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Research article

Rational Use of Antibiotics in Fresh Traumatic Wounds: A Case of Community Hospital in Khon Kaen

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Abstract

Objective: To determine the prevalence of antibiotic prescribing in fresh traumatic wound, evaluate such antibiotic uses according to the criteria on rational drug use and the prevalence of wound infection after treatment. **Methods:** This prospective study was conducted in patients with fresh traumatic wound from accident at Pueai Noi Hospital, Khon Kaen province between December 1, 2019 and May 31, 2020. The study collected the data from electronic medical records and patient interviews including patients' demography, wound characteristics, medication treatment and clinical outcomes at 14 days after treatment, i.e., wound healing and wound infection. **Results:** A total of 360 participants were recruited in this study. Antibiotics were prescribed in 37.5% of all participants. Most commonly used antibiotics was dicloxacillin (63.7%). Average duration of antibiotic use was 5.1 ± 1.6 days. The rate of rational antibiotic prescribing was 30.8%. 249 irrational uses of antibiotics composed of failure to prescribe necessary drugs, inappropriate duration of treatment, unnecessary antibiotic prescribing, and inappropriate choices of drugs in 54.6, 27.7, 16.1 and 1.6% of patients, respectively. **Conclusion:** Percentage of antibiotic use in patients with fresh traumatic wounds in the hospital complied with the criteria on rational drug use set at less than 40%. However, the majority of prescribing was considered irrational. The rate of wound infection was low.

Keywords: fresh traumatic wound, antibiotic use, rational drug use

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บทความวิจัย

ความสมเหตุผลของการใช้ยาปฏิชีวนะในบาดแผลสดจากอุบัติเหตุ: กรณีโรงพยาบาลชุมชนแห่งหนึ่งในจังหวัดขอนแก่น

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บทคัดย่อ

วัตถุประสงค์: เพื่อหาความชุกของการสั่งใช้ยาปฏิชีวนะในกรณีบาดแผลสดจากอุบัติเหตุประเมินการสั่งใช้ยาปฏิชีวนะดังกล่าวตามแนวทางการใช้ยาอย่างสมเหตุผล และความชุกของการติดเชื้อของบาดแผลหลังการรักษา **วิธีการ:** การศึกษาแบบไปข้างหน้าครั้งนี้ทำในผู้ป่วยที่มารับการรักษาบาดแผลสดจากอุบัติเหตุ ณ โรงพยาบาลเปือยน้อย จังหวัดขอนแก่น ระหว่างวันที่ 1 ธันวาคม 2562 ถึง 31 พฤษภาคม 2563 การศึกษาเก็บข้อมูลจากเวชระเบียนผู้ป่วยอิเล็กทรอนิกส์และการสัมภาษณ์ผู้ป่วย ได้แก่ ข้อมูลทั่วไปของผู้ป่วย ข้อมูลลักษณะบาดแผล ข้อมูลการรักษาด้วยยา และผลลัพธ์ทางคลินิกที่ 14 วันถัดมา ได้แก่ ผลการรักษาและการติดเชื้อของบาดแผล **ผลการวิจัย:** ผู้ป่วย 360 รายเข้าร่วมการศึกษา พบการสั่งใช้ยาปฏิชีวนะในผู้ป่วยร้อยละ 37.5 ยาปฏิชีวนะที่ใช้มากที่สุดร้อยละ 63.7 คือ dicloxacillin ระยะเวลาของการใช้ยาเฉลี่ย 5.1 ± 1.6 วัน การสั่งใช้ยามีความสมเหตุผลร้อยละ 30.8 การใช้ยาอย่างไม่เหมาะสม 249 ครั้ง ประกอบด้วยการไม่สั่งใช้ยาที่จำเป็น ระยะเวลาไม่เหมาะสม การสั่งใช้ยาโดยไม่จำเป็น และชนิดของยาไม่เหมาะสม ในผู้ป่วยร้อยละ 54.6, 27.7, 16.1 และ 1.6 ตามลำดับ การศึกษาพบแผลติดเชื้อในผู้ป่วยร้อยละ 1.67 **สรุป:** ร้อยละของการใช้ยาปฏิชีวนะในผู้ป่วยบาดแผลสดจากอุบัติเหตุของโรงพยาบาลผ่านเกณฑ์การใช้ยาปฏิชีวนะอย่างรับผิดชอบที่กำหนดไว้ที่น้อยกว่าร้อยละ 40 แต่การสั่งใช้ส่วนใหญ่ไม่สมเหตุผลและอัตราการเกิดแผลติดเชื้อต่ำ

