© 2021 Journal of Pharmacy & Pharmacognosy Research, 9 (4), 474-483, 2021
ISSN 0719-4250
http://jppres.com/jppres

Original Article

The use of an antibiotic order form in a tertiary hospital: Influence on physicians' prescribing patterns

[El uso de un formulario de pedido de antibióticos en un hospital de tercer nivel: influencia en los patrones de prescripción de los médicos]

Duc Chien Vo[1], Tuan Anh Mai[2], Thu Thao Nguyen[3], Dang Thoai Nguyen[4], Thi Ha Vo[3,4*]

[1]Department of Respiratory Medicine, Nguyen Tri Phuong Hospital, Ho Chi Minh, V-70000, Vietnam.
[2]Department of Pharmacy, Hanoi Pharmacy University, Ha Noi, 100000, Vietnam.
[3]Department of Pharmacy, Nguyen Tri Phuong Hospital, Ho Chi Minh, V-70000, Vietnam.
[4]Faculty of Pharmacy, Pham Ngoc Thach University of Medicine, Ho Chi Minh, V-70000, Vietnam.
*E-mail: havt@pnt.edu.vn

Abstract

Context: Vietnam is one of the countries at the high alert of antibiotic resistance.

Aims: To evaluate the compliance rate and changes in physicians' prescribing patterns in patients with community-acquired pneumonia (CAP) before and after using the antibiotic order form (AOF) in a tertiary hospital.

Methods: 120 inpatient medical records having antibiotic use and 115 patient medical records diagnosed with CAP at a Department of Respiratory Medicine during 3 months before and 3 months after using the AOF were retrospectively collected for assessment.

Results: The compliance rate was 92%, and the average rate of filling in information fields was 58%. Comparison of prescribing behavior of CAP in control and intervention group showed that the rate of bacterial culture increased from 70% to 77% (p = 0.690), in which the rate of culture prior prescribing administration increased from 14% to 45% (p < 0.001), the initial antibiotic regimen with narrow-spectrum increased from 26% to 36% (p = 0.353), the proportion of patients improved clinically after 72 hours increased from 64% to 89% (p = 0.138), and the de-escalation decreased from 23% to 20% (p = 0.713). The treatment failure at hospital discharge decreased from 12% to 6% (p = 0.447). However, the length of treatment and the days of antibiotic treatment were not significantly different.

Conclusions: The compliance rate was high, but the AOF filling rate was incomplete. Improving prescribing patterns and treatment efficacy in CAP patients is a suggestion to combine the AOF into multifaceted interventional efforts for specific patients.

Keywords: antibiotic order form; antibiotic stewardship program; community acquired pneumonia; prescribing; Vietnam.

Resumen

Contexto: Vietnam es uno de los países en alerta máxima de resistencia a los antibióticos.

Objetivos: Evaluar la tasa de cumplimiento y el cambio en los patrones de prescripción de los médicos en pacientes con neumonía adquirida en la comunidad (NAC) antes y después de usar el formulario de pedido de antibióticos (AOF) en un hospital terciario.

Métodos: Se recolectaron retrospectivamente 120 historias clínicas de pacientes hospitalizados con uso de antibióticos y 115 historias clínicas de pacientes diagnosticados con NAC en un Departamento de Medicina Respiratoria durante los 3 meses antes y 3 meses después de usar la AOF para su evaluación.

Resultados: La tasa de cumplimiento fue del 92% y la tasa promedio de llenado de los campos de información fue del 58%. La comparación del comportamiento de prescripción de CAP en el grupo de control y de intervención mostró que la tasa de cultivo bacteriano aumentó del 70% al 77% (p = 0,690), en el que la tasa de cultivo antes de la administración de prescripción aumentó del 14% al 45% (p < 0,001), el régimen antibiótico inicial con espectro estrecho aumentó del 26% al 36% (p = 0,353), la proporción de pacientes que mejoraron clínicamente después de 72 horas aumentó del 64% al 89% (p = 0,138) y la disminución del 23% al 20% (p = 0,713). El fracaso del tratamiento al alta hospitalaria disminuyó del 12% al 6% (p = 0,447). Sin embargo, la duración del tratamiento y los días de tratamiento con antibióticos no fueron significativamente diferentes.

Conclusiones: La tasa de cumplimiento fue alta, pero la tasa de llenado de la AOF fue incompleta. Mejorar los patrones de prescripción y la eficacia del tratamiento en pacientes con NAC es una sugerencia para combinar la AOF en esfuerzos intervencionistas multifacéticos para pacientes específicos.

Palabras Clave: formulario pedido antibióticos; neumonía adquirida en la comunidad; prescribir; programa administración antibióticos; Vietnam.

ARTICLE INFO
Received: January 14, 2021.
Received in revised form: March 8, 2021.
Accepted: March 9, 2021.
Available Online: March 11, 2021.

