Assessment of Community Pharmacists' Knowledge, Attitude and Practice Regarding Non-Prescription Antimicrobial Use and Resistance in Thailand

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ABSTRACT

Background:

An estimated two-thirds of global sales of antimicrobials occur over the counter without a prescription. Furthermore, antimicrobials are the most commonly sold medicines in developing countries. The overuse, misuse, or inappropriate use of antimicrobials are major contributing factors to the emergence of antimicrobial resistance. This does not only lead to failure of therapy, increased morbidity and mortality, and rise in healthcare costs, but it puts these countries on a fast track to the pre-antibiotic era.

Thailand is experiencing soaring antimicrobial resistance. A few studies suggest that inadequate knowledge, incorrect attitudes and malpractices of healthcare professionals and patients regarding the use of antimicrobials and reducing the emergence of antimicrobial resistance may be fuelling this crisis. Pharmacists in particular, may have a key role in rationalising the use of antimicrobials in community and reducing the emergence of resistance.

Aim

This study aims to assess pharmacists' knowledge, attitudes and practices regarding antimicrobials use over the counter and antimicrobial resistance.

Methods

A cross-sectional descriptive study was conducted using online self-administered questionnaire for pharmacists in Bangkok and Chonburi province in Thailand between May and July 2017. The self-administered questionnaire was developed following a review the literature relating to pharmacists and healthcare professionals using the Knowledge, Attitude and Practices (KAP) model regarding antimicrobial use and resistance. The questionnaire was validated by an expert panel and its validity and reliability was tested in a pilot study. Statistic Package for the Social Science (SPSS) software version 24 was used for statistical analysis. The Cronbach's alpha and Interclass correlation coefficients (ICC) were used to test of reliability. Kolmogorov-Smirnov Test was used for normal distribution testing. Descriptive data were examined by the median, interquartile range (IQR), Chi-squared test. Mann-Whitney U Test and Kruskal-Wallis test were used to describe associations between demographics with knowledge, attitude and practice of participants. Relationships between knowledge, attitude and practice dimensions were analysed by regression equations and Spearman's correlation coefficient statistic. Qualitative data were coded and presented as percentages.

Results

372 pharmacists completed the questionnaire obtaining a response rate of 71.4%. The community pharmacists age average was 32.02 (± 5.81) years. Most participants hold a bachelor degree in pharmacy (77.2%), and work at individual/ independent drug stores (62.6%). The average experience in community pharmacy is 5.46 (± 4.31) years. 69.4% of the participants work in Bangkok and 30.6% work in Chonburi. More than 90% of pharmacists have good knowledge, attitude and practice in antimicrobial use and resistance. However, there is only a slight correlation between attitude and practice score at rho = 0.149, p-value 0.004. The most commonly encountered infections are respiratory infections and Aminopenicillin is the main drug provided in pharmacies. The main reported reason of pharmacists to provide antimicrobials without a prescription was their confidence in their competency.

Conclusion

Respiratory infections were the most commonly encountered infections in community in Thailand, with Aminopenicillin being the most commonly dispensed antibiotic. Community pharmacists in Thailand report competence as the main reason for them providing antimicrobials without a prescription. This study shows that over 90% of them have good knowledge, attitude, and practice regarding antimicrobial use and resistance. Pharmacists in Thailand could sustain their competence through continuing education, adherence to antimicrobials guidelines, collaboration with other healthcare providers, and raising public awareness regarding antimicrobial use and resistance. Pharmacy associations could support pharmacists to improve pharmacy services through research, training, campaigning, professional standards and guidelines, and increasing inter-professional collaboration in fighting antimicrobial resistance. Further, government and policy makers could enhance pharmacists' role in ensuring the appropriate use of antimicrobial and combatting antimicrobial resistance through the provision of national databases and surveillance programmes, research funding and healthcare regulations.

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CHAPTER 1
INTRODUCTION

Antimicrobial resistance is becoming an imminent public health threat, fuelled by the increased consumption of antimicrobials worldwide, and the lack of development of new agents (WHO, 2016). Combatting antimicrobial resistance is now a main priority and is being promoted by healthcare professionals in all sectors including pharmacists. However, there is limited research on antimicrobial stewardship within community pharmacy in developing countries such as Thailand; especially that antibiotics can legally be obtained or dispended without a prescription.

This chapter will first explain the problem and mechanisms of antimicrobial resistance, followed by a discussion of the various initiatives to combat resistance, including antimicrobial stewardship programmes. The chapter will then explain the rationale of this research and the thesis organisation.

Principle of antimicrobial resistance

The World Health Organisation (WHO) defines antimicrobial resistance as a biological phenomenon that develops when microorganisms (bacteria, fungal, virus or parasites) change when they are exposed to antimicrobials. This change renders the microorganism resistant and can survive the previous lethal antimicrobial. (WHO, 2015a; WHO, 2016).

Antimicrobial resistance is a natural process and has existed for thousands of years (Hwang & Gums, 2016). It can be divided into two types: Intrinsic resistance and acquired resistance.

Intrinsic resistance occurs when the drug cannot affect the microorganism because of the drug's structure. Acquired resistance occurs when the microorganism acquires processes to decrease the effectiveness of drugs (Byarugaba, 2010).

