

## Original article

# Evaluation of rational antibiotic use in simple traumatic wounds (STWs) based on Thailand core indicators in database of university hospital

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## ABSTRACT

In Thailand, Ministry of Public Health (MoPH) enforces core rational drug use (RDU) indicators in hospital. Antibiotics for simple traumatic wounds (STWs) cases, one of rational antibiotic indicator for out-patient department (OPD), must less than 40% of all cases. This study aims to evaluate antibiotic use in STWs cases from database of the university hospital. OPD service data are gathered during January to November 2018. We include totally 13,566 medical records which stated ICD-10 code of STWs through phpMyAdmin program and an entity-relationship (E-R) diagram. Followed the manual, non-rational prescribing of oral and injection antibiotics (ATC-ID code: J01) are 2,549 times (18.8%). It somehow achieves target of MoPH's indicator. From literature review and expert's opinion, some types of STWs need antibiotics for treatment. When we exclude necessary cases, non-rational antibiotic use is only 11.4%. Beside quantitative data, we explore a list of prescribed antibiotics. A number of drugs is not in accordance with standard guidelines e.g. norfloxacin, ofloxacin, co-trimoxazole, clindamycin, moxifloxacin, and roxithromycin. Inadequate dose and duration of treatment are detected. Amoxicillin-clavulanic acid is the most frequently prescribed, which is not a drug of choice and high cost. Injection antibiotic, such as ertapenem, at OPD is not appropriate when oral formulations are available. Yearly cost of antibiotics for STWs is 274,275 Thai Baht, 21.00% of this cost is non-rational use. This study reflects wastage of scarce resources and leading to increased risk of antimicrobial resistance. Further study needs more information to improve irrational items, dose, range, and route of antibiotics.

## Keywords:

Rational drug use;  
Simple traumatic wound;  
Antibiotics; Antibiotic smart use

## 1. INTRODUCTION

World Health Organization (WHO) estimates that more than half of all drugs are irrationally prescribed, and more than half of the patients fail to adhere the prescribed regimens. Rational drug use (RDU) generally aims to promote appropriate prescribing medicines for diseases and health conditions together with cost-effective and community affordable<sup>1</sup>. In Thailand, Ministry of public health (MoPH) announces RDU manual to monitor core indicators for quantitative evaluation of rational drug use in hospital<sup>2</sup>. RDU manual does major purpose for assisting practitioners in rational clinical decision-making. In case of infectious diseases, routine approach of manual is often in conflict with the concept of personalized medicine and shared decision-making. Assessment qualitative of care through antibiotic use from hospital

database is somewhat additional interesting. We need to discover details of regimen, route of administration, duration of treatment, cost of drug therapy, preventable adverse drug reactions, drug interactions, and patient adherence to maximize therapeutic outcomes<sup>1,3</sup>.

In previous study, we conducted LibreOffice program and an entity-relationship (E-R) diagram as a tool for RDU evaluation. Results of upper respiratory infections (URIs) and acute diarrhea (AD) cases showed both quantitative of antibiotics use and interesting qualitative data of medication errors and drug related problems. The weak point of the tool was limited amount of input data<sup>4</sup>. Assessment RDU of simple traumatic wounds (STWs), another important core indicator, is waiting to explore by an improvement tool. Over 500 ICD-10 codes of STWs is stated in RDU manual. Antibiotic prescribed must less than 40% of all STWs cases at out-patient department (OPD)<sup>2</sup>. Nevertheless, too many literatures<sup>5-7</sup> and expert's opinion suggest that some types of STWs need antibiotics for treatment. Beside quantitative indicators followed RDU manual, this study decided to exclude ICD-10 codes of necessary cases.

