drug use, improving the management efficiency of prescribing and using drugs in hospitals, and at the same time regularly implementing scientific activities throughout the hospital, helping doctors learn from experience, reduce errors, improve the quality of prescriptions and medical care, and improve patients' health (Dreischulte et al., 2022; National Assembly, 2016; SHPA Committee of Specialty Practice in Clinical Pharmacy, 2005). To implement clinical pharmacy activities, there are many types of interventions, such as educational materials, conferences and training, audits and feedback, reminders, outreach visits, marketing, patient-mediated interventions, and local opinion leaders (Kunstler et al., 2019).

The irrational use of antibiotics is influenced by many factors. Research by Nguyen et al. (2021) pointed out some groups of factors influencing the decision to prescribe antibiotics by doctors in an elderly care facility, such as diagnostic resources, physicians' perception, pressure from patients and their families, clinical situation (age, underlying condition, and drug use), care plans, and environmental factors. Each group can directly or indirectly affect the decision to use antibiotics for patients. According to Holloway (2011), factors leading to the inappropriate use of antibiotics in hospitals include irrational and poor drug supply, lack of training, insufficient supervision or support for prescribers, and lack of diagnostic support services. Some factors from physicians include prescribing habits, peer pressure, and poor availability of independent medicines information such as clinical guidelines and drug bulletins.

The appropriate use of antibiotics plays a vital role in the hospital, especially when COVID-19 appeared. In Vietnam, studies on pharmacists' intervention on the use of antibiotics in hospitals are limited. Therefore, we conducted this study with the aim at determining the effect of clinical pharmacists' interventions on the use of antibiotics and factors related to inappropriate antibiotic use in inpatients at the Department of Surgery, Gia Rai Town Medical Center, Vietnam.

MATERIAL AND METHODS

Study design and subjects

Study design

A cross-sectional and interventional descriptive study was implemented from January 1, 2021, to June

30, 2022, at the Department of Surgery, Gia Rai Town Medical Center in Bac Lieu province, Vietnam.

Research subjects

Medical records of inpatients who were treated with antibiotics at the Department of Surgery, Gia Rai Town Medical Center between 2021 and 2022 (the pre-intervention phase lasted from January 1, 2021, to June 30, 2021, and the post-intervention phase lasted from January 1, 2022, to June 30, 2022); doctors participated in the examination and treatment and prescribed antibiotic use at the Department of Surgery.

Criteria for sample selection

Medical records of patients who were admitted directly to the Department of Surgery. Medical records of inpatients that were transferred from other departments to the department where patients were diagnosed and prescribed antibiotics from the beginning until the end of the treatment and discharged from the hospital.

Doctors were assigned to work in the Department of Surgery.

Criteria of exclusion

Medical records of inpatients who used antibiotics with a hospital stay of fewer than 2 days.

Doctors are attending courses during the study period (from 2021 to 2022).

This study was performed in accordance with the ethical principles for medical research outlined in the Declaration of Helsinki 1964 as modified by subsequent revisions (World Medical Association, 2020). The study was approved by The Ethics Committee for Biomedical Research of Can Tho University of Medicine and Pharmacy (No. 566/PCT-HDDD, 30 March 2021). The personal information of participants would be anonymized.

Data collection and sample size

The sample size was calculated according to the formula [1] for estimating a population proportion.

$$n = z^2_{(1-\alpha/2)}\, p\, (1- p)/d^2 \qquad [1]$$

Where, n: The sample size; z: The value of the normal distribution (if α was 0.05, then z was 1.96); α: The probability of type I error (α = 0.05 was used); p: Irrational antibiotic use rate, according to a study by Bui et al. (2018) at the Department of Surgery in Binh Dan Hospital, Vietnam, p = 0.362 was used; d: The margin of error (d = 0.05 was used).

Substituting the value of z, α, p, and d into the formula [1], we had $n = 1.96^2\ 0.362\ (1\text{-}0.362)/0.05^2 = 355$. Hence, we collected 355 medical records.