คำสำคัญ: บาดแผลสดจากอุบัติเหตุ การใช้ยาปฏิชีวนะ การใช้ยาอย่างสมเหตุผล

Introduction

Fresh traumatic wound is a common health problem that causes patient to visit hospital emergency department. (1,2) The consequent problem is the inappropriate use of antibiotics to prevent wound infection.(3) Although, infected wounds may increase the patients' morbidity and mortality, the results from meta-analysis or randomized controlled trials showed no benefit of antibiotics for preventing wound infection.(4,5) Moreover, the incidence of wound infection varied from 1.1 to 12%.(6) Therefore, the antibiotic prophylaxis is recommended for preventing wound infection only in high-risk patients, e.g., patients with heavily contaminated wounds, immunocompromised patients or patients taking immunosuppressive drugs.(6)

In Thailand, a study at Siriraj Hospital in 2012 found that antibiotics were prescribed in most patients with traumatic wounds (90%) and 80.3% of antibiotics prescribed were dicloxacillin. While the prevalence of microbial detection in traumatic wounds was less than 10% and wound infection was reported in only 1.2% of patients with contaminated wounds. (2) In addition, a study in Mahasarakham Hospital also found that the prevalence of antibiotic use in patients with traumatic wounds was 65.5%. The rate of wound infections in patients with antibiotic prophylaxis was 0.75% but no infection occurred in patients without antibiotic prophylaxis. (7)

As the necessity and benefit of antibiotic use for preventing wound infection is unclear, the Sub-Committee on Rational Drug Use has therefore designated the Responsible Use of Antibiotics (RUA) as a part of the Rational Drug Use (RDU) Hospital program. A key indicator is less than 40% antibiotic prescribing in patients with fresh traumatic wounds.(8) This policy has been implemented since 2014 in hospitals under the Ministry of Public Health at all levels including Pueai Noi Hospital, a 30-bed government hospital located in Khon Kaen province.(8) In fiscal year 2017, the antibiotic prescribing rate in patients with fresh traumatic wounds was 47.2% which was higher than the threshold of RUA.(9) Therefore, this study aimed to determine the prevalence of antibiotic use, the patterns of antibiotic prescribing, the appropriateness of antibiotic use and the outcomes of wound infection in patients with fresh traumatic wounds.

Methods

Study design

This research was a prospective cohort study in outpatients with fresh traumatic wounds treated at Pueai Noi Hospital, Khon Kaen. It was approved by the Khon Kaen University Ethic Committee for Human Research (No. HE622231).

Subjects

The participants were outpatients with fresh traumatic wounds treated at Pueai Noi Hospital, Khon Kaen province in fiscal year 2020. Sample size was calculated using the formula: $Z^2_{\alpha/2}\ \pi\ (1-\pi)/\varepsilon^2$. Type I error was set at 0.05 and $Z_{\alpha/2}$ was 1.96. Expected proportion of antibiotic prescribing rate for fresh traumatic wound (π) was 0.3387 (9) and precision (ε) was 0.05. The calculated sample size was 344.18 and being increased to 360 patients to compensate for 5% of dropout cases. Patient recruitment was started on December 1, 2019 until the total number of subjects was attained.

Inclusion criteria were patients aged 18 years or over, who were diagnosed with fresh traumatic wounds at the emergency or outpatient department within 6 h after skin injury and were willing to participate the study. Exclusion criteria were patients receiving antibiotics within two weeks before the study, those being pregnant, those with incomplete medical record or those with loss of follow up.

Data collection and data analysis

Information on patients' characteristics, wound characteristics, antibiotics use and wound infection was

collected from the HOSxP electronic database, outpatient medical records and patient interview on the first day and 14 day after treatment that was on the appointment day for follow up.

Wound was classified by the researchers based on criteria in the RDU Hospital manual in Figure 1 composing of group 1 wound (clean wounds), group 2 wound (wounds with a chance of infection) and group 3 wound (wounds with contaminants). (8) The treatment outcomes including wound healing and wound infection were evaluated by physicians.