INTRODUCTION

Antibiotic resistance (ABR) has been recognized as a global health issue. Inappropriate antibiotic use is one of the major causes leading to ABR. A systematic review in 2015 indicated that inappropriate empirical antibiotic utilization rates ranged from 14.1% to 78.9% (Marquet et al., 2015).

Vietnam is one of the countries at the high alert of ABR (Bordier et al., 2018). In 2016, the Vietnam Ministry of Health (VNMOH) approved a national program in effort to prevent spread of ABR and a guideline on the implementation of "Antibiotic stewardship programs (ASP) in hospitals" (Vietnam Minister of Health, 2016). ASP is a multifaceted, multidisciplinary team approach to combat antibiotic misuse (Barlam et al., 2016).

An exclusive antibiotic order form (AOF) has been used in many hospitals worldwide since the 1980s to reduce antibiotic use and increase appropriate antibiotic use (Durbin et al., 1981; Echols et al., 1984; Boyles et al., 2013). An AOF is designed to "focus antibiotic prescribing on distinct infection episodes" (Boyles et al., 2013), in which the physicians are required to fill in patient-related, disease-related, and antibiotic-related information. A national survey of ASP in France found that 69.9% hospitals used nominative prescription and 57.8% applied nominative delivery form (Miliani et al., 2008).

The use of AOF has been issued in a tertiary hospital since May 2019. This study aimed to evaluate compliance with AOF use and its' impact on antibiotic use and prescribing patterns for treating community-acquired pneumonia.

MATERIAL AND METHODS

Study setting

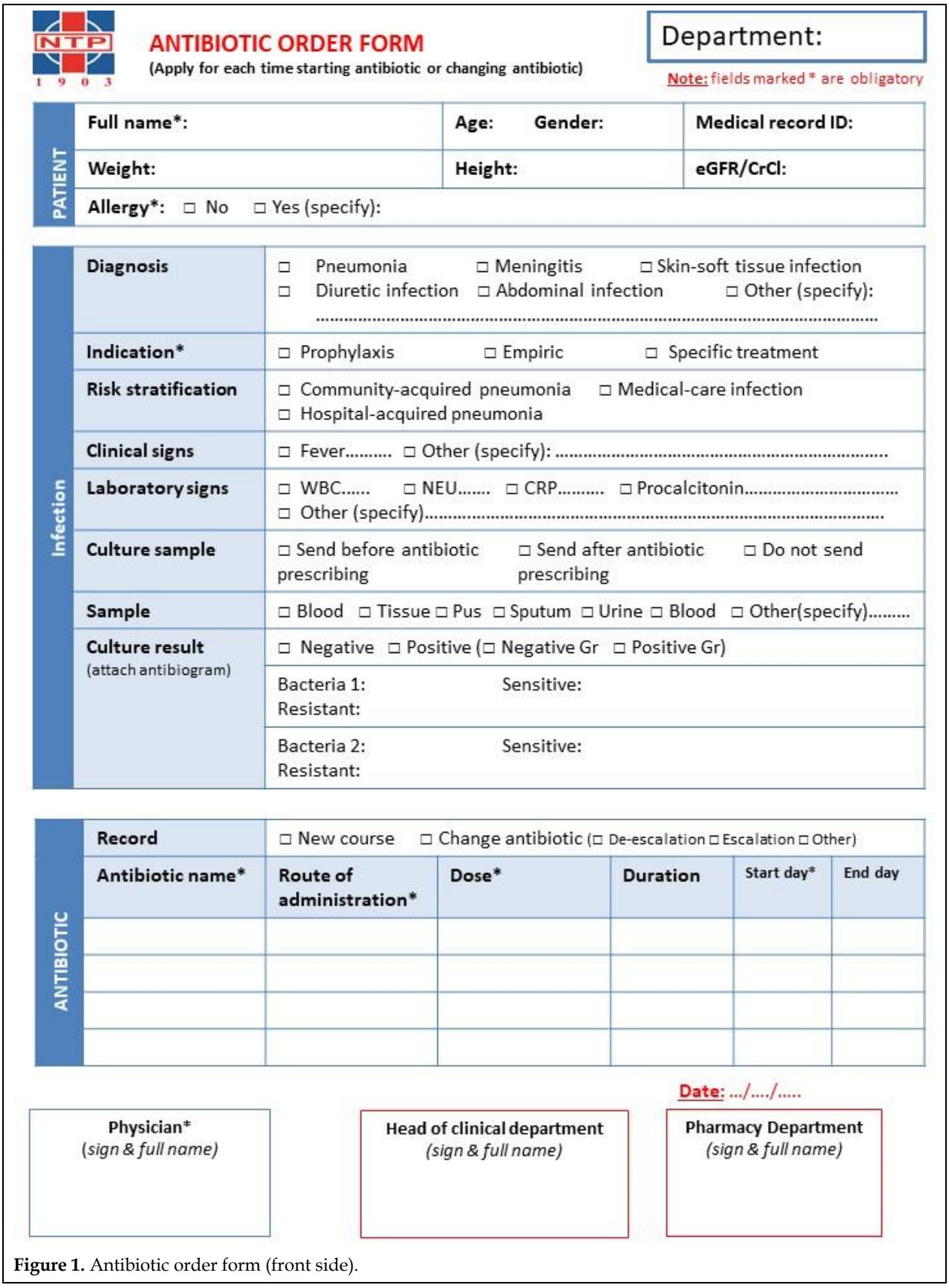
Nguyen Tri Phuong Hospital (NTPH), the 800-bedded tertiary teaching hospital, offers medical and surgical care. In order to improve clinical pharmacy practice in NTPH, four lecturers on clinical pharmacy from Pham Ngoc Thach University of Medicine have worked as part-time clinical pharmacists with four hospital clinical pharmacists in the Clinical Pharmacy Unit (CPU) in NTPH since January 2019. Beginning in May 2019, the study piloted the introduction of a dedicated AOF.