The study subjects included patients and doctors. The following variables used for characterizing patients in the sample were sex (male and female), age (<18, 18-59, 50-59 and ≥60), glomerular filtration rate [≥90, 60-89, 45-59, 30-44, 15-29, ≤15 and others (unavailable data)], comorbidities (yes and no), infectious diseases [skin and subcutaneous tissue, digestive system, urinary tract and urogenital tract and others (trauma, burns, and tumors)].

The variables in terms of the characteristics of doctors included age (≤35 and >35), qualification (bachelor's degree (general doctor) and first-degree specialist) and work year (≤10 and >10).

The following variables used for characterizing antibiotics use included type of antibiotics, route (oral route and parenteral route), regimen (1 antibiotic, 2 antibiotics, and >2 antibiotics), the rationality of the indication (rational and irrational), the rationality of the dose (rational and irrational), the rationality of number of times (rational and irrational), the rationality of the time (rational and irrational) and the general rationality (rational and irrational).

Rational means that antibiotics were used strictly according to Gia Rai Town Medical Center Treatment Protocol (2017), and Ministry of Health (2015; 2018), Ministry of Health (2015) of Vietnam Ministry of Health and Medical leaflets. Irrational means that antibiotics were not used strictly according to these scientific materials.

Intervention

At the seminar of the Medical Center, data on irrationalities in antibiotic use at phase 1 was reported.

Necessary information related to the use and the increase of the rate of rational use of antibiotics (antibiotic selection, dose, time gap, and time to use) was discussed with doctors. From July 1, 2021, to December 31, 2021, the patient's medical records at the Department of Surgery were viewed during their hospital stays.

Scientific materials supplied included recommendations for clinical practice guidelines in printed form, electronic publications on antibiotic use (treatment protocols of Gia Rai Town Medical Center in 2017 promulgated together with Decision No. 301/QD-YTGR dated October 10, 2017, of the Chief of Gia Rai town Medical Center), medical leaflets, Guide to the use of antibiotics 2015 of Vietnam Ministry of Health and National Pharmacopoeia 2018 (Gia Rai Town Medical Center, 2017; Ministry of Health, 2015; 2018).

Three conferences and training sessions were organized at the Department of Surgery to present topics related to antibiotic use with a frequency of one time per month within three months (from July 2021 to September 2021). In July 2021, the intervention on issues of antibiotic choices. In August 2021, the intervention on issues of dose and frequency of use. In September 2021, the intervention on issues of time to take antibiotics.

Data processing and data analysis

Microsoft Excel 2010 and Stata 14.0 software were used to make statistics, process, and analyze data. Qualitative variables were described as numbers and percentages. The χ^2 test was used to compare the difference in the rate of antibiotic use following the treatment protocols and the rate of treatment results between pre-intervention and post-intervention. The difference was statistically significant when $p<0.05$.

RESULTS

In Table 1, there were 710 patients (355 patients in the pre-intervention phase and 355 patients in the post-intervention phase) and 10 doctors. Most of the patients in pre and post-intervention phases were male (62.5% in pre-intervention and 61.1% in post-intervention), aged from 18 to 59 (63.7% in pre-intervention and 61.1% in post-intervention), glomerular filtration rate (GFR) at 60-89 mL/min/1.73 m^2 (50.7 mL/min/1.73 m^2 in pre-intervention and 45.9 mL/min/1.73 m^2 in post-intervention), no underlying health conditions (66.2% in pre-intervention and 65.9% in post-intervention). In the pre-intervention stage, the most common infectious diseases were skin diseases (49.8%); in the post-intervention stage, diseases related to trauma, burns, and tumors accounted for a high portion (44.7%). Regarding the characteristics of doctors, the majority of them were ≤35 years old (60.0%) with work experience of ≤10 years (60.0%) and the same level of education [bachelor's degree and first specialist in medicine (50.0%)].