The emergence of antimicrobial resistance within microorganism can be explained by natural selection theory (Holmes et al., 2016). It is divided into four types 1) Inactivation of drugs via hydrolysis. 2) Alteration of drug targets within cells thus making them unrecognisable to the drug. 3) Bypassing the drug target by changing permeability, preventing access of medication to the target, and 4) Increasing the export of the drug out of cells such as increasing efflux pumps (Penesyan et.al, 2015; Holmes et al., 2016).

The mutation genes encoded in chromosomes can transfer to other microorganisms and hence transfer resistance. There are three mechanisms of transmission between microbes; Transformation, Transduction and Conjugation (Holmes et al., 2016; Hwang & Gums, 2016). *(See figure 1 for an illustration of the transfer of resistance)*

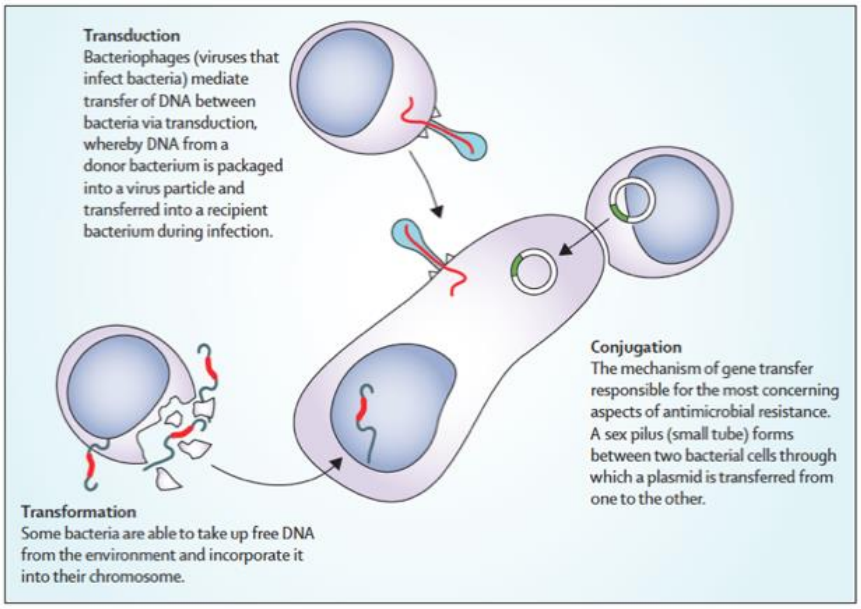


Figure 1: Transmission mechanism of bacteria resistance DNA (Holmes et al., 2016)

Causes of antimicrobial resistance

Antimicrobial resistance occurs as a result of various factors including: lack of effective antimicrobials to treat infectious diseases, inappropriate use of antimicrobials in humans and animals, and improper infections control. These causes are explained in the following paragraphs.

Antimicrobials innovation and development

Antimicrobial resistance continues to emerge while new class of antibiotics has not been developed since 1987 (Theuretzbacher, 2015). Only seven new antibiotic agents were launched between 2012 and 2016; most of them are gram-positive antibiotics (U.S.FDA, 2016). This highlights the difficulty to treat resistant gram-negative bacteria which is often implicated in severe and resistant infections (Marston et al., 2016). It is noteworthy that the last-resort antimicrobials are more expensive and could not be afforded in developing countries (Laxminarayan et al., 2015). This highlights the gap between the urgency to develop new antibiotics and the lack of this development.

New antimicrobials development has been hindered by limited economic funding and stringent regulations (Ventora, 2015). Research funding from government and academic areas has been dramatically reduced following the economic crisis. In some pharmaceutical companies, research and development teams were reduced. Further, pharma has an inherent lack of interest in developing medicines for short/ minor illness if contrasted with highly ludicrous management of long-term conditions (Ventora, 2015; Marston et al 2016). Secondly, regulatory processes are an important factor for development; clinical trial studies and ethics require a high cost investment (Ventora, 2015). In February 2017, the WHO published the list of urgently need new antibacterial agents. The list aims to guide and promote research and development of new antimicrobials. The list, broken down into 3 groups includes: critical, high and medium priority (WHO, 2017). Gram-negative bacteria were highlighted because of multi-resistance to antibiotics.

Collaboration between public and private sectors has proven to be useful for antimicrobials development such as the Innovative Medicines Initiative (IMI) between European Commission and pharmaceutical companies or the Generating Antibiotic Incentive Now (GAIN) in the US which launched new five antibiotics drugs since 2014 (Theuretzbacher, 2015).

Antimicrobials use in animal and food industry

Antimicrobial use in agriculture is a major cause of resistance development. It is estimated that there is around 80 % of antibiotic use in agriculture. Antimicrobials are used in farm animals for growth-promotion (Laxminarayan et al., 2015; Hwang & Gums, 2016). The research of Van Boeckel and colleagues in 2015 demonstrate that 63,200 tons of antibiotics were used in livestock in 2010. The top five largest consumers of antibiotics in agriculture in 2010 are China (23%), the US (13%), Brazil (9%) India (3%) and Germany (3%). Moreover, the rate of antibiotic use in food animal products may rise to 105,600 tons in 2030. The top five countries which are predicted to have an increasing rate by 2030 are Myanmar (205%), Indonesia (202%), Nigeria (163%), Peru (160%) and Vietnam (157%).

In Thailand, the database of this research of Centre for Disease Dynamics, Economic and Policy (CDDEP) shows that antibiotic use in animals was 82.4 mg per population correction unit (PCU) in 2010 and might increase to 24.8mg per PCU in 2030. *(See Figure 2 for a comparison)* The rate of consumption depends on the policy of each country. Restricting antibiotic use in food and animal industry can certainly lead to reduce consumption rate in the future (Van Boeckel et.al, 2015; CDDEP, 2016).