Appropriateness of antibiotic use were assessed according to the guidelines of antibiotic use for fresh traumatic wounds from accidents in the RDU Hospital manual by a pharmacist with experience in hospital pharmacy for 9 years. (8) Briefly, antibiotics for preventing wound infections is not recommended for patients with group 1 wound but recommended for patients with the other 2 wound groups. All data were analyzed using descriptive statistics.

Results

Subject's characteristics

A total of 360 patients participated in the study. Most of them were males (63.1%) aged between 41-60 years (41.1%), graduated from elementary school (50.6%) and working in agriculture (43.6%). Universal coverage (UC) was the major health benefit scheme (66.9%). Common comorbidities or medical conditions in participants were cardiovascular diseases (12.5%), endocrine diseases (7.2%) and respiratory diseases (2.8%) as shown in Table 1

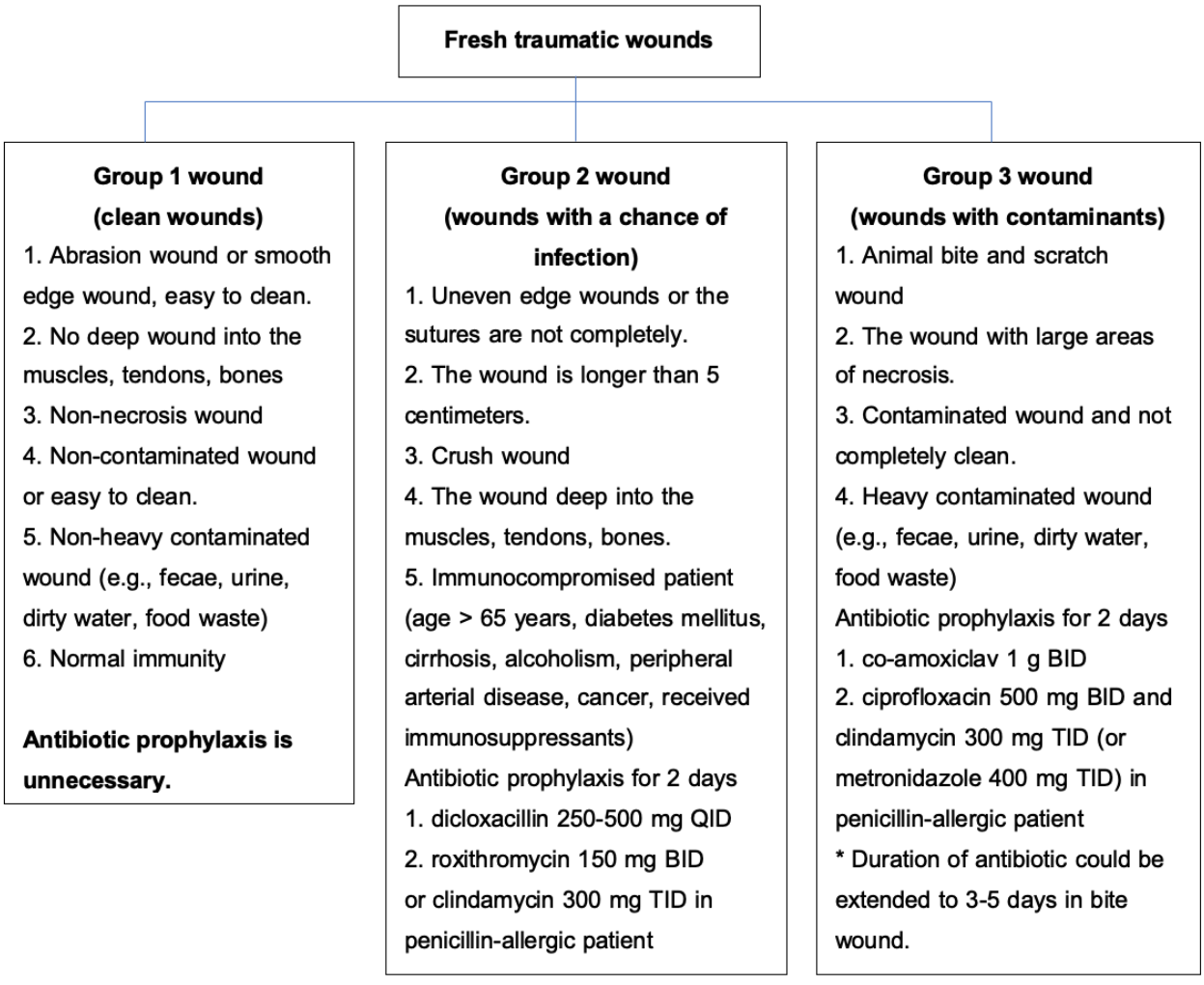

Figure 1. Fresh traumatic wound classification and antibiotic use

Table 1. Demographic characteristics of participants (n = 360)