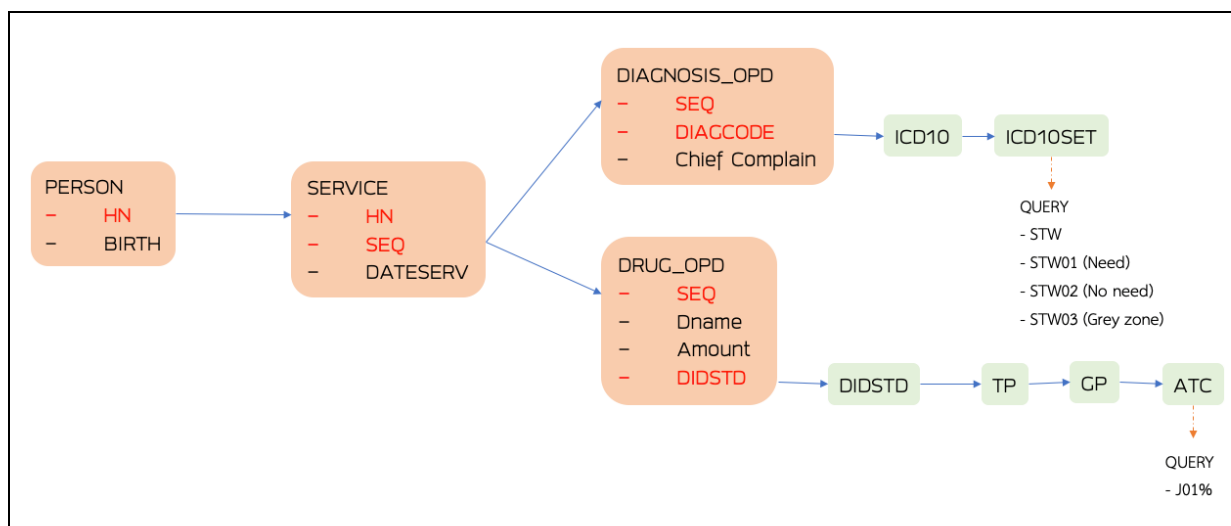
This study aims to encounters with percentage prescription of antibiotics and quality of care for STWs from the hospital's database. We use phpMyAdmin program and SQL (Structured Query Language) database which is an open-source software tool. Basically, phpMyAdmin is a tool to manage

and manipulating the tables and data inside the database. It mainly purposes to create, update, drop, alter, delete, import, and export data in hospital database without limit in amount of data. SQL database is a domain-specific language used in programming and design for managing data held in a relational database management system. We draw a specific entity-relationship (E-R) diagram that crosses boundaries and enables variables from hospital database to calculate an outcome more easily and gain more productive information.

## 2. MATERIALS AND METHODS

### 2.1. Data collection for STWs cases

We create a tool from phpMyAdmin program and SQL database. It uses to analyze RDU data from hospital's database. The study code D-PHA-2561-05365 is exempt for ethic allowance from the ethical review committee for human research, Faculty of medicine, Chiangmai University on January 17<sup>th</sup>, 2019. All prescription records are collected during January to November 2018. Inclusion criteria were patient who (1) diagnosed for ICD-10 of STWs and (2) prescribed systematic antibiotics (ATC-ID code J01). All ICD-10 of STWs are regulated in "Rational drug use manual for rational drug use in health promotion hospital"<sup>2</sup>. We excluded patient who referred and prescribed antibiotics from other hospitals.



**Figure 1.** An entity-relationship (E-R) diagram that crosses boundaries and enables variables form hospital database to calculate an outcome more easily. *HN* = Hospital Number, *BIRTH* = Birthday, *SEQ* = Sequence Number, *DATESERV* = Date Service, *DIAGCODE* = Diagnosis Code, *Dname* = Drug Name, *DIDSTD* = Drug Identification Standard, *ICD10* = International Classification of Diseases 10th Revision, *STWs* = Simple Traumatic Wounds, *TP* = Trade Product, *GP* = Generic Product, *ATC* = Anatomical Therapeutic Chemical code, *J01%* = ATC code J01, Antibacterial for Systemic Use in Subgroup of the Anatomical Therapeutic Chemical Classification System