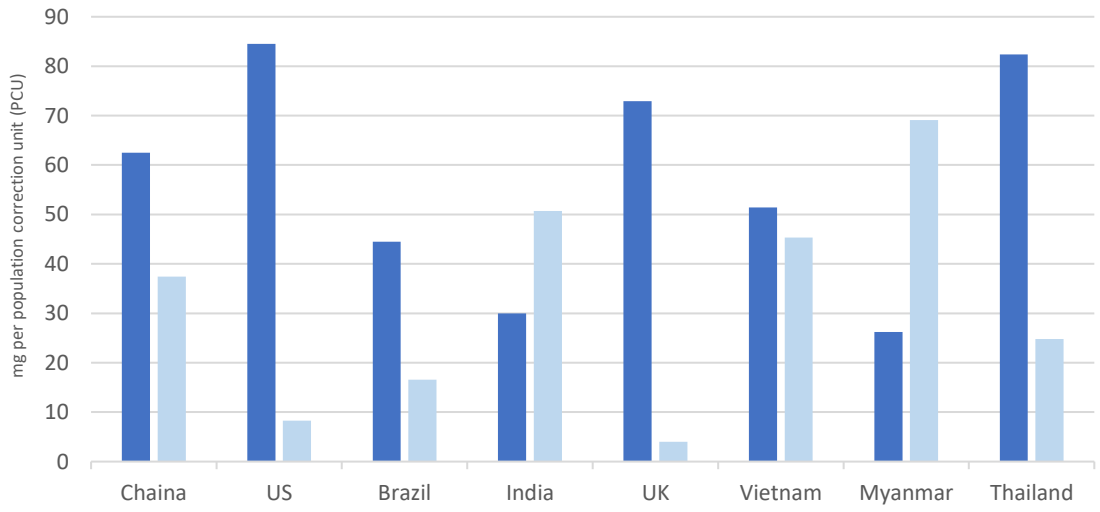


Figure 2: Comparisons of antibiotic use in animal between 2010 and 2030 (CDDEP, 2016).

Antibiotic use in animals might have a positive correlation with resistance rate (Laxminarayan et al., 2015). Bacterial resistant strains such as extended spectrum β-lactamase (ESBL) have been found in poultry. Prevalence of extended spectrum β-lactamase (ESBL)-coding gene was detected in around 80% of chicken meat tested in the multi-centre study. The same strains were detected in human rectal and blood samples from hospitals within the same areas of the chicken meat. (Overdevest et al., 2011). Resistant bacteria (as New Delhi metallo-β-lactamase

(NDM-1) genes) have been found in cattle. Also, aquaculture animals, horses, donkey and mules have been found to contain resistant bacterial (CDDEP, 2015). A research of ESBL producing *E. coli* prevalence indicates that the bacterial were prevalent in food product chain. There were highly positive *E. coli* tests around 77.3% of farm workers and 75.5% of food industry workers. Also, *E. coli* was found in livestock, commonly in pigs (76.7%) and broilers (40%). Moreover, the ESBL producing *E. coli* could be detected in fresh meat and vegetables in markets and environments particularly nearby animal farms (Boonyasiri et.al, 2014). This research highlights the ease of transfer of antibiotic resistant bacteria form animals, food products and the environment to humans.

Legislation for the appropriate use of antimicrobials in agriculture can reduce the problem of antimicrobial resistance. Sweden has banned inappropriate antimicrobial use in animals since 1986, followed by Denmark in 1994. The European Union has regulated antibiotic use in animals since 2006. This regulation has led to reduction in antibiotics consumption and a decrease is resistance in the region (Laxminarayan et al., 2015; CDDEP, 2015). To prevent and control antibiotic use in this sector, their use must be under veterinary supervision. Antibiotics should not be used for growth promotion and disease prevention in this sector. Also, good practice in hygiene and animal health in farming should be promoted (WHO, 2016).

Inappropriate consumption of antimicrobials in healthcare

Global antibiotic use in humans has seen a 36% increase between 2000 and 2010 (Van Boeckel et.al, 2014). Antibiotics are used in healthcare-settings between 20% and 80% in primary care with or without prescription worldwide (Kotwani & Holloway, 2011). Half of antibiotic provision in community is inappropriate and leads to antibiotic resistance (CDDEP, 2015).

Inappropriate provision of antimicrobials fuels overconsumption. Antibiotics consumption rate between 2000 and 2010 rose by 36% globally (Van Boeckel et.al, 2014). The research shows that inappropriate treatment of acute diarrhoea and febrile illness in children increased cephalosporin and fluoroquinolone consumption particular in Bangladesh, Thailand, China and India. India had the highest consumption rate in 2010 by 10.7 units per person, followed by China which consumed 7.5 units per person. In 2010, the top 3 mostly used antibiotics were board spectrum penicillin, cephalosporin and macrolides. However, carbapenems, polymyxin, glycopeptide and monobactam were increasingly being consumed in many countries. Cephalosporin and fluoroquinolone were highly being used in middle-income countries, India and China than others (Van Boeckal et al., 2014).