In Table 2, the total number of times of using antibiotics before and after the intervention was 775 and 996, respectively. Beta-lactam was the most common group (pre- and post-intervention prescribing rates were 60.2% and 61.0%, respectively). Gentamycin was the most widely used (pre- and post-intervention prescribing rates were 29.5% and 25.5%, respectively). The parenteral route was most commonly used (63.9% in pre-intervention and 60.7% in post-intervention). The single antibiotic guideline was the most widely used (52.5% in pre-intervention and 53.1% in post-intervention). The rationality of the indication increased after intervention (from 85.7% to 96.2%). The rationality of the number of times of use increased after the intervention (from 90.4% to 98.4%). The rationality of the time increased after the intervention (from 94.8% to 95.1%). The general rationality increased after the intervention (from 66.5% to 85.6%).

Table 3 shows a relationship between infectious diseases and inappropriate antibiotic use ($p<0.05$).

DISCUSSION

The gender distribution before and after the intervention had similar results. The percentage of men was higher than that of women. This is simply because there were soft tissue and bone infections (complex flesh wounds, injuries caused by occupational accidents or traffic accidents) that usually occurred in men of working age (Ki and Rotstein, 2008; Mohsien et al., 2014). This gender characteristic was also consistent with the age characteristic of the research subjects (most of them were in the working age group and men were the main breadwinners of their families).

The rates of using antibiotics in the two periods before and after the intervention were similar. Patients were treated with empirical broad-spectrum antibiotics and nearly half of them received a combination of antibiotics in their treatment. The most commonly used group of antibiotics was beta-lactam followed by aminoglycosides. The beta-lactam group was widely used because it has the advantage of many types, a broad spectrum of action, and many brand-name drugs with a bacterial action mechanism by inhibiting the synthesis of the peptidoglycan layer of bacterial cell walls, the ability to combine with other groups to extend antibacterial, and little toxicity. This is also similar to the general trend of other hospitals all over the world. In a study by Versporten et al. (2018) on antibiotic use in 303 hospitals in 53 countries around the globe in 2018, a combination of penicillin and a beta-lactamase inhibitor was the most frequently prescribed antibiotic, especially in Northern Europe and Western Europe (particularly at hospitals in Belgium). Third-generation cephalosporins, mainly ceftriaxone, were the most commonly prescribed antibiotics in Asia, Latin America, and countries in Southern and Eastern Europe.

Research results showed that monotherapy antibiotic regimens were used a lot. This may be because mild and moderate infections were common in the district Medical Center, so the combination therapy of antibiotics was not necessary, helping to reduce the cost of treatment for patients (Ministry of Health, 2015). The use of a single antibiotic was also recommended in most cases to reduce drug interactions.

Table 1. Characteristics of study subjects before and after the intervention.

Characteristics	Classification	Before the intervention n (%)	After the intervention n (%)
Patients			
Gender	Male	222 (62.5)	217 (61.1)
	Female	133 (37.5)	138 (38.9)
Age	<18	50 (14.1)	34 (9.6)
	18-59	226 (63.7)	217 (61.1)
	≥60	79 (22.2)	104 (29.3)
Glomerular filtration rate (mL/min/1.73 m^2)	≥90	106 (29.9)	84 (23.7)
	60-89	180 (50.7)	163 (45.9)
	45-59	20 (5.6)	43 (12.1)
	30-44	6 (1.7)	15 (4.2)
	15-29	2 (0.6)	3 (0.9)
	≤15	1 (0.3)	6 (1.7)
	Others (unavailable data)	40 (11.3)	41 (11.5)
Comorbidities	Yes	120 (33.8)	121 (34.1)
	No	235 (66.2)	234 (65.9)
Infectious diseases	Skin and subcutaneous tissue	177 (49.8)	89 (25.1)
	Digestive system	52 (14.7)	73 (20.6)
	Urinary tract and urogenital tract	19 (5.4)	34 (9.6)
	Others (trauma, burns, and tumors)	107 (30.1)	159 (44.7)
Doctors			
Age	≤35	6 (60.0)	6 (60.0)
	>35	4 (40.0)	4 (40.0)
Qualification	Bachelor's degree (general doctor)	5 (50.0)	5 (50.0)
	First-degree specialist	5 (50.0)	5 (50.0)
Work year	≤10	6 (60.0)	6 (60.0)
	>10	4 (40.0)	4 (40.0)