## 2.2. Mapping drug code from hospital database to standard research variables

Thai FDA determines outcome of RDU from ICD-10 for diagnosis and ATC-ID for drug code<sup>2</sup>. But the university hospital database uses DIDSTD (Drug Identification Standard) for local drug code. Consequence, this study does an entity relationship (E-R) diagram as shown in Figure 1. This relationship of entity sets crossing boundaries and enables variables from hospital database to calculate an outcome more easily. We map all codes of systemic antibiotics both orally and injection from DIDSTD code in hospital database to ATC code. Each ATC-ID code is paired to DIDSTD code in hospital database through TPID and GPID. The mapping feature enables to replace requested ATCID from National policy to specific drug for analysis in hospital database (Figure 2). ATC-ID codes, in this study, covered J01GB06, J01CR02, J01CA04, J01CR01,

J01CA01, J01CR51, J01FA10, J01CE08, J01CE01, J01DH05, J01DC04, J01DB01, J01DC03, J01DB04, J01DD15, J01DD16, J01DE01, J01DD08, J01DC12, J01DD62, J01DD12, J01DD01, J01DC01, J01DE02, J01DD02, J01DD14, J01DD04, J01DC02, J01BA01, J01AA03, J01DH51, J01MA02, J01FA09, J01FF01, J01CF02, J01XB01, J01XX09, J01CF01, J01DH04, J01AA02, J01DH03, J01FA01, J01RA02, J01XX01, J01XC01, J01MA16, J01GB03, J01GB04, J01MA12, J01AA56, J01FF02, J01XX08, J01AA04, J01DH02, J01XD01, J01AA08, J01MA14, J01GB07, J01XE01, J01MA06, J01MA01, J01AA06, J01CR50, J01EB20, J01CE02, J01MB04, J01CR05, J01CA12, J01CA02, J01MA17, J01FA06, J01MA10, J01MA21, J01XC01, J01FA02, J01GA01, J01CG01, J01EC02, J01EE02, J01EE01, J01CR04, J01XA02, J01FA15, J01AA07, J01BA02, J01AA12, J01EA01, J01XA01.

DIDSTD	TPID	GPID	ATCID
100702000003750120381169	163239	210120	M01AB05
100702000003750120381202	163343	210120	M01AB05
100702000003750121781257	163447	210120	M01AB05
100702000003850121781169	164246	210183	M01AB05
100702000003850120381202	164267	210183	M01AB05
124813000003620120381506	154988	210448	C08CA01
124813000003620120381202	155020	210448	C08CA01
124813000003620120381421	155065	210448	C08CA01
124813000003620120381247	155077	210448	C08CA01
124813000003620120381176	155083	210448	C08CA01
124813000003620120381079	155096	210448	C08CA01
124813000003400121781401	155123	210453	C08CA01
124813000003521121781401	155134	210469	C08CA01
124813000003521120381202	155168	210476	C08CA01
124813000003521120381421	155201	210476	C08CA01
124813000003521120381179	155217	210476	C08CA01

**Figure 2.** Example relation of mapping drug code. ATCID code was paired to DIDSTD code in hospital database through TPID and GPID. The mapping feature enables to replace requested ATCID from National policy to specific drug for analysis in hospital database. *DIDSTD* = drug identification standard, *TPID* = Trade product identification, *GPID* = Generic product identification, *ATCID* = Anatomical Therapeutic Chemical code identification

## 2.3. Descriptive analysis of rational antibiotic use for STWs

ICD-10 codes of STWs are S-00S01, S05, S-07S11, S-16S21, S-28S31, S-38S41, S-46 S51, S-56S61, S-66S71, S-76S81, S-86S91, S-96 S99, T-00T01, T-04T07, T-0.09T1.09, T-0.11 T1.11, T-0.13T1.13, T-0.14T1.14, T-6.14T9.14, T-20T25, T-29T32, W-50W64, X-00X19, X-20

X29, X-30X39. Infection risk assessment based on type and location of wound. Then, we classify the ICD-10 codes into 3 groups.