Furthermore, inappropriate prescribing and dispensing can lead to misuse and overuse of antimicrobials. For example, in the US, an antibiotic was prescribed in 221 prescriptions per 1000 population for acute respiratory infection but only half of these prescriptions were appropriate treatment (Fleming-Duta et al., 2016).

In England, antibiotic consumption has increased from 21.6 to 23.0 defined daily doses (DDD) per 1000 inhabitants per day between 2011 and 2014. The most commonly prescribed antibiotic is Co-Amoxiclav; 13.8% of it for treatment and 20.60% for surgical prophylaxis (Public and International Health, 2016).

The CDDEP database shows that Thai people used 19,696 standard units per thousand population in 2007.This has decreased to 17,699 standard units per thousand population in 2014. The top three antibiotics used were penicillins included board and narrow spectrums, fluoroquinolones and cephalosporin (CDDEP, 2016). *(See Figure 3 for a comparison of consumption rates)*

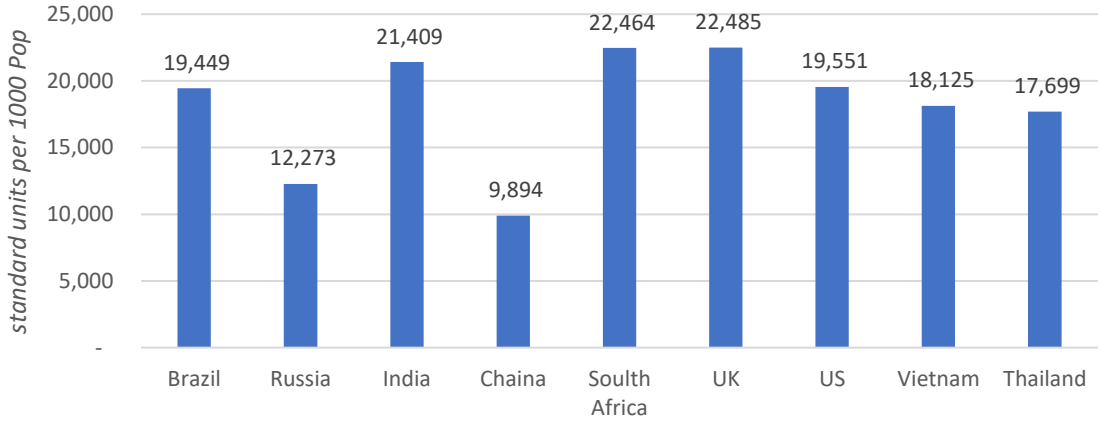


Figure 3: Comparisons of antibiotic use in 2014 (CDDEP, 2016 based on Van Boeckal et al., 2014).

Infections prevention and control

Infections prevention and control (ICP) practices can contribute to the development of resistance. Resistant microorganisms develop because of poor infection control, hygiene and sanitisation (WHO, 2016; O'neill, 2016). O'Neill (2016) highlights that poor infection prevention and control can increase incidence of infections and lead to increased antimicrobial use and resistance. It can also lead to increased morbidity, mortality and reduced quality of life.

Poor sanitisation can lead to infectious diseases. O'Neill (2016) describes that around 60% of diarrhoea illnesses are a result of poor sanitisation and unsafe water. Though 70% of diarrhoea cases are viral infections, most patients receive antibiotics for its treatment. Healthcare-associated infections (HAI) are a result of poor infections control in hospital. 7-10% of hospital infections in patients worldwide are healthcare acquired (O'Neill, 2016). Danchaivijitr et.al (2007) indicate that prevalence of HAI in Thai hospitals was 6.5%. Most infections sites were lower respiratory tract (36%) and urinary tract (26%). This has resulted in 12 days of increased hospital stay; increase of 13% in mortality rate, and on average, Thailand spent $150 per case for HAI treatment.

Outcomes of antimicrobial resistance

Antimicrobial resistance is a global threat that is causing increasing morbidity and mortality. The World Health Organisation (WHO) reports that 6.1million died from lower respiratory infections, HIV/AIDS and diarrhoeal diseases respectively in 2012. This increase in fatality has been attributed to antimicrobial resistance (WHO, 2014).

According to the global action plan on antimicrobial resistance (WHO, 2015a), antimicrobial resistance has a direct and indirect effect. The direct effect involves increasing severity of infection leading to longer sickness, increased mortality, extended hospital staying time and decreased effectiveness of prevention in medical procedures such as operations and chemotherapy. The indirect effect relates to the increased health risks both in people and animals and increased economic burden through loss of productivity and higher costs of treatment and prevention.

The European Centre for Disease Prevention and Control (ECDC) and the European Medicines Agency (EMA) estimate that infections caused by resistant bacteria cause 25,000 deaths in Europe annually and increase health costs and productivity loss costs to around 1.5 billion EU per year (ECDC/EMA, 2009). The picture in Thailand is similar; antimicrobial resistant infections add an additional 3.24 million hospitalisation days and 38,481 deaths by infections annually. Thailand spent $84.6- 202.8 million a year on antibiotics, and at least $1.3 billion of productivity loss costs through morbidity and mortality (Pumart et al., 2012). In the US, at least 2 million people had infections and 23,000 people died as result of antimicrobial resistance (Centre for Disease Control and Prevention (CDC), 2013). The direct healthcare cost from antibiotic resistance was $20 billion and a societal cost of approximately $35 billion a year (CDC, 2013). (*See table 1 for a comparison of mortality and expenditure on antimicrobial resistance among countries)*

	Global (O'Neill, 2014)	**European (ECDC & EMA, 2009)**	**USA (CDC, 2013).**	**Thailand (Pumart et al., 2012).**
Death	700,000 deaths/ yr. (10 million by 2050)	25,000 deaths/yr.	23,000 deaths/yr.	38,481deaths/yr.
Economic burden	60 to100 trillion USD/yr.	1.5 billion EU/yr.	antibiotics cost 20 billion USD/yr. societal cost 35 billion USD/ yr.	antibiotics cost 84.6- 202.8 million USD/yr. productivity loss 1.3 billion USD USD/yr.