Before and after the intervention, parenteral antibiotics accounted for a higher proportion than oral antibiotics. Parenteral antibiotics should be selected only for severe life-threatening infections, deep tissue infections, or in cases when the patient is unable to take oral medications or has gastrointestinal dysfunction leading to malabsorption (Ministry of Health, 2015). Parenteral antibiotics have been used at a high rate in many hospitals, possibly due to the traditional treatment perspective, aiming to respond and improve quickly and strongly in the clinical way right from the initial regimen (McCarthy and Avent, 2020). The prominent advantage of the parenteral route is its high bioavailability and rapid onset of action. The oral route has the advantages of simplicity, ease of use, and low cost (Ministry of Health, 2015). However, the oral route has the disadvantage that the effectiveness of the drug depends on the extent of absorption from the gastrointestinal tract. Some factors such as food, digestive fluid pH, enzyme system, and hepatic metabolism affect oral bioavailability. Currently, more and more antibiotics with high oral bioavailability have been invented, with suitable dosage forms, low cost compared to the parenteral route, and increasingly accessible to a wide variety of patients (McCarthy and Avent, 2020). Therefore, it is necessary to evaluate whether switching antibiotics from the parenteral route to the oral one will save costs and reduce adverse reactions associated with parenteral antibiotic use in patients eligible for oral antibiotics.

Table 2. Characteristics of antibiotic use before and after the intervention.

Characteristics	**Classification**	**Before the intervention n (%)**	**After the intervention n (%)**	**p-value**
Type of antibiotics	**Beta-lactam**			0.73
	Amoxicillin/ Amoxicillin – clavulanic acid	87 (11.2)	131 (13.2)	
	Ampicillin + sulbactam	9 (1.2)	0 (0.0)	
	Cefaclor	1 (0.1)	1 (0.1)	
	Cefadroxil	70 (9.0)	77 (7.7)	
	Cephalexin	12 (1.6)	13 (1.3)	
	Cefamandol	25 (3.2)	46 (4.6)	
	Cefixime	43 (5.6)	135 (13.6)	
	Cefoperazoze	0 (0.0)	4 (0.4)	
	Cefotaxime	195 (25.2)	199 (20.0)	
	Cefpodoxime	2 (0.3)	0 (0.0)	
	Cefradin	7 (0.9)	0 (0.0)	
	Ceftizoxime	15 (1.9)	1 (0.1)	
	Nitroimidazole			
	Metronidazole	23 (23.0)	112 (11.2)	
	Tinidazole	41 (5.3)	5 (0.5)	
	Aminoglycosides			
	Gentamycin	229 (29.5)	254 (25.5)	
	Amikacin	3 (0.4)	0 (0.0)	
	Quinolones			
	Levofloxacin	2 (0.3)	0 (0.0)	
	Ciprofloxacin	9 (1.2)	15 (1.5)	
	Ofloxacin	2 (0.3)	3 (0.3)	
Route	Oral route	280 (36.1)	391 (39.3)	0.86
	Parenteral route	495 (63.9)	605 (60.7)	
Regimen	1 antibiotic	255 (52.5)	330 (53.1)	0.86
	2 antibiotics	173 (35.6)	210 (33.8)	
	>2 antibiotics	58 (11.9)	82 (13.2)	
The rationality of the indication	Rational	664 (85.7)	958 (96.2)	**<0.05**
	Irrational	111 (14.3)	38 (3.8)	
The rationality of the dose	Rational	601 (90.5)	912 (95.2)	**<0.05**
	Irrational	63 (9.5)	46 (4.8)	
The rationality of the number of times	Rational	543 (90.4)	897 (98.4)	**<0.05**
	Irrational	58 (9.6)	15 (1.6)	
The rationality of the time	Rational	515 (94.8)	853 (95.1)	0.9
	Irrational	28 (5.2)	44 (4.9)	
General rationality	Rational	515 (66.5)	853 (85.6)	**<0.05**
	Irrational	260 (33.5)	143 (14.4)	

Table 3. Factors associated with irrational antibiotic use.