Antibiotic order form (AOF)

The AOF was designed after review of similar antibiotic prescription chart used in other studies (Durbin et al., 1981; Echols et al., 1984; Boyles et al., 2013) and the restricted antibiotic order form of the Ministry of Health (Vietnam Ministry of Health, 2016) and was modified by one author and underwent content validation by a peer group comprising two clinical pharmacists, one surgical physician, and one medical physician. It was pretested on a group of 9 patients to ensure that AOF was unambiguous and appropriate. Afterward, AOF was used in NTPH for a pilot during one month (April 2019). All feedbacks and suggestions of physicians were carefully considered to complete the final form. The final AOF was presented on a 2-side A4 page: the front side includes 4 sections (patient-related section; disease-related section; antibiotic-related section, and administrative section); while the backside presents a list of restricted antibiotics and details of risk stratification of an infectious patient (risk factors, bacterial agents, and recommended antibiotic treatment) (Fig. 1).

Physicians were asked to fill in a new AOF whenever they wanted to start/initiate antibiotic prescribing or change their antibiotics regime. The AOF was used solely for antibiotics and antifungals, but not for antiviral drugs, for both prophylactic and treatment antibiotics.

NTPH still uses a global drug dispensation for each ward daily, does not yet implement a nominative drug dispensation, and does not have electronic medical records. It means that nurses summarized daily antibiotic amounts for all patients in their ward and send it to pharmacy for validation and dispensation. Therefore, pharmacists cannot access to specific patient information and AOF before dispensing antibiotics. Pharmacy only conducts a retrospective audit for AOF use.



ANTIBIOTIC ORDER FORM

(Apply for each time starting antibiotic or changing antibiotic)

Department:

Note: fields marked * are obligatory

PATIENT

Full name*:	**Age: Gender:**	**Medical record ID:**
Weight:	**Height:**	**eGFR/CrCl:**
Allergy*: ☐ No ☐ Yes (specify):		

Infection

Diagnosis	☐ Pneumonia ☐ Meningitis ☐ Skin-soft tissue infection ☐ Diuretic infection ☐ Abdominal infection ☐ Other (specify): .....
Indication*	☐ Prophylaxis ☐ Empiric ☐ Specific treatment
Risk stratification	☐ Community-acquired pneumonia ☐ Medical-care infection ☐ Hospital-acquired pneumonia
Clinical signs	☐ Fever..... ☐ Other (specify): .....
Laboratory signs	☐ WBC..... ☐ NEU..... ☐ CRP..... ☐ Procalcitonin..... ☐ Other (specify).....
Culture sample	☐ Send before antibiotic prescribing ☐ Send after antibiotic prescribing ☐ Do not send
Sample	☐ Blood ☐ Tissue ☐ Pus ☐ Sputum ☐ Urine ☐ Blood ☐ Other(specify).....
Culture result (attach antibiogram)	☐ Negative ☐ Positive (☐ Negative Gr ☐ Positive Gr)
	Bacteria 1: Sensitive: Resistant:
	Bacteria 2: Sensitive: Resistant:

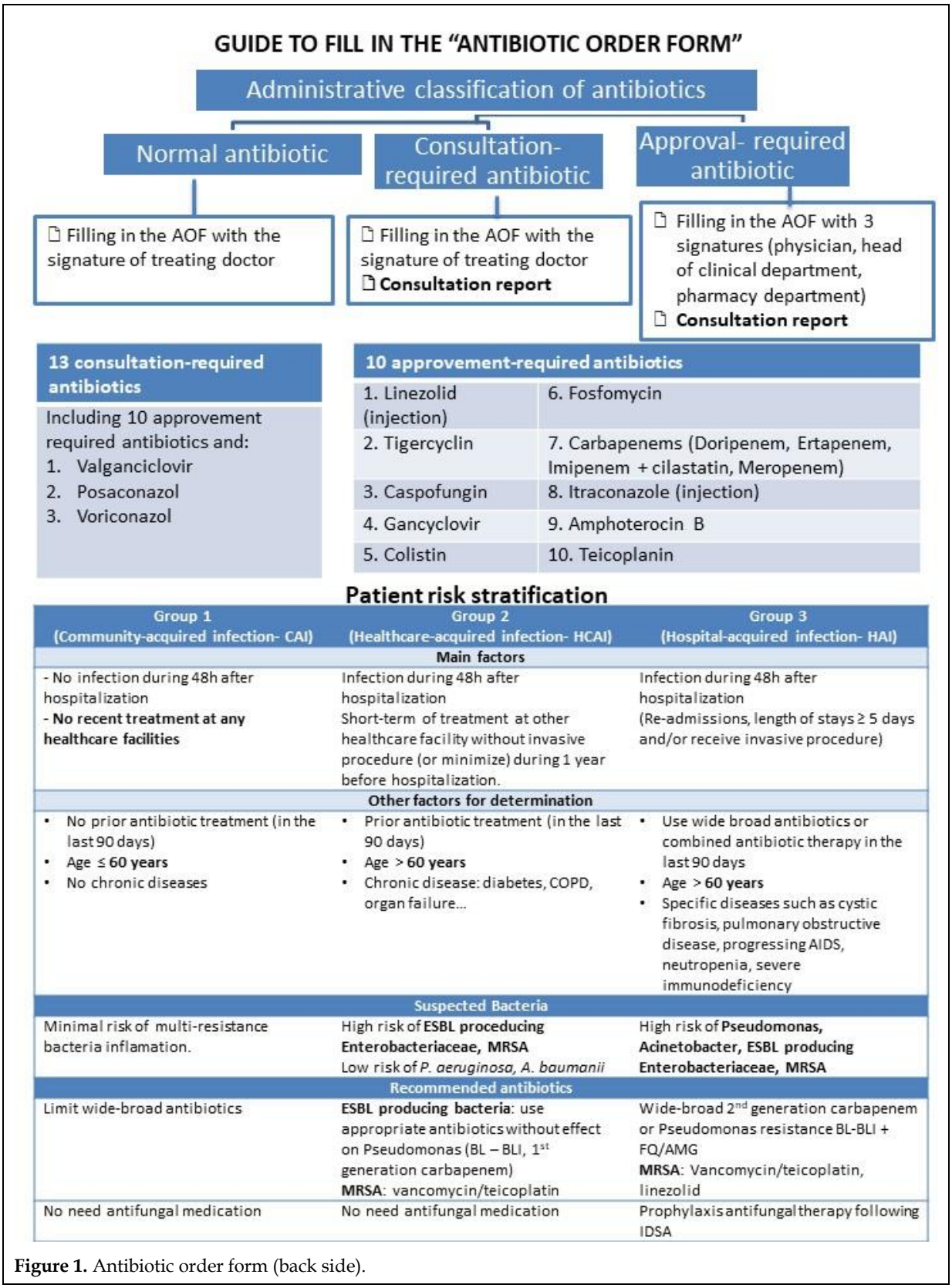
ANTIBIOTIC

Record	☐ New course ☐ Change antibiotic (☐ De-escalation ☐ Escalation ☐ Other)				
Antibiotic name*	**Route of administration***	**Dose***	**Duration**	**Start day***	**End day**

Date: .../..../.....

Physician* *(sign & full name)*	**Head of clinical department** *(sign & full name)*	**Pharmacy Department** *(sign & full name)*

Figure 1. Antibiotic order form (front side).



GUIDE TO FILL IN THE "ANTIBIOTIC ORDER FORM"

Administrative classification of antibiotics

Normal antibiotic	Consultation-required antibiotic	Approval- required antibiotic
☐ Filling in the AOF with the signature of treating doctor	☐ Filling in the AOF with the signature of treating doctor ☐ **Consultation report**	☐ Filling in the AOF with 3 signatures (physician, head of clinical department, pharmacy department) ☐ **Consultation report**

13 consultation-required antibiotics

Including 10 approvement required antibiotics and:
1. Valganciclovir
2. Posaconazol
3. Voriconazol

10 approvement-required antibiotics

1. Linezolid (injection)	6. Fosfomycin
2. Tigercyclin	7. Carbapenems (Doripenem, Ertapenem, Imipenem + cilastatin, Meropenem)
3. Caspofungin	8. Itraconazole (injection)
4. Gancyclovir	9. Amphoterocin B
5. Colistin	10. Teicoplanin