### 2.3.1. ICD-10 codes of STWs which need antibiotic

Antibiotics is likely to be used when the wound was more than 8 hours old, involved a puncture, or involved a skin or subcutaneous fat amputation in emergency departments. Traumatic

wound from a dog bite also deserves on a case-by-case basis for oral antibiotics, especially in high risk bite wounds (such as extremity wounds)<sup>6</sup>. In accordance with expert's opinion, antibiotics do necessity for open wound at genital area, amputation, crushing wound, bite wounds from mammals<sup>3,7</sup>. In summary, this group of ICD-10 codes take account of S4.05, S5.05, S6.05, S7.05, S0.07, S1.07, S8.07, S9.07, S0.08, S1.08, S8.08, S9.08, S1.09, S2.09, S0.16, S0.17, S8.17, S9.17, S0.28, S1.28, S0.29, S2.31, S3.31, S4.31, S5.31, S0.38, S1.38, S2.38, S3.38, S0.39, S0.46, S1.46, S2.46, S3.46, S7.46, S8.46, S9.46, S0.48, S1.48, S9.48, S7.49, S8.49, S9.49, S0.56, S1.56, S2.56, S3.56, S4.56, S5.56, S7.56, S8.56, S0.57, S8.57, S9.57, S0.58, S1.58, S9.58, S7.59, S8.59, S9.59, S0.66, S1.66, S2.66, S3.66, S4.66, S5.66, S6.66, S7.66, S8.66, S9.66, S0.67, S8.67, S0.68, S1.68, S2.68, S3.68, S4.68, S8.68, S9.68, S7.69, S8.69, S9.69, S0.76, S1.76, S2.76, S3.76, S4.76, S7.76, S0.77, S1.77, S2.77, S0.78, S1.78, S9.78, S7.79, S8.79, S9.79, S1.86, S2.86, S3.86, S7.86, S8.86, S9.86, S0.87, S8.87, S0.88, S1.88, S9.88, S7.89, S8.89, S9.89, S0.96, S1.96, S2.96, S7.96, S8.96, S9.96, S0.97, S1.97, S8.97, S0.98, S1.98, S2.98, S3.98, S4.98, S7.99, S8.99, S9.99, T0.04, T1.04, T2.04, T3.04, T4.04, T7.04, T8.04, T9.04, T0.05, T1.05, T2.05, T3.05, T4.05, T5.05, T6.05, T8.05, T9.05, T4.06, T5.06, T7.14, T6.14, W0.50, W0.53, W0.54, W0.55, W0.58, W0.59.

### 2.3.2. ICD-10 codes of STWs which unnecessary antibiotics

There is no evidence to support antibiotic prophylaxis for superficial injury, bite wound from non-mammal animals, burn, simple laceration, and corrosions<sup>5,8</sup>. Then, this group of ICD-10 codes consist of S0.00, S1.00, S2.00, S3.00, S4.00, S5.00, S7.00, S8.00, S9.00, S1.05, S0.10, S7.10, S8.10, S9.10, S0.20, S1.20, S2.20, S3.20, S4.20, S7.20, S8.20, S0.30, S1.30, S2.30, S7.30, S8.30, S9.30, S0.40, S7.40, S8.40, S9.40, S0.50, S1.50, S7.50, S8.50, S9.50, S0.60, S1.60, S2.60, S7.60, S8.60, S9.60, S0.70, S1.70, S7.70, S8.70, S9.70, S0.80, S1.80, S7.80, S8.80, S9.80, S0.86, S0.90, S1.90, S2.90, S3.90, S7.90, S8.90, S9.90, T0.00, T1.00, T2.00, T3.00, T6.00, T8.00, T9.00, T0.09, T0.11, T0.13, T0.14, T0.20, T1.20, T2.20, T3.20, T4.20, T5.20, T6.20, T7.20, T0.21, T1.21, T2.21, T3.21, T4.21, T5.21, T6.21, T7.21, T0.22, T1.22, T2.22, T3.22, T4.22, T5.22, T6.22, T7.22, T0.23, T1.23, T2.23, T3.23, T4.23, T5.23, T6.23, T7.23, T0.24, T1.24, T2.24, T3.24, T4.24, T5.24, T6.24, T7.24, T0.25, T1.25, T2.25, T3.25, T4.25, T5.25, T6.25, T7.25, T0.29, T1.29, T2.29,

T3.29, T4.29, T5.29, T6.29, T7.29, T0.30, T1.30, T2.30, T3.30, T4.30, T5.30, T6.30, T7.30, T0.31, T1.31, T2.31, T3.31, T4.31, T5.31, T6.31, T7.31, T8.31, T9.31, T0.32, T1.32, T2.32, T3.32, T4.32, T5.32, T6.32, T7.32, T8.32, T9.32, W0.52, W0.57, W0.60, W0.64, X0.20, X0.21, X0.22, X0.23, X0.24, X0.25, X0.26, X0.27, X0.28, X0.29.