Characteristics	Classification	Irrationality n (%)	Rationality n (%)	OR (95% CI)	p-value
Doctor's age	≤35	163 (36.1)	289 (63.9)	1.31 (0.97-1.78)	0.08
	>35	97 (30.0)	226 (70.0)		
Doctor's qualification	Bachelor's degree	142 (36.5)	247 (63.5)	1.31 (0.97-1.78)	0.08
	Postgraduate degree	118 (30.6)	268 (69.4)		
Doctor's work year	≤10	163 (36.1)	289 (63.9)	1.31 (0.97-1.78)	0.08
	>10	97 (30.0)	226 (70.0)		
Patient's age	≥60	68 (35.4)	124 (64.6)	1	
	18-59	162 (32.6)	335 (67.4)	1.13 (0.8-1.6)	0.482
	<18	30 (34.9)	124 (65.1)	1.02 (0.6-1.74)	0.93
Gender	Male	159 (33)	323 (67)	0.94 (0.69-1.27)	0.67
	Female	101 (34.5)	192 (65.5)		
Infectious diseases	Digestive system	26 (18.7)	113 (81.3)	1	
	Urinary tract	16 (41.0)	23 (59.0)	0.33 (0.15-0.71)	**0.005**
	Skin and subcutaneous tissue	136 (35.1)	252 (64.9)	0.43 (0.27-0.69)	**<0.001**
	Others (trauma, burns and tumors)	82 (39.2)	127 (60.8)	0.36 (0.21-0.59)	**<0.001**

Intervention in prescribing antibiotics by disease group is a basic and effective method to reduce unnecessary antibiotic use. In principle, the selected antibiotics must be appropriate to the pathology, based on the sensitivity of the pathogenic bacteria to the antibiotic, the position, the organ, and the characteristics of the patient (Ministry of Health, 2015). In this study, the rate of rational indications after the intervention was 96.2%, an increase of 10.5% compared to that before the intervention, and the difference was statistically significant ($p<0.05$). Based on the characteristics of the patients before and after the intervention, both groups were similar in terms of age, gender, patterns of infection, and comorbidities, which shows that clinical pharmacy activities were effective, contributing to a higher appropriate rate of indications. This can be explained by the fact that the majority of doctors in the Department of Surgery are still young, so it is easier to update knowledge and coordinate with clinical pharmacy activities.

The rate of rational antibiotic dose after the intervention was 95.2%, an increase of 4.7% compared to before the intervention, and the difference was statistically significant ($p<0.05$). After the intervention, the rate of antibiotic prescription according to the recommended dose for all disease groups increased. When prescribing insufficient doses lower than the minimum dose, the medicine will not work, leading to treatment failure and the increase of drug-resistant bacteria. If the medicine is used in excess, it will affect the patient's health, and may even cause death (Daughton and Ruhoy, 2013). Therefore, it is very important to prescribe the correct dose, contributing to ensuring the safe and rational use of antibiotics and preventing the issue of antibiotic resistance that has been rising nowadays. The dose of each antibiotic prescribed is specified in the drug list of the clinical departments and the hospital's treatment protocol with the review, observation, and evaluation of clinical pharmacists.

The rate of rational use of antibiotics after the intervention was 98.4%, an increase of 8.0% compared to before the intervention, and the difference was statistically significant ($p<0.05$). Prescribing an insufficient number of times will lead to low drug concentration at a certain time. If concentration does not reach the effective minimum level, the medicine will not work, leading to treatment failure, increasing length of hospital stay, treatment costs, and the likelihood of antibiotic-resistant bacteria. If the number of times of using antibiotics prescribed is greater than recommended, the time gap will be shorter and the drug concentration will go up, even to the toxicity threshold, affecting the patient's health, and even causing death. At the same time, the number of times in excess will increase the number of drugs, leading to a rise in treatment costs (Ministry of Health, 2015). Therefore, it is very important to indicate the correct number of times, contributing to assuring the safe and rational use of antibiotics and preventing the current problem of antibiotic resistance.