Patient risk stratification

Group 1 (Community-acquired infection- CAI)	Group 2 (Healthcare-acquired infection- HCAI)	Group 3 (Hospital-acquired infection- HAI)
Main factors		
- No infection during 48h after hospitalization - **No recent treatment at any healthcare facilities**	Infection during 48h after hospitalization Short-term of treatment at other healthcare facility without invasive procedure (or minimize) during 1 year before hospitalization.	Infection during 48h after hospitalization (Re-admissions, length of stays ≥ 5 days and/or receive invasive procedure)
Other factors for determination		
• No prior antibiotic treatment (in the last 90 days) • Age ≤ **60 years** • No chronic diseases	• Prior antibiotic treatment (in the last 90 days) • Age > **60 years** • Chronic disease: diabetes, COPD, organ failure...	• Use wide broad antibiotics or combined antibiotic therapy in the last 90 days • Age > **60 years** • Specific diseases such as cystic fibrosis, pulmonary obstructive disease, progressing AIDS, neutropenia, severe immunodeficiency
Suspected Bacteria		
Minimal risk of multi-resistance bacteria inflamation.	High risk of **ESBL proceducing Enterobacteriaceae, MRSA** Low risk of *P. aeruginosa, A. baumanii*	High risk of **Pseudomonas, Acinetobacter, ESBL producing Enterobacteriaceae, MRSA**
Recommended antibiotics		
Limit wide-broad antibiotics	**ESBL producing bacteria**: use appropriate antibiotics without effect on Pseudomonas (BL – BLI, 1st generation carbapenem) **MRSA**: vancomycin/teicoplatin	Wide-broad 2nd generation carbapenem or Pseudomonas resistance BL-BLI + FQ/AMG **MRSA**: Vancomycin/teicoplatin, linezolid
No need antifungal medication	No need antifungal medication	Prophylaxis antifungal therapy following IDSA

Figure 1. Antibiotic order form (back side).

Training of AOF use

A local hospital guideline of AOF use was issued and sent to each clinical ward in paper and uploaded into the hospital's intranet. Print AOFs were placed in the emergency unit and all clinical wards who prescribed antibiotics. One-hour direct training on AOF use was conducted for physicians by a senior clinical pharmacist.

Audit of AOF use

To determine compliance with AOF use, 120 medical records in which physicians prescribed antibiotics in June 2019 were collected randomly. The use of AOF when prescribing antibiotics was recorded. In addition, the rate of completion of 30 separate indicators on AOF was also assessed.

Prescribing patterns for patient with community-acquired pneumonia

To evaluate whether AOF changes physicians' prescribing patterns, a retrospective study of 54 medical records of patients with community-acquired pneumonia treated during June, July, and August 2019 (intervention period), compared to 60 medical records of the patient treated during January, February, and March 2019 (control period) was conducted.

The socio-demographic data, which was collected, comprised of age, gender. The clinical profile of patients consisted of infection-related data (CURB 65, timing of culture, culture site, Gram stain, antibiotic susceptibility testing), antibiotic treatment, and outcomes.

Ethics statement

The study was approved by the local hospital ethical review board (N87-2018/NTP-CĐT). The study was conducted in the spirit of respecting the private information related to patients and health care providers. Information, which was collected from routine data of drug charts was anonymized.

Statistical analysis

All data were analyzed by using SPSS software version 20.0. Two means were compared by the t-test, and two percentages were compared by the *Chi*-squared test. The results are presented as mean ± SD or %. $P<0.05$ was considered statistically significant.

RESULTS

Audit of AOF implementation

In the audit of 120 patients who had been prescribed antibiotics, the rate of medical records using at least one AOF was 92%. Since one AOF was required for either starting or changing antibiotics, the required number of AOF for 120 patients was 182. However, only 162 AOFs were obtained, corresponding to 89%. The more times antibiotics were changed, the lower compliance rate of filling in AOF was obtained.

Of 30 information fields required to fill in the AOF, the fill rate of each field varied from 0% to 100%. The average fill rate was 58% for all fields. The fields most likely to be omitted from charts were "Bacterial name" (73%) and antibiogram of "Sensitivity" (79%) and "Resistance" (80%).

Prescribing patterns for the patient with community-acquired pneumonia before and after using the AOF

The characteristics of two patient groups with CAP before and after using AOF were considered similar in age, gender, and CURB 65 (Table 1).

Control of ABR depends greatly on the rational prescribing behavior of physicians. Changes in prescribing patterns between control and intervention periods were summarized in (Table 2).

Table 1. Characteristics of community-acquired pneumonia patients before and after using the antibiotic order form.

	Patient before using AOF (%)	Patient after using AOF (%)	p-value
No. of patient	60	55	
Age			
< 65	13 (22%)	21 (38%)	
≥ 65	47 (78%)	34 (62%)	
Mean ± SD	71.76 ± 15.34	67.96 ± 18.97	0.685
Gender			
Male	24 (40%)	21/55 (38%)	0.876
Female	36 (60%)	34/53 (62%)	0.900
CURB 65			
Mean ± SD	2.3 ± 0.8	2.1 ± 0.9	0.655

AOF: antibiotic order form; SD: standard deviation; CURB 65: score for severity of community-acquired pneumonia.

Table 2. Prescribing patterns and outcomes of community-acquired pneumonia patients before and after using the antibiotic order form.