characteristics	number of cases (%)
age (years): mean±SD: 49.6 ± 17.3	
< 20	17 (4.7)
20 – 40	87 (24.2)
41 – 60	148 (41.1)
> 60	108 (30)
gender	
male	227 (63.1)
female	133 (36.9)
education level	
unlettered	3 (0.8)
elementary school	182 (50.6)
high school (m 1-3)	55 (15.2)
high school (m 4-6)	81 (22.5)
diploma	10 (2.8)
bachelor's degree or higher	29 (8.1)
health benefit scheme	
universal coverage	241 (66.9)
out of pocket	62 (17.2)
civil servant	37 (10.3)
social security	20 (5.6)
occupation	
unemployed	50 (13.9)
agriculture	157 (43.6)
employee	85 (23.6)
bachelor's degree student	24 (6.7)
government officer	24 (6.7)
private officer/business owner	16 (4.4)
monk/priest	4 (1.1)
underlying diseases	
no underlying	261 (72.5)
cardiovascular diseases	45 (12.5)
endocrine diseases	26 (7.2)
respiratory diseases	10 (2.8)
kidney diseases	6 (1.7)
bone and joint diseases	7 (1.9)
infectious diseases	3 (0.8)
psychiatric diseases	2 (0.6)

Characteristics of wounds

The median time between traumatic wound occurrence and visit of Pueai Noi Hospital was 30.0 min (5-360 min). The median sizes of the wound were length of 2.0 cm (0-20 cm), width of 0.2 cm (0-10 cm) and depth of 0.2 cm (0-3 cm). The lesions were mainly on hands (29.4%), legs (24.2%) and feet (20.8%). Most wounds were bites (33.9%), followed by laceration (32.8%) and abrasion (21.1%). All patients had their wounds cleaned upon hospital arrival. (Table 2)

Table 2. Characteristics of wounds (n = 360)

characteristics	number of cases (%)
position	
hand	106 (29.4)
leg	87 (24.2)
feet	75 (20.8)
arm	29 (8.1)
face	24 (6.7)
head and neck	21 (5.8)
body	11 (3.1)
knee	7 (1.9)
types of wounds	
bite wound	122 (33.9)
laceration wound	118 (32.8)
abrasion wound	76 (21.1)
stab wound	27 (7.5)
burn wound	7 (1.9)
crushed wound	5 (1.4)
penetrating wound	5 (1.4)
contamination	
non-contaminated wound	118 (32.8)
contaminated wound	242 (67.2)
stool, urine or other secretions	117 (32.5)
soil	82 (22.8)
rust	19 (5.3)
wood	8 (2.2)
dirty water	6 (1.7)
oil/grease	3 (0.8)
others	7 (1.9)

Table 2. Characteristics of wounds (n = 360) (continue)

characteristics	number of cases (%)
wound cleaning before hospital visit	
no cleaning	183 (50.8)
cleaning	177 (49.2)
clean water	94 (26.1)
antiseptic	57 (15.8)
soap	19 (5.3)
others	7 (2.0)

Wound classification and treatment

Proportion of patients with group 1 wounds (clean wounds), group 2 wounds (wounds with a chance of infection) and group 3 wounds (wounds with contaminants) were 35.8%, 16.7% and 47.5%, respectively. (Table 3)

From Table 3, 37.5% of patients received antibiotics for preventing wound infections. Proportions of patients with antibiotic treatment were 31.0%, 46.7% and 39.2% in group 1, group 2 and group 3 wounds, respectively. The most commonly used antibiotics were dicloxacillin (63.7%), followed by amoxicillin (27.4%). The average durations of antibiotic treatment with dicloxacillin and amoxicillin were 4.74 days (range 2-7 days) and 5.61 days (range 3-10 days), respectively. (Table 4)