The rate of rational antibiotic use time after the intervention was 95.1%, an increase of 0.3% compared to before the intervention, and the difference was statistically significant ($p<0.05$). The duration of treatment depends on the status of the infection, the location of the infection, and the patient's resistance. Mild and moderate infections are usually resolved in 7 to 10 days. Long-term treatment is not recommended to avoid drug resistance, the incidence of undesirable effects, and the increase in treatment costs (Ministry of Health, 2015).

After the intervention, the general rate of rational antibiotic use was 85.6%, an increase of 19.1% compared to before the intervention, and the difference was statistically significant ($p<0.05$). Annually, the Medical Center has a large number of inpatients treated with a wide range of drugs, of which antibiotics account for a large proportion. Therefore, the rational use of antibiotics is very important. WHO has launched a global campaign to control antibiotic use. In Vietnam, the Ministry of Health has issued "Guidelines on antibiotic use" and "Guidelines for implementation of antibiotic use management in hospitals" to increase the rational use of antibiotics, reduce unwanted effects of antibiotics, decrease treatment costs, and limit drug resistance. Therefore, monitoring antibiotic use is always a vital aim in treatment in hospitals (Ministry of Health, 2015; Government, 2020).

There was a statistically significant difference between the type of infectious diseases and the inappropriate use of antibiotics ($p<0.05$). This difference may be due to different infectious pathologies (digestive system, urinary-genital system, skin, and subcutaneous tissue diseases, and other diseases such as trauma, burns, and tumors), which will have different medical conditions and pathogens, leading to variance in the physician's treatment experience and the rate of irrational antibiotic use (Ministry of Health, 2015).

Nowadays, hospitals in Vietnam have established clinical pharmacy units at the request of the Ministry of Health, and the role of clinical pharmacists is constantly expanding and improving (American College of Clinical Pharmacy, 2014; Government, 2020; Horák et al., 2018; Onatade et al., 2018; SHPA Committee of Specialty Practice in Clinical Pharmacy, 2005). The research showed that clinical pharmacists' interventions were effective because the rate of rational antibiotic use increased after the intervention, similar to other studies worldwide (Bao et al., 2018; Davey et al., 2017; Grégori et al., 2020). Clinical pharmacists' interventions not only have many clinical benefits but also help reduce patient costs, increase antibiotic adherence, and reduce the duration of treatment and hospital stay (Davey et al., 2017; Grégori et al., 2020).

Limitations of this study

This study had some limitations. The number of doctors participating in the study was small because the study was conducted in only one department in the hospital. Also, there were still many difficulties in the process of implementing clinical pharmacists' interventions. First, there was just a small amount of staff in the clinical pharmacy unit. Moreover, the clinical pharmacy activities were not focused. Last but not least, the implementation of the interventions was still affected by the COVID-19 pandemic.

CONCLUSION

After the intervention, the general rate of rational antibiotic use was 85.6%, an increase of 19.1% compared to before the intervention, the difference was statistically significant ($p<0.05$). The rational use of antibiotics is extremely important, especially in the current situation when antibiotic resistance has become too widespread. Effective clinical pharmacists' interventions help improve the rate of appropriate antibiotic use, so it needs to be considered in the future.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

ACKNOWLEDGMENTS

Authors would like to express the gratitude to colleagues of the Can Tho University of Medicine and Pharmacy, Vietnam, for their invaluable support throughout this study. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

American College of Clinical Pharmacy (2014) Standards of practice for clinical pharmacists. Pharmacotherapy 34(8): 794–797. https://doi.org/10.1002/phar.1438

Andes D, Craig WA (2005) Treatment of infections with ESBL-producing organisms: pharmacokinetic and pharmacodynamic considerations. Clin Microbiol Infect 11(6): 10–17. https://doi.org/10.1111/j.1469-0691.2005.01265.x

Bao Z, Ji C, Hu J, Luo C, Fang W (2018) Clinical and economic impact of pharmacists on sampled outpatient prescriptions in a Chinese teaching hospital. BMC Health Serv Res 18: 519–528. https://doi.org/10.1186/s12913-018-3306-4

Bui HN, Nguyen TD, Nguyen PCH (2018) Efficacy of antibiotic stewardship in prophylactic antibiotic utilization in some surgical wards at Binh dan hospital. Ho Chi Minh City Medicine (Vietnam) 22(1): 148–154.