Table 1: Burden of antimicrobial resistance in Global, European, USA and Thailand

The disease burden of antimicrobial resistance and the damaging consequences on people's health and economies warrant efforts to combat resistance at local, regional, national and international levels.

Strategies to combat antimicrobial resistance

Given the complexity and multi-factorial nature of antimicrobial resistance, interventions to tackle the issue have to be layered and multifaceted. Interventions to address this issue will be discussed in this section at four levels: international, national, organisation (community and hospital) and individual levels. There are 14 approaches to combat AMR issue (Uchil et.al, 2014). *(See figure 4 for an illustration of the key interventions to tackle antimicrobial resistance)*

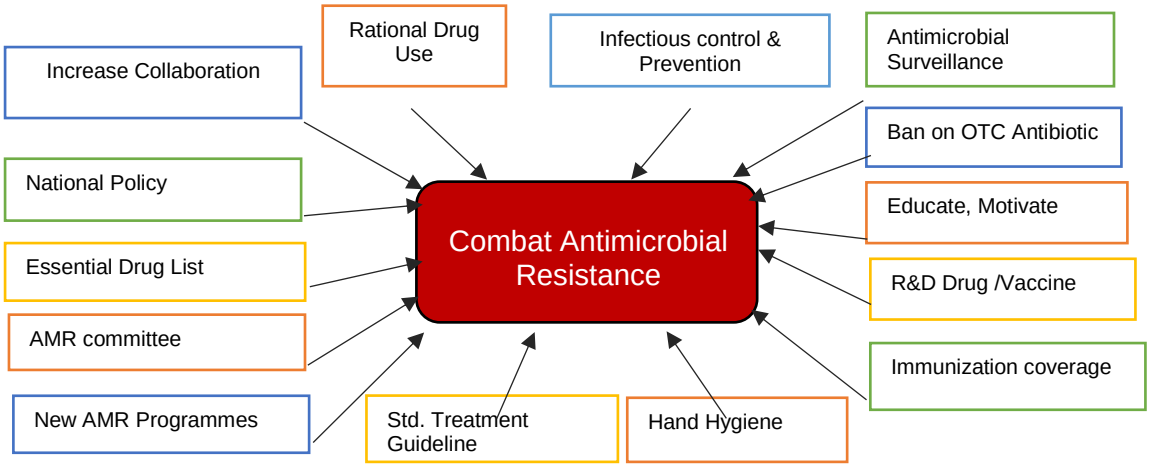


Figure 4: Approaches to combat antimicrobial resistance (Uchil et.al, 2014).

According to the fourteen approaches to combat antimicrobial resistance, it need to consider to individual country background. National policy and AMR committee seem to uncomplicated for generating by government, while some of actions have to more discussion with many stakeholders such as banning non-prescription antimicrobial.

For example, in Thailand, the legal allows pharmacists to dispense non-prescription antimicrobials. It is a reason of healthcare system and affordable medication problem. Morgan and colleagues (2011) estimate that have no evidence to support prescription antimicrobials is better than non-prescription. Nevertheless, appropriate practice of healthcare profession could be more consider. It covers with other approaches in the model such as treatment guideline, rational drug use, infection control, hand hyenine, education and motivations. Similarly, the International Pharmaceutical Federation (FIP) (2015) suggests that community pharmacist has a role to triage patients and they could provide over-the-counter antimicrobials in minor infection diseases but referral to physician and specialist need to consider for serious health problem. So, appropriate practice in antimicrobial use is might better than legal force and healthcare profession have to collaborate each other to improve service and activities to combat the resistance problem.

International level

The World Health Organisation (WHO) has been considering this issue for decades. The global strategy for containment of antimicrobial resistance was published in 2001 to encourage member countries to act on this global health threat. In 2015, WHO launched a global action plan on antimicrobial resistance. It aims to ensure, for as long as possible, continuity of effective and safe medicines for the treatment and prevention of infectious disease. The member countries are expected to develop their nation action plan to combat antimicrobials resistance.

However, an analysis of the response to WHO antimicrobial resistance plans by WHO (2015b) shows that the members are yet to act on WHO recommendations. Not all of the 6 key elements were addressed (National plan or strategy, Surveillance data, Access of quality and safety antimicrobials, Antimicrobial misuse control, Awareness and understanding of general public and Effective of infection prevention and control programme). The results show that an AMR strategy has not been developed in many countries (WHO, 2015b).

National level

National level policy can reduce inappropriate use of antimicrobial medicine and resistance situation in the country (Uchil et.al, 2014). A “One- health’ approach is essential to ensure collaboration of all stakeholders; healthcare, farming, environment, and industry sectors.

The UK formulated the UK five-year antimicrobial resistance strategy, 2013-2018 which uses an integrated approach to combat AMR. The primary goal of the strategy is to slow antimicrobial resistance developing and spreading (Davies & Gibbens, 2013). Consequently, the UK has the lowest level of resistance in EU/EEA (Public and International Health, 2016).