### 2.3.3. ICD-10 codes of STWs which indistinguishable decision to propose antibiotics

Routine use of prophylactic systemic antibiotics is likely unnecessary and should be considered on a case by case basis. This group is a set of ICD-10 codes of open wound at leg, arm, head, and body. Any traumatic injury of the hand should be considered for a possible tendon injury, especially if located on the volar or dorsal side.<sup>7</sup> The included ICD-10 codes are S0.01, S1.01, S2.01, S3.01, S4.01, S5.01, S7.01, S8.01, S9.01, S0.05, S2.05, S3.05, S8.05, S9.05, S0.09, S7.09, S8.09, S9.09, S1.10, S0.11, S1.11, S2.11, S7.11, S8.11, S9.11, S7.19, S8.19, S9.19, S0.21, S1.21, S2.21, S7.21, S8.21, S9.21, S7.29, S8.29, S9.29, S0.31, S1.31, S7.31, S8.31, S6.39, S7.39, S8.39, S9.39, S0.41, S1.41, S7.41, S8.41, S0.51, S7.51, S8.51, S9.51, S0.61, S1.61, S7.61, S8.61, S9.61, S0.71, S1.71, S7.71, S8.71, S0.81, S7.81, S8.81, S9.81, S0.91, S1.91, S2.91, S3.91, S7.91, T0.01, T1.01, T2.01, T3.01, T6.01, T8.01, T9.01, T0.06, T1.06, T2.06, T3.06, T8.06, T1.09, T1.11, T1.13, T1.14, T8.14, T9.14. We include elderly (>65 years old)<sup>7</sup> and immunocompromised population in this high-risk group as well. This group is a set of ICD-10 codes of patients with HIV/AIDS, chemotherapy recipients, organ transplant recipients, vascular diseases and diabetics<sup>6,7</sup>.

## 3. RESULTS AND DISCUSSION

This study aims to evaluate quantitative of rational of antibiotic use and qualitative of care for STWs in a university hospital. Results show 13,543 records of STWs. Patients are equally both genders. An average age is 27 years old, about 10% of patients are over 65 years old. The most two diagnoses are S610: Open wound of finger (s) without damage to nail and W550: Bitten or struck by other mammals at home. On-third of common concomitant disease is E119 (type 2 diabetes mellitus at without complications).

Siriraj hospital, a large university hospital, has been implementing a clinical practice guideline (CPG) for STWs. Class 1 is clean-contaminated wound, normally do not need

antibiotic prophylaxis because the infection rate is only 5% or less. It covers smooth border of wound edge, easy to clean, not human or animal bite wound, no exposure of muscle, bone, or tendon, no necrotic tissue, no contamination with feces, urine, saliva, dirt, dirty water, or food<sup>5</sup>. Administration of oral antibiotic at triage also failed to reduce the meaningful reductions in infection rates. The best way to prevent wound infection is thorough wound cleansing and appropriate closure technique<sup>7</sup>. Class 2 wounds

and contaminated wounds should receive antibiotics<sup>5,7</sup>. Because this way of classification requires record of chief complaint and physical examination, this research is not able to calculate the percentage of antibiotic use as recommend in RDU manual. We lastly classified ICD-10 codes of STWs into 3 groups; based on details in CPG, available evidence, and expert's opinion. They are group of ICD-10 codes of STWs which need antibiotic, unnecessary antibiotics, and uncertainly need antibiotics.