Daughton CG, Ruhoy IS (2013) Lower-dose prescribing: Minimizing “side effects” of pharmaceuticals on society and the environment. Sci Total Environ 443: 324–337. https://doi.org/10.1016/j.scitotenv.2012.10.092

Davey P, Marwick CA, Scott CL, Charani E, McNeil K, Brown E (2017) Interventions to antibiotic prescribing practices for hospital inpatients. Cochrane Database of Syst Rev 2017(2): CD003543. https://doi.org/10.1002/14651858.CD003543.pub4

Dreischulte T, van den Bemt B, Steurbaut S (2022) European Society of Clinical Pharmacy definition of the term clinical pharmacy and its relationship to pharmaceutical care: a position paper. Int J Clin Pharm 44(4): 837–842. https://doi.org/10.1007/s11096-022-01422-7

Gia Rai Town Medical Center (2017) Gia Rai Town Medical Center Treatment Protocol in 2017 promulgated together with Decision No. 301/QD-YTGR dated October 10, 2017, of the Chief of Gia Rai town Medical Center, Vietnam.

Gorems K, Beyene G, Berhane M, Mekonnen Z (2018) Antimicrobial susceptibility patterns of bacteria isolated from patients with ear discharge in Jimma Town, Southwest, Ethiopia. BMC Ear Nose Throat Disord 18: 17. https://doi.org/10.1186/s12901-018-0065-0

Government (2020) [Decree 131/2020/ND-CP on the regulations on organization and clinical pharmacy activities of medical examination and treatment facilities dated November 2, 2020]. https://thuvienphapluat.vn/van-ban/The-thao-Y-te/Nghi-dinh-131-2020-ND-CP-to-chuc-hoat-dong-duoc-lam-sang-cua-co-so-kham-benh-chua-benh-456678.aspx [Consulted October 18, 2021].

Grégori J, Pistre P, Boutet M, Porcher L, Devaux M, Pernot C, Boulin M (2020) Clinical and economic impact of pharmacist medications in an ambulatory hematology–oncology department. J Oncol Pharm Pract 26(5): 1172–1179. https://doi.org/10.1177/1078155220915763

Holloway KA (2011) Promoting the rational use of antibiotics. Regional Health Forum 15: 122–130.

Horák P, Underhill J, Batista A, Amann S, Gibbons N (2018) EAHP European Statements Survey 2017, focusing on sections 2 (Selection, Procurement and Distribution), 5 (Patient Safety and Quality Assurance) and 6 (Education and Distribution) Research). Eur J Hosp Pharm 25(5): 237–244. https://doi.org/10.1136/ejhpharm-2018-001659

Ki V, Rotstein C (2008) Bacterial skin and soft tissue infections in adults: A review of their epidemiology, pathogenesis, diagnosis, treatment and site of care. Can J Infect Dis Med Microbiol 19: 173–184. https://doi.org/10.1155/2008/846453

Kunstler BE, Lennox A, Bragge P (2019) Changing prescribing behaviours with educational outreach: an overview of evidence and practice. BMC Med Educ 19: 311. https://doi.org/10.1186/s12909-019-1735-3

Lester R, Musicha P, Van Ginneken N, Dramowski A, Hamer DH, Garner P, Feasey NA (2020) Prevalence and outcome of bloodstream infections due to third-generation cephalosporin-resistant Enterobacteriaceae in sub-Saharan Africa: a systematic review. J Antimicrob Chemother 75(3): 492–507. https://doi.org/10.1093/jac/dkz464

Lin WP, Huang YS, Wang JT, Chen YC, Chang SC (2019) Prevalence of and risk factor for community-onset third-generation cephalosporin-resistant *Escherichia coli* bacteremia at a medical center in Taiwan. BMC Infect Dis 19(1): 245. https://doi.org/10.1186/s12879-019-3880-z

McCarthy K, Avent M (2020) Oral or intravenous antibiotics? Aust Prescr 43(2): 45–48. https://doi.org/10.18773/austprescr.2020.008

Ministry of Health (2013) [Decision No. 2174/QD-BYT National Action Plan on Antimicrobial Resistanced dated June 21, 2013]. https://thuvienphapluat.vn/van-ban/The-thao-Y-te/Quyet-dinh-2174-QD-BYT-nam-2013-Ke-hoach-hanh-dong-quoc-gia-chong-khang-thuoc-199623.aspx [Consulted October 19, 2021].