In 2017, Ministry of Public Health Thailand (MOPH) and Ministry of Agriculture and Cooperatives Thailand (MOAC) launched a national strategic plan to combat antimicrobial resistance from 2017 to 2021 using an integrated “one Health” approach (MOPH & MOAC, 2017). It aims to reduce AMR morbidity, decrease antimicrobial use in humans and animals, increase public knowledge and awareness and improve capacity of AMR management in the country.

Organisation level

Antimicrobial resistance has spread widely in community and hospital settings resulting in community acquired or hospital acquired resistant infections. Therefore, addressing AMR at an organisational level is urgent.

In communities, public awareness of antimicrobial resistance is important to combating AMR. The common misuse is widely in community such as uncompleted antibiotic courses, ineffective dosing, unnecessary use and sharing medicines with other patients (Ocan et al., 2015). The work of Uchil and colleagues (2014) recommend that community level actions could increase rational use of antibiotics. These include regulating non-prescription antibiotic provision, antibiotic use guidelines in community and improving hygiene and sanitation.

In hospital settings, strict infection prevention and control can restrict the spread of resistance. Health providers have to preserve antimicrobial agents and improve their rational use. Also, they could encourage and educate their patients to understand antimicrobial resistance issues and how to use antimicrobials appropriately (WHO, 2015a). Hospital surveillance systems and microbiology to inform drug therapy are key to improving medical treatment and feeding into resistance database (Uchil et.al, 2014).

Individual level

Antimicrobial resistance awareness and adherence to appropriate antimicrobial use need to intensify in the public domain. A multi-country study on awareness of antibiotic use demonstrates that knowledge of people was inadequate, and they often misunderstood antibiotic use, 25% of participants shared antibiotics, 64% of them believed the medicine could cure a common cold and flu caused by viruses (WHO, 2015a).

The key persons to motivate antimicrobial awareness and appropriate use of antimicrobials are healthcare providers. Healthcare professionals have the core responsibility of antimicrobial stewardship and promoting antimicrobial resistance awareness, good infection prevention and control including vaccination and screening programmes and educating the general public (Public Health England (PHE), 2015).

Antimicrobial Stewardship

Antimicrobial stewardship is an approach to promoting and monitoring antimicrobial use appropriately (National institute for health and clinical excellence (NICE), 2015). The main objective of antimicrobial stewardship is to achieve the most effective clinical outcome with less toxicity and adverse reactions. Also, it considers the effective antimicrobial dose, duration of action and route of administration (Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA) & Paediatric Infectious Diseases Society (PIDS), 2012). In the UK, NICE launched the antimicrobial stewardship guideline. The guideline suggests that healthcare workers should follow, support and apply antimicrobial stewardship in their practices. Once the patient needs to use an antimicrobial, the prescriber would select the shortest treatment course, appropriate regimen and route of administration (NICE, 2015). Moreover, the antimicrobial stewardship teams should be multidisciplinary including physicians, pharmacists, nurses, microbiologists and others (SHEA, IDSA & PIDS, 2012; NICE, 2015). A randomised control trial in Australia found that the multidisciplinary antimicrobial stewardship team could improve therapy in terms of timeliness of treatment with blood culture infections (Cairns, et.al, 2016). Healthcare providers are important players in encouraging their patient and the public to be aware of AMR issues and antimicrobial stewardship programmes. Also, the general public needs to consider the problems and improve their knowledge and adherence with antimicrobial therapy.

Role of pharmacist in antimicrobial stewardship

The role of pharmacists in antimicrobial use and resistance can be vital in hospital and community pharmacy because each setting contributes differently to antimicrobial resistance. It is widely agreed that hospital pharmacists can improve patients' clinical outcomes through multidisciplinary practices while community pharmacists can reduce inappropriate antimicrobials use through improving public awareness and adherence.

Hospital pharmacists can improve patients' outcomes through inter-professional interactions (FIP, 2015). Hospital pharmacists in the UK have been key drivers of antimicrobial stewardship programme development in hospitals. They have improved prescribing standards and infection prevention and control practices (Howard et al., 2013). Similarly, researchers in Thailand demonstrate that trained clinical pharmacists can increase appropriate use of antimicrobials in hospital settings (Apisarnthanarak et al., 2015).

Community pharmacies are the first point of contract point to patients who have a minor illness. So, community pharmacists can encourage appropriate antimicrobial use and awareness of resistance directly (FIP, 2015). The campaign "Mirror, mirror on the wall, do I need antibiotics at all?" was developed by community pharmacy association of Thailand (CPA) to promote appropriate use of antibiotics in upper respiratory tract infections. Community pharmacists checked their patients' throats to differentiate viral and bacterial infections and encouraged patients to self-care (CPA, 2012). In addition, Booth and colleagues (2013) indicate that good community pharmacy practice can reduce workload of general practice (GP) doctors. Community pharmacist could lead on health promotion, education regarding infection prevention, and provision of immunisation services. They could perform appropriate triage and refer patients as needed, and support optimising the use of antimicrobials in relation to adherence and safety (FIP, 2015).