Parameter/Outcome	Patient before using AOF (%)	Patient after using AOF (%)	p-value
Number of patients	60	55	
Bacteria culture	42 (70%)	42 (77%)	0.690
Obtaining culture before antibiotic administration	8 (14%)	25 (45%)	0.001*
Initial empirical antibiotic therapy			
Narrow spectrum	16 (26%)	20 (36%)	0.353
Broad spectrum	47 (74%)	35 (64%)	
Clinical improvement after 72 h	38 (64%)	48 (89%)	0.138
Changing in antibiotic	23 (38%)	16 (28%)	0.395
De-escalation	11/47 (23%)	7/35 (20%)	0.713
DOT# (mean ± SD)	12.5 ± 7.13	12.17 ± 7,27	0.351
LOT* (mean ± SD)	8.18 ± 4.32	8.08 ± 4,50	0.478
Length of stay (mean ± SD)	7.52 ± 3.22	8.57 ± 3,25	0.173
Treatment failure at discharge	7 (12%)	4 (6%)	0.447

*p < 0.05; AOF: antibiotic order form; DOT: duration of treatment; LOT: length of treatment; SD: standard deviation.

DISCUSSION

Most hospitals still have a lot of difficulties in implementing the ASP. The ASP in another Vietnamese hospital has initially shown promising results (Nguyen el al., 2017) but impact of specific intervention of ASP is not reported. This is the first study to introduce the AOF and evaluate its impact in Vietnam.

Antibiotic order form

Since 2016, VNMOH has provided a nominative prescribing order for restricted antibiotics, and physicians have to fill in this order in order that patient's antibiotics will be reimbursed by health insurance (Vietnam Ministry of Health, 2016). However, this form still lacks some important information fields, and the information is not presented in logical clinical reasoning.

The final AOF used in NTPH was designed to print on paper, be filled by physicians whenever starting or changing any antibiotics and be inserted into patient medical records. Therefore, the antibiotic prescription form is short-formatted with many fields in check-list forms so that it does not take much time to complete. The AOF covers the main information fields for physicians' antibiotic prescribing reasoning. Each AOF was used only once, although more than one antibiotic could be prescribed simultaneously.

There were some differences between the implementation of AOFs in this study and in other studies. Firstly, solely physicians were empowered to write AOFs without other prospective audits and feedback. Secondly, there was not an automatic discontinuation after a fixed duration of antibiotics (like "after two days (prophylactic), three days (empirical), or seven days (therapeutic)" in the study of Durbin et al. (1981) or "after 2 days (prophylaxis) or five days (other indications)" in the study of Echols et al. (1984)) because the hospital ASP team did not have enough clinical pharmacists to follow up in order to prevent inadvertent or premature discontinuation. Thirdly, the limited resources of NTPH did not allow clinicians to use a nominative drug delivery for each patient. Pharmacists then cannot contribute to validate individual antibiotic therapies to prevent medication errors (Labrosse et al., 2010). Fourthly, there were no antibiotic stewardship multi-professional ward rounds like in the study of Boyles et al. (2013) though it is likely that a major factor affecting prescribing behavior change was ward round.

Audit of AOF implementation

In the similar research of Boyles et al. (2013), there was a similar high compliance rate of AOF use (92% *vs*. 96%). The average fill rate was 58% for all fields. Boyles et al. (2013) reported the median of unfilled fields was two per 12 fields chart (range 0-6). The fields most likely to be omitted from charts were "Bacterial name" and antibiogram of "Sensitivity" and "Resistance". These results are reasonable because most AOFs were filled in starting empiric antibiotics when lacking bacterial identification and antibiotic susceptibility testing results.

Prescribing patterns for the patient with community-acquired pneumonia before and after using the AOF

There are many metrics to study the impact of an intervention of ASPs with its own advantages and disadvantages (Morris, 2014). This study aimed to evaluate disease-specific consumption measures in order to focus more on physicians' prescribing behaviors.

Microbiological testing is an important tool in the rational prescribing of antibiotics (Giuliano et al., 2019). It is essential to carry out antibiotic-susceptibility testing because the local annual antibiogram data can guide clinicians in selecting an appropriate empirical treatment regimen for an infection (Barlam et al., 2016). There was an increase in obtaining culture (from 70% to 77%, $p = 0.690$), of which ordering culture before antibiotic administration significantly increased from 14% to 45% ($p = 0.001$). This was a positive impact since obtaining cultures prior to antibiotic administration can help physicians in identifying a causative organism, allowing potential de-escalation. If cultures are drawn after antibiotic administration, the likelihood of culture positivity is greatly reduced, which can increase the cost and length of stay for the patient (Murphy et al., 2015). Bacterial detections declined with increasing time between inpatient antibiotic administration and specimen collection (Harris et al., 2017). With using AOF, physicians were likely to order specimen collections

more promptly, preferably before antibiotics, providing data for improved antibiotic selection.

Concerning antibiotic prescribing behavior between group using AOFs compared to control groups, physicians were likely to prescribe more often a narrow spectrum on day 1 (from 26% to 36%, p = 0.353), and patients' clinical improvement after 72 hours was better (from 64% to 89%, p = 0.138). Then physicians were less likely to have to change antibiotics (from 38% to 28%, p = 0.395), or de-escalation (23% to 20%, p = 0.713). However, these changes were not statistically significantly different ($p < 0.05$).