Ministry of Health (2015) [Decision No. 708/QD-BYT on the promulgation of the professional document "Guide to the use of antibiotics" dated March 2, 2015]. https://thuvienphapluat.vn/van-ban/The-thao-Y-te/Quyet-dinh-708-QD-BYT-2015-tai-lieu-chuyen-mon-huong-dan-su-dung-khang-sinh-267486.aspx [Consulted October 19, 2021].

Ministry of Health (2018) National Pharmacopoeia of Vietnam, 2nd edn. Hanoi: Medical Publishing House.

Mohsien RA, Al Mohammedawi MC, Yahya AG (2014) Virulance factors enhancing microbial infection in chronic osteomylitis and antibiotic susceptability pattern. Am J Med Case Rep 2(6): 126–132. https://doi.org/10.12691/ajmcr-2-6-5

National Assembly (2016) [Pharmacy Law No. 105/2016/QH13]. https://thuvienphapluat.vn/van-ban/The-thao-Y-te/Luat-Duoc-2016-309815.aspx [Consulted October 19, 2021].

Nguyen LV, Pham LTT, Bui AL, Vi MT, Nguyen NK, Le TT, Pham ST, Nguyen PM, Nguyen TH, Taxis K, Nguyen T, Tran DH (2021) Appropriate antibiotic use and associated factors in Vietnamese outpatients. Healthcare 9(6): 693. https://doi.org/10.3390/healthcare9060693

Onatade R, Appiah S, Stephens M, Garelick H (2018) Evidence for the outcomes and impact of clinical pharmacy: context of UK hospital pharmacy practice. Eur J Hosp Pharm 25(1): 21–28. https://doi.org/10.1136/ejhpharm-2017-001303

SHPA Committee of Specialty Practice in Clinical Pharmacy (2005) SHPA Standards of Practice for Clinical Pharmacy. J Pharm Pract Res 35: 122–148. https://doi.org/10.1002/j.2055-2335.2005.tb00322.x

Song JH, Jung SI, Ko KS, Kim NY, Son JS, Chang HH, Shibl A (2004) High prevalence of antimicrobial resistance among clinical *Streptococcus pneumoniae* isolates in Asia (an ANSORP study). Antimicrob Agents Chemother 48(6): 2101–2107. https://doi.org/10.1128/AAC.48.6.2101-2107.2004

Versporten A, Zarb P, Caniaux I, Gros MF, Drapier N, Miller M, May S (2018) Antimicrobial consumption and resistance in adult hospital inpatients in 53 countries: results of an internet-based global point prevalence survey. Lancet Glob Health 6(6): 619–629. https://doi.org/10.1016/S2214-109X(18)30186-4

World Medical Association (2020) Declaration of Helsinki: Medical Research Involving Human Subjects. https://www.wma.net/what-we-do/medicalethics/declaration-of-helsinki [Consulted August 20, 2020].

AUTHOR CONTRIBUTION:

Contribution	Huynh DTM	Luong CL	Vo QLD	Tran BK	Tran VD
Concepts or ideas	x	x		x	
Design	x	x		x	x
Definition of intellectual content	x				
Literature search	x	x		x	
Experimental studies		x			
Data acquisition		x			
Data analysis	x	x	x	x	
Statistical analysis	x	x	x		x
Manuscript preparation	x		x		x
Manuscript editing	x	x	x	x	x
Manuscript review	x	x	x	x	x

Citation Format: Huynh DTM, Luong CL, Vo QLD, Tran BK, Tran VD (2023) Assessment of the results of clinical pharmacists' interventions on the use of antibiotics at a medical center in Vietnam between 2021 and 2022. J Pharm Pharmacogn Res 11(5): 787–796.
https://doi.org/10.56499/jppres23.1663_11.5.787