**Table 1.** Antibiotics use for STWs from hospital database.

Conditions	Number of prescription (time)
<b>Analysis followed National criteria</b>	
All STWs cases	13,566
All STWs cases who prescribed antibiotics	2,549
<b>Analysis followed Research criteria</b>	
STWs who was necessary cases for antibiotics	2,088
STWs who was necessary cases for antibiotics and had been prescribed antibiotics	188
STWs who was unnecessary cases for antibiotics	5,805
STWs who was unnecessary cases for antibiotics and had been prescribed antibiotics	662
STWs who was uncertainly cases for antibiotics	5,673
STWs who was uncertainly cases for antibiotics and had been prescribed antibiotics	1,699

STWs = Simple Traumatic Wounds

RDU manual determines that STWs cases must prescribed antibiotics less than 40% of all cases. In the quantitative evaluation, non-rational prescribing in this study is 18.79 % (Table 1). If we exclude necessary cases following expert's opinion, overtreatment with antibiotics in this hospital is only 11.40%. It is acceptable compared with the national target and relatively better than other developing countries<sup>3</sup>.

Antibiotics were used in a lot of ED patients with uncomplicated lacerations despite a lack of evidence for efficacy<sup>9</sup>. This is still leading to increased risk of antimicrobial resistance. Surprisingly, 90.99% of necessity cases are under treatment with antibiotics. This is leading to potential increased morbidity and mortality. We suggest finding balancing act between under treatment and overtreatment hereafter.

**Table 2.** Uncertain conditions of antibiotics use for STWs in unnecessary cases.

Conditions	Number of prescription (time)
<b>Over 65 years old</b>	
STWs cases who over 65 years old	912
STWs cases who over 65 years old and prescribed antibiotics	178
<b>Concomitant diseases*</b>	
STWs cases who has concomitant diseases	334
STWs cases who has concomitant diseases and prescribed antibiotics	80

STWs = Simple Traumatic Wound

\*Immunocompromised case, Diabetes Mellitus, Cirrhosis, Cancers, HIV

We mention that a number of STWs cases were defined unnecessary for antibiotics. Somehow, we might prescribe antibiotics for uncertain conditions. This study presents only 19.52% of elderly and 23.95% of concomitant diseases were prescribed antibiotics (Table 2). It seems leading to deliver under treatment for the risk group. In term of quality of route of

administration, this study shows prescription of an antibiotic injection at OPD. In a prescription pattern, ertapenem and meropenem are not appropriate when oral formulations are available. This prescribing practices for antibiotic injection show deviation from the standard recommended by WHO<sup>10,11</sup>. This finding suggests that antibiotic injection prescribing needs to be regulated. Lastly, we are

able to explore duration of treatment from quantity of dispensing and the define daily dose (DDD). DDD is an average maintenance dose per

day for a drug used for its main indication in adults. Constraint of this estimation is absence of exact regimen in the hospital's database.

**Table 3.** Number of prescription and medication cost of antibiotics for STWs in all cases.

List	Medication cost (Thai baht)	Number of prescription (time)	Medication cost (Thai baht)
1	Amoxicillin-Clavulanic acid	2,160	181,234
2	Cephalexin	204	13,298
3	Clindamycin	42	3,224
4	Ciprofloxacin	79	1,397
5	Cefixime	3	804
6	Ceftriaxone	13	755
7	Meropenem	1	295
8	Doxycycline	25	269
9	Amoxicillin	5	181
10	Norfloxacin	5	96
11	Cloxacillin	5	84
12	Ofloxacin	4	64
13	Clarithromycin	2	22
14	Co-trimoxazole	1	6
		2,549	201,729

STWs = Simple Traumatic Wound

Assessment qualitative of care from treatment regimen is somewhat interesting. Despite amoxycillin is a drug of choice for essential cases, it is prescribed only 0.2% of all medication.