The guidelines state that antibiotic therapy should be reassessed between 48 and 72 hours after treatment initiation in order to narrow the spectrum of antibiotics if possible (Pérut et al., 2019). Using AOFs was not likely to improve de-escalation. In a French study by Pérut et al. (2019), 44% of antibiotic therapies with a broad spectrum on day 1 benefited from a de-escalation at 72 hours, which was higher in this study. Pérut et al. concluded that clearly recorded reassessment at 72 hours was associated with de-escalation (p = 0.025).

Many studies confirmed that antibiotic prescribing was infrequently influenced by microbiological culture results (Maraha et al., 2000). However, in this study, using AOFs was statistically significantly associated with increasing microbiological analysis but not statistically significantly associated with antibiotic prescribing change. This finding was similar to a study by Roger et al. (2013) in which they found microbiological findings were not contributive to a modification of the initial antibiotic treatment.

There was no statistically significant difference in days of therapy (DOT), length of therapy (LOT), length of hospital stays (LOS) between the two groups. In the study of Echols et al. (1984), the introduction of the AOF showed a significant decline in the number of antibiotic treatment courses and the percentage of patients receiving any antibiotics. Durbin et al. (1981) described the use of a prescription form used exclusively for antibiotic orders in surgical and medical wards and found this antibiotic prescribing system has a substantial impact on antibiotic use, including a decrease in prophylactic antibiotics from 68% to 60%, decrease in duration of prophylaxis from 4.9 ± 2.4 days to 2.9 ± 1.6 days. Similarly, another study in South Africa (Boyles et al., 2013), which applied an AOF, and weekly antibiotic stewardship ward rounds, represents a 19.6% decrease in volume with a cost reduction of 35% of the pharmacy's antibiotic budget.

Response to treatment of an infection can be assessed using both clinical, biochemical, and microbiological parameters. Many factors contribute to an antibiotic treatment failure at discharge (Bassetti et al., 2018). The rate of antibiotic treatment failure at hospital discharge in the group using the AOF was lower compared to the control group (6% and 12%, respectively, p = 0.447). In another Vietnamese study, the overall treatment response rate was 87.7% (Nguyen et al., 2017).

In order to change antibiotic prescribing patterns, multifaceted interventional efforts are the need for an effective antimicrobial stewardship program (Miliani et al., 2008; Barlam et al., 2016). The sole AOF introduction as physicians' self-reflection had only a modest impact on changing prescribing behavior. The effect of organizational changes such as continuous audit and feedback, educational sessions, ward rounds, nominative drug delivery cannot be ignored.

This study remains some limitations, which need to be considered when interpreting the results. Firstly, the sample size was small but suitable for the purpose of audit and evaluation in detail of prescribing behavior related to CAP. Secondly, audit-related to filling in AOF did not evaluate whether the filled information was accurate.

CONCLUSIONS

The key finding of this study is that the introduction of a AOF itself as physicians' antibiotic prescribing reasoning had a very high compliance rate and impacted antibiotic prescribing patterns related to CAP treatment. However, change in physicians' prescribing behavior was still limited, which needs integration of the AOFs into other

interventions like multi-discipline ward rounds or retrospective audit and feedback.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

ACKNOWLEDGMENTS

The authors wish to thank hospital clinical pharmacists (Ton Thi Thanh Thao, Nguyen The Anh, Pham Kim Ngan, Ha Thi Thuy, Vu Thu Thao, Dang Thi Nga) and physicians in Nguyen Tri Phuong Hospital for helping us to conduct the study. This study was funded by a research grant from Nguyen Tri Phuong hospital in 2019 (N87/QĐ-NTP).

REFERENCES

Barlam TF, Cosgrove SE, Abbo LM, MacDougall C, Schuetz AN, Septimus EJ, Srinivasan A, Dellit TH, Falck-Ytter YT, Fishman NO, Hamilton CW, Jenkins TC, Lipsett PA, Malani PN, May LS, Moran GJ, Neuhauser MM, Newland JG, Ohl CA, Samore MH, Seo SK, Trivedi KK (2016) Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. Clin Infect Dis 62(10): e51–77.

Bassetti M, Montero JG, Paiva JA (2018) When antibiotic treatment fails. Intensive Care Med 44(1): 73–75.

Bordier M, Binot A, Pauchard Q, Nguyen DT, Trung TN, Fortané N, Goutard FL (2018) Antibiotic resistance in Vietnam: moving towards a One Health surveillance system. BMC Public Health 18(1): 1136.

Boyles TH, Whitelaw A, Bamford C, Moodley M, Bonorchis K, Morris V, Rawoot N, Naicker V, Lusakiewicz I, Black J, Stead D, Lesosky M, Raubenheimer P, Dlamini S, Mendelson M (2013) Antibiotic stewardship ward rounds and a dedicated prescription chart reduce antibiotic consumption and pharmacy costs without affecting inpatient mortality or re-admission rates. PLoS One 8(12): e79747.