It is clear that community pharmacists are essential in the overall strategy of combatting antimicrobial resistance. They need to perform their antimicrobial stewardship at all times, and they are expected to provide essential information to the public regarding antimicrobial use and resistance. This is particularly advocated since several studies in this area confirm that they have adequate knowledge, good attitude and proper practice in antimicrobials use and resistance. However, the varying legal and professional pharmacy context in each country, particularly in developing countries such as Thailand, may define different roles of pharmacists in relation to antimicrobial stewardship. This study explores community pharmacists' knowledge, attitude, and practice of antimicrobials use and resistance in Thailand and draws on the wider literature to compare and benchmark Thai pharmacists, within the global picture of antimicrobial stewardship practices.

This research purposes to assess community pharmacists' knowledge, attitudes, and practice in Thailand regarding non-prescriptions antimicrobials use and resistance. A self-administrated questionnaire was developed from existing literature to measure community pharmacists' knowledge and attitudes regarding antimicrobials use and resistance. The study was

conducted in two provinces of Thailand, Bangkok and Chonburi which cover more than 30% of pharmacies in the country.

Results of this study provide insights into the current situation of antimicrobial use and resistance in community pharmacy practice. The use of the Knowledge, Attitude, and Practice (KAP) model is particularly advantageous here since previous studies have mainly used the Theory of Planned Behaviour (TPB) model to explore community pharmacists 'behaviours in relation to antimicrobial provision; not covering pharmacists' knowledge in relation to this aspect. Moreover, the study is an initial assessment of community pharmacists regarding antimicrobial use following the introduction of the antimicrobial resistance national strategic in Thailand at the beginning of 2017. This research can inform future interventions for community pharmacist such as continuing professional development (CPD) courses and antimicrobial stewardship training; these could be designed around the study findings on pharmacists' current knowledge, attitude and practice.

This thesis examines antimicrobial stewardship practices of community pharmacists in Thailand through assessing their knowledge, attitude, and practice (KAP) using the KAP model. The healthcare context in Thailand will be presented in Chapter 2 including a background of the health system in Thailand and community pharmacy service in the country. A literature review (Chapter 3) will discuss existing research on community pharmacists' antimicrobial stewardship and the KAP studies in the pharmacy profession regarding antimicrobials use and resistance. Then, chapter 4 will be discuss theoretical frameworks including a detailed description of the knowledge, attitude, and practice (KAP) framework and other relevant models. Methodology and statistical analysis will be described in chapter 5 followed by a presentation of the study findings in chapter 6. The results will then be discussed in chapter 7, followed by the conclusions of the study and suggested future research. Ethics approval letters, the research instrument, and supplementary data analysis tables will be included as appendices.

CHAPTER 2
STUDY CONTEXT

Although antimicrobial resistance is a threat to public health globally, strategies to overcome this issue have to be tailored to the individual country context. Thailand is a developing country with specific healthcare needs and a specific healthcare system. This chapter includes an overview of the health service system and pharmacy in Thailand, including pharmacy education. It then discusses the current antimicrobial stewardship activities to combat resistance particularly in community pharmacists.

Health service in Thailand

Health service administration

The ministry of public health (MOPH) is a government department that is responsible for healthcare policy and system development, health administration and implementation on a national level. Legally, the ministry has the primary role of supporting health promotion, disease prevention and control, treatment and rehabilitation (MOPH, 2013).

The ministry is divided into two levels, central level and provincial level. At a central level, there are four clusters that oversee eight departments. At a regional level, there are 77 provincial health offices in Thailand, controlled by the Office of the Permanent Secretary from the central level (Tangcharoensathien, 2015). *(See Figure 5 for a summary of the health service administration structure in Thailand*)

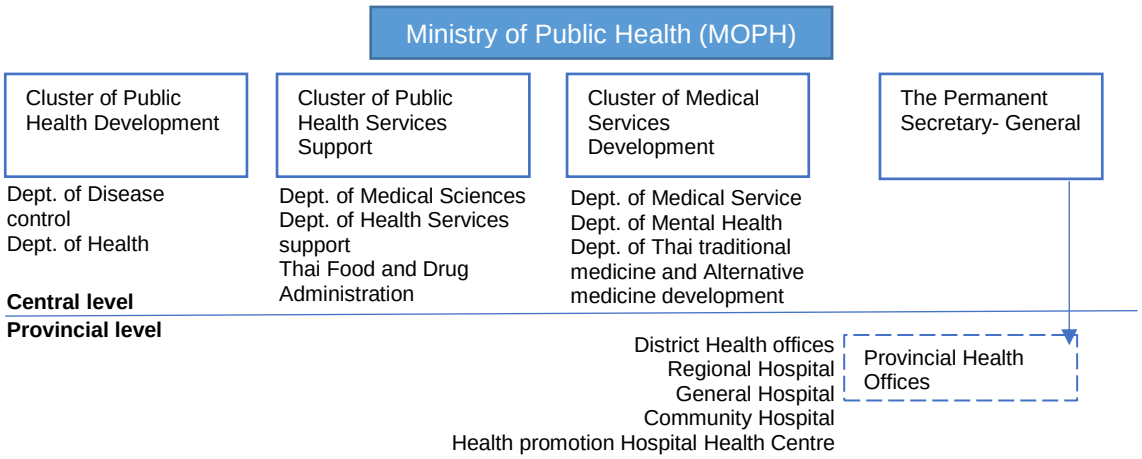


Figure 5: Ministry of Public Health Organisation

At a central level: The Office of the Permanent Secretary is an administration department. It also links with the provincial level administration. The Cluster of Medical Services Development supports the medical department, traditional medicine and alternative medicine department and mental health department. The Cluster of Health Development is responsible for public health services including the disease prevention department. The Cluster of Public Health Service Support is responsible for drug and medical devices control. This cluster includes the department of health service support, department of medical sciences and the Food and Drug Administration (Tangcharoensathien, 2015).