From Table 5, the overall rate of appropriate antibiotic use was 30.8%. Antibiotic is not recommended for patients with group 1 wound and there were no antibiotic prescribing in 89 patients (69.0%) in this group. Therefore, the appropriate rate of antibiotic use in this group was 69.0%. For patients with the other 2 wound groups, antibiotic prescribing for the prevention

Table 3. Classification of wounds and antibiotic prescribing (n = 360)

classification of wounds[a]	antibiotic prescribing		total
	yes	no	
group 1 clean wounds	40 (31.0)	89 (69.0)	129 (35.8)
group 2 wounds with a chance of infection	28 (46.7)	32 (53.3)	60 (16.7)
group 3 wounds with contaminants	67 (39.2)	104 (60.8)	171 (47.5)
total	135 (37.5)	225 (62.5)	360

[a]Antibiotics should be used for group 2 and group 3 wounds.

Table 4. Types of antibiotics and duration of treatment (n = 135)

antibiotic	number of patients (%)	duration of treatment (day)	
		mean (SD)	range
dicloxacillin			
- 500 mg qid	84 (62.2)	4.74 (1.1)	2-7
- 250 mg qid	2 (1.5)	5 (-)	
amoxicillin			
- 500 mg tid	28 (20.7)	5.61 (1.8)	3-10
- 250 mg tid	9 (6.7)	5.89 (1.5)	3-7
clindamycin 300 mg	10 (7.4)	5.7 (3.1)	3-10
roxithromycin 150 mg	1 (0.7)	5 (-)	-
ceftriaxone 2 g +clindamycin 600 mg	1 (0.7)	8 (-)	-
total	135 (100)	5.1 (1.6)	2-10

Table 5. Types of wounds and appropriateness of antibiotic use in accordance with antibiotic guidelines (n = 360)

wound type	n	appropriate use of antibiotic drug (%)				
		indication	drug	dosage regimen	duration	all
group 1 clean wounds	129	89 (69.0)	-	-	-	89 (69.0)
group 2 wounds with a chance of infection	60	28 (46.7)	28 (46.7)	28 (46.7)	1 (1.7)	1 (1.7)
group 3 wounds with contaminants	171	67 (39.2)	42 (24.6)	67 (39.2)	21 (12.3)	21 (12.3)
3.1 non-animal bite wounds	49	29 (59.2)	25 (51.0)	29 (59.2)	4 (8.2)	4 (8.2)
3.2 animal bite wounds	122	38 (31.1)	17 (13.9)	38 (31.1)	17 (13.9)	17 (13.9)
total (n = 360)	360	184 (51.1)	70 (19.4)	184 (51.1)	22 (6.1)	111 (30.8)

of wound infections are useful and recommended. There were 1 patient with group 2 wound and 21 patients with group 3 wound receiving appropriate antibiotic prophylaxis (appropriate rates of 1.7 and 12.3% respectively). The detail of inappropriate antibiotic treatments for patients with group 2 wounds and group 3 wounds were shown in Table 6.

Treatment outcomes

The treatment outcomes including wound healing and wound infection were evaluated on the 14th day after treatment initiation. Wounds were completely and partially healed in 348 patients (96.6%) and 6 patients (1.7%), respectively. For patients with fresh traumatic wound in group 1, 126 participants (97.7%) were cured meanwhile 3 participants (2.3%) had wound infections. For those with group 2 wound, complete cure was achieved in 55 patients (91.7%), wound improved in 3 patients (5%) but 2 patients (3.3%) had wound infection. Finally, those with group 3 wound, 167 patients (97.7%) were cured, 3 patients (1.8%) were improved but 1 patient (0.6%) had wound infection. The characteristics of patients with infected wound in each group were shown in Table 7.