Durbin WA Jr, Lapidas B, Goldmann DA (1981) Improved antibiotic usage following introduction of a novel prescription system. JAMA 246(16): 1796–1800.

Echols RM, Kowalsky SF (1984) The use of an antibiotic order form for antibiotic utilization review: influence on physicians' prescribing patterns. J Infect Dis 150(6): 803–807.

Giuliano C, Patel CR, Kale-Pradhan PB (2019) A guide to bacterial culture identification and results interpretation. P T 44(4): 192–200.

Harris AM, Bramley AM, Jain S, Arnold SR, Ampofo K, Self WH, Williams DJ, Anderson EJ, Grijalva CG, McCullers JA, Pavia AT, Wunderink RG, Edwards KM, Winchell JM, Hicks LA (2017) Influence of antibiotics on the detection of bacteria by culture-based and culture-independent diagnostic tests in patients hospitalized with community-acquired pneumonia. Open Forum Infect Dis 4(1): ofx014.

Labrosse H, Duchamp F, Vantard N, Darlay AL, Kohler A, Sebert P, Mégard R (2010) Experience with an automated dispensing system in department of pharmacy. [French]. Ann Pharm Fr 68(2): 104–112.

Maraha B, Bonten M, Fiolet H, Stobberingh E (2000) The impact of microbiological cultures on antibiotic prescribing in general internal medicine wards: microbiological evaluation and antibiotic use. Clin Microbiol Infect 6(2): 99–102.

Marquet K, Liesenborgs A, Bergs J, Vleugels A, Claes N (2015) Incidence and outcome of inappropriate in-hospital empiric antibiotics for severe infection: a systematic review and meta-analysis. Crit Care 19(1): 63.

Miliani K, L'Hériteau F, Alfandari S, Arnaud I, Costa Y, Delière E, Carbonne A, Astagneau P, Antimicrobial Surveillance Network (2008) Specific control measures for antibiotic prescription are related to lower consumption in hospitals: results from a French multicentre pilot study. J Antimicrob Chemother 62(4): 823–829.

Morris AM (2014) Antimicrobial Stewardship Programs: Appropriate measures and metrics to study their impact. Curr Treat Options Infect Dis 6(2): 101–112.

Murphy D, Overton E, Steinberg J, Jacob J (2015) Effect of blood culture acquisition time relative to antibiotic administration on diagnostic yield. Crit Care Med 43(12): S271.

Nguyen TS, Ton TT, Pham TNT (2017) Antimicrobial Stewardship Program at a tertiary teaching hospital in Vietnam: A longitudinal observational study. Clin Microbiol Infect Dis 2(1): 1–5.

Pérut V, Gauzit R, Kernéis S, Canouï E, Chedhomme FX, Batista R, Conort O, Bouam S, Raymond J, Loubinoux J, Chevallier A, Salmon-Ceron D (2019) Assessing the benefit of the 72-hour antibiotic therapy reassessment documentation. Med Mal Infect 49(3): 187–193.

Roger PM, Labate C, Serre S, Zumbo C, Valério L, Bonnet H, Jurado A, Bélé N, Brofferio P (2013) Factors associated with effective reassessment of antibiotic therapy on day 3. Med Mal Infect 43(3): 123–127.

Vietnam Ministry of Health (2016) [Guideline on Antibiotic Use Management in Hospitals]. https://thuvienphapluat.vn/van-ban/the-thao-y-te/Quyet-dinh-772-QD-BYT-Huong-dan-quan-ly-su-dung-khang-sinh-benh-vien-2016-304975.aspx. [Consulted October 16, 2020].

Vietnam Minister of Health (2016). [A guidance on antibiotic management in hospitals]. https://thuvienphapluat.vn/van-ban/The-thao-Y-te/Quyet-dinh-772-QD-BYT-Huong-dan-quan-ly-su-dung-khang-sinh-benh-vien-2016-304975.aspx [Consulted October 16, 2020].

AUTHOR CONTRIBUTION:

Contribution	Vo DC	Mai TA	Nguyen TT	Nguyen DT	Vo TH
Concepts or ideas	x	x	x	x	x
Design	x	x	x	x	x
Definition of intellectual content	x	x	x		x
Literature search	x			x	x
Experimental studies	x			x	x
Data acquisition	x			x	x
Data analysis	x			x	x
Statistical analysis	x			x	x
Manuscript preparation	x	x	x	x	x
Manuscript editing	x	x	x	x	x
Manuscript review	x	x	x	x	x

Citation Format: Vo DC, Mai TA, Nguyen TT, Nguyen DT, Vo TH (2021) The use of an antibiotic order form in a tertiary hospital: Influence on physicians' prescribing patterns. J Pharm Pharmacogn Res 9(4): 474–483.