Amoxycillin and clavulanic acid is the frequently prescribed as same as previous study, even though bacterial contaminations of infected patients are usually non-fermentative gram-negative rods, *E. cloacae*, and mixed organisms<sup>12</sup> (Table 3). Meanwhile direct costs of antibiotics in Thailand is burden expenditure<sup>13</sup>, this study investigates cost of antibiotics for STWs either. Source of the drugs' price use for cost calculation is retrieved from drugs' cost in the university hospital. In the period 11 months, total antibiotics cost was 5,699,165 Thai baht. Antibiotic cost for STWs takes account for 3.53%. Based on RDU manual, non-rational use of antibiotics

for STWs is 25.48% of all cases, it costs 57,604 baht yearly. Antibiotics cost for unnecessary STWs cases is double than cost of antibiotics in essential cases (Table 4). As determine conditions in this research, antibiotic cost for STWs in unnecessary cases is 51,409 Thai baht yearly (Table 5). If the hospital strictly controls an antibiotic stewardship and CPG, cost of antibiotics for STWs will reduce.

Limitation of this study is mapping of local drug codes in hospital database (DIDSTD code) and ATC-ID code through E-R diagram in Figure 1. Incomplete relation that crosses boundaries of enable DIDSTD, GP (generic product), TP (trade product), and ATC-ID, is failing to determine the outcome. For example, there is no DIDSTD code of dicloxacillin, we cannot catch ATC-ID. Then we are unable to calculate percentage of antibiotic use based on recommendation in RDU

**Table 4.** Medication cost of antibiotics for STWs.

Conditions	Medication cost (Thai baht)	Percentage (%) of use (compare with all antibiotics use for STWs)	Percentage (%) of use (compare with all antibiotics use in hospital database)
All antibiotics use in hospital database	5,699,165	-	100.00
Antibiotics use for STWs	201,729	100.00	3.53
Antibiotics use for STWs in necessary cases	17,261	8.56	0.30
Antibiotics use for STWs in unnecessary cases	51,409	25.48	0.90
Antibiotics use for STWs in uncertain cases	133,059	65.96	2.33

STWs = Simple Traumatic Wounds



**Table 5.** Number of prescription and medication cost of antibiotics for STWs in unnecessary cases.

List	Medication cost (Thai baht)	Number of prescription (time)	Medication cost (Thai baht)
1	Amoxicillin-clavulanic acid	563	45,760
2	Cephalexin	49	3,446
3	Clindamycin	12	979
4	Cefixime	1	440
5	Ciprofloxacin	12	227
6	Ceftriaxone	4	216
7	Doxycycline	9	107
8	Amoxicillin	2	78
9	Norfloxacin	4	72
10	Cloxacillin	2	28
11	Ofloxacin	1	28
12	Clarithromycin	2	22
13	Co-trimoxazole	1	6
		662	51,409

STWs = Simple Traumatic Wound

manual. We approximately lose 30% of data in this study.

#### 4. CONCLUSIONS

On the basis of the finding of this study, only 18.8% STWs in ambulatory patients was prescribed antibiotics and it costs 57,604 baht yearly. Follow RDU manual, this result encounters with less than 40% of antibiotic use in all STWs cases. Follow research criteria, overtreatment STWs with antibiotics in this hospital is only 11.40%. Many STWs cases who are necessity for antibiotics are under treatment. It is leading to potential increased morbidity and mortality. The finding suggests balancing act between under treatment and overtreatment. In term of quality of care, the common drug of choice is amoxicillin and clavulanic acid. It is not adhering with the standard CPG which recommends amoxicillin. Injection of antibiotic at OPD is also improper when oral administration is available. Yearly cost of antibiotics for STWs take account for 3.53% of all infection diseases. A number of STW cases are under investigation for antibiotics which lead to potential increased morbidity and mortality. In summary, the university hospital has a special responsibility to society to promote rational prescribing by their staffs and, through them, the future generations of doctors. The first concrete recommendations to improve use of medicines is a set of simple indicators for measuring the quality of drug use at the hospital. Drug use evaluation should be done for some of the antibiotics to check whether they were appropriately prescribed or not.

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#### Conflict of interest

None to declare.

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#### Ethics approval

The study code D-PHA-2561-05365 is exempt for ethic allowance from the ethical review committee for human research, Faculty of medicine, Chiangmai University on January 17, 2019.

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