Discussion and conclusions

The overall antibiotic prescribing rate in the present study was 37.5% and met the RDU indicator. The RDU hospital program recommended that antibiotic prophylaxis was unnecessary for clean wounds because the pathogenic bacterial contamination was low and wound infection was uncommon.(8) When comparing to a previous study in Mahasarakam Hospital, higher antibiotic prescribing rate of 65.5% in that study was related to a higher proportion (74.5%) of contaminated wounds.(7) Lower antibiotic prescribing

Table 6. Inappropriate use of antibiotics in accordance with antibiotic prophylactic guidelines in patients with indication (n = 249)

inappropriate use of drug	number of patients (% calculated using 249 as denominator)				
	group 1	group 2	group 3.1	group 3.2	total
unnecessary antibiotics prescribing	40 (16.1)	0	0	0	40 (16.1)
not receiving antibiotics	0	32 (12.9)	20 (8.0)	84 (33.7)	136 (54.6)
improper duration	0	27 (10.8)	25 (10.0)	17 (6.8)	69 (27.7)
improper antibiotics	0	0	0	4 (1.6)	4 (1.6)
total (n=249)	40 (16.1)	59 (23.7)	45 (18.1)	105 (42.1)	249

Table 7. Details of patients with infected wound (n = 6)

no	age/ comorbidities	group wound	type of wound	site of wound	treatment before hospital visit	antibiotic treatment
1	18/no	1	laceration	feet	no	dicloxacillin
2	35/no	1	penetrating	arm	antiseptic	dicloxacillin
3	72/no	3	burn	feet	no	no
4	64/no	1	laceration	feet	no	dicloxacillin
5	76/no	2	laceration	hand	antiseptic	dicloxacillin
6	81/hypertension	2	laceration	feet	no	dicloxacillin

rate in the present study may also be resulted from the policy of the Pharmacy and Therapeutic Committee (PTC) of Pueai Noi Hospital. The PTC set up the plan to monitor all indicators on antibiotic prescribing quarterly and provided feedback to the clinicians if any indicators tended to fall below the threshold. Therefore, the antibiotic prescribing in Pueai Noi Hospital achieved the targeted threshold of RUA, not only indicator for fresh traumatic wound but also those for respiratory tract infection, acute diarrhea and normal birth delivery in that year.(9)

Antibiotic prescribing for patients with group 1 wound, group 2 wound and group 3 wound were appropriate in 69.0%, 1.7% and 12.3% of patients, respectively (or 31.0%, 98.3% and 87.7% of inappropriate rate, respectively). A study in Mahasarakham Hospital reported that the rates of inappropriate antibiotic prophylaxis prescribing were 11.1%, 27.8% and 13.0%, respectively.(7) From another study in Siriraj Hospital, the rates of inappropriate antibiotic use according to the guideline were 82.6%, 1.7% and 15.7% in the participants with group 1, group 2, and group 3 wounds, respectively.(3) Inappropriate antibiotic prophylaxis may be resulted from unfamiliarity with guideline recommendation of among many clinicians. In addition, wound classification may be inaccurate such as group 2 or group 3 wound may be classified into group 1 wounds or some bite wounds may be classified as wound without contamination. In some cases, clinicians may be concerned about superinfection in group 1 with clean contaminated wounds and prescribe inappropriate antimicrobial prophylaxis for the patients.(3) Even though the antibiotic use indicator in the hospital met the RUA threshold (<40%), the overall rate of inappropriate use was still high (69.2%) which reflected the lack of RUA indicator for assessing the quality and appropriate use of medicine.

There were only 6 participants presented with wound infections (1.7%). The infection rate was 0-1.2% higher than that reported in previous studies in Thailand (2,3,7,10,11) and 1% higher than that from a study in U.S. (12) but within the range 1.1-12.0% from that reported in a meta-analysis. (6) The variation of wound infection rate might be due to the differences of wound characteristic or contamination among the studies. Differences in treatment algorithm, antibiotic prescribing and wound dressing of each hospital may also affect the rate of wound infection. Moreover, wound assessment and outcome monitoring may be different among clinicians.

There were limitations of this study. First, this study did not collect patients' wound cleaning data between day 1 and day 14, which may affect wound infection. Additionally, the appropriateness of antibiotic use was assessed by a single researcher, and the outcome of wound treatment was also assessed by a single clinician. it would be better if these 2 variables were evaluated by more than 1 experts to ensure reliability. Finally, future studies should be conducted in

multicenter settings composing of many community hospitals and a large number of participants with various patient characteristics to represent the wider population of patients

In conclusion, the overall antibiotic prescribing rate in the present study was 37.5% and met the RDU indicator (<40%). However, the overall rate of inappropriate use was still high (69.2%) and wound infection was low.

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