At a provincial level: 77 provincial health offices in Thailand are controlled by the Office of the Permanent Secretary at a central level. The health offices are grouped into 12 health areas by geographic region, health resources and service planning. Overall, each provincial health office is responsible for health administration and controlling public hospitals and health centres in their province (Tangcharoensathien, 2015).

Access to medicines

Thailand has a population of around 68 million people (World Bank, 2016). Thai people can access medicines through hospitals, private medical clinics and pharmacies. Medicines can also be purchased in retail shops (Apisonthanarak et.al, 2008; Saramunee et.al., 2011). The National Statistics Office (NSO) in Thailand reports that households spent 0.9 % of their expense on purchasing self-medication in 2013 and this has increased to 1.4% in 2016.

There are three types of health insurance systems that cover 99% of population. The Universal Coverage Scheme (UCS) covers 75% of people, the Civil Servant Medical Benefit Scheme (CSMBS) for government officers covers 8% of people and the Social Health Insurance (SHI) covers around 10% employees in the private sector (Tangcharoensathien, 2016). The rest are uninsured. The health insurances schemes provide medical services and medications which are listed in the national list of essential medicines. The national list of essential medicines (NLEM) formulary is compiled based on an evidence–based selection system. The NLEM committees consider the health need, safety, efficacy, compliance, quality, treatment cost, cost-effectiveness, equity and national affordability. Thai NLEM is divided into five sub-lists including standard drugs, specialised drugs and high cost medicines (Yoongthong et.al, 2012).

Medicines classification

The current drug law in Thailand has been in place for around 50 years. It is the Drug Act of Thailand B.E. 2510 (The Royal Thai Government, 1967). The Drug Act of Thailand classifies medicines into four groups (Saramunee et. al, 2011):

1. **Home remedies:** are general medicines for self-care and minor symptoms. These can be purchased in convenience stores and pharmacies without licence requirements for selling (approximately equivalent to UK General Sales List (GSL) medicines).

2. **Ready-packed pharmaceuticals:** are medications that can be sold without prescription but only through certain types of pharmacies (Type I and Type II pharmacies; this will be explained in the community pharmacy in Thailand section below)
3. **Dangerous drugs**: can be dispensed by pharmacists without medical prescription in Type I pharmacy. Most of oral medicines are classified in this category including oral antibiotics.
4. **Special control drugs:** are medications that require a prescription to be dispensed. This category includes narcotic drugs and psychiatry medicines.

Community pharmacy service in Thailand

The main role of community pharmacy in Thailand is dispensing medications to patients with or without prescription. The Community Pharmacists Association (CPA) and National Health Security Office (NHSO) encourage the involvement of community pharmacy in health promotion and disease prevention projects (Chiyakunapruck et.al, 2016). However, providing vaccination service (such as flu vaccination) is not allowed in Thai community pharmacy. Furthermore, some community pharmacists develop their services in areas of home health care; these include medication use reviews (MURs), identifying drug-related problems (DRPs), patients' education and developing treatment plans (Tunpichart et.al, 2012). This highlights the wide and active role of pharmacists in providing and ensuring appropriate access to medication, and emphasises the potential role of pharmacists in public health through ensuring appropriate use of antimicrobials and educating patients and the public on matters of antimicrobial resistance.

Type of community pharmacy

Legally, community pharmacies in Thailand can be classified as either Type I or Type II (The Royal Thai Government, 1967).

Type I pharmacy is required to have a registered pharmacist working during service hours. The pharmacists provide medicines with and without prescription depending on the drug classification. There are around 15,000 type I pharmacies in the country (Bureau of drug control, 2016). These pharmacies are reported to not always have a pharmacist working as per legal requirements. Some of these pharmacies do not have pharmacists present and they still provide medicines at all time (Saramunee et.al, 2011).

Type II pharmacy does not legally require the presence of a registered pharmacist in order to provide medication as it can only provide home remedies and ready-packed pharmaceuticals. However, these pharmacies face challenges to control drugs provision because some sell medication without permission (Wuttipanich & Kitisopee, 2015).

The drug law in Thailand has yet to allow online pharmacies to practice. So, medicines provision online and social media is currently illegal (The Royal Thai Government, 1967).

In terms of ownership, independent pharmacies in Thailand are still higher than chain pharmacies (comprising only 3% pf pharmacies in Thailand (Saramunee et al., 2011)). However, the trend of chain store pharmacies is increasing. It is important to consider this rising trend as the pressure of sales and performance in those chains may affect pharmacists' decisions to provide medicines (including antibiotics) appropriately.

Legislation relating to community pharmacy service

The Good Pharmacy Practice (GPP) guidance argues that Thailand has strictly controlled community pharmacy practice since laws were updated in 2014. The regulation aims to improve community pharmacy service and reduce drug-related problems in primary care service (Wuttipanich & Kitisopee, 2015). Moreover, the pharmacy council of Thailand requires maintaining professional standards through continuing pharmacy education (CPE). This has only become compulsory recently (since 2016) and can lead to pharmacists losing their licence if they fail to comply (The Pharmacy Council of Thailand, 2015). This is anticipated to have a positive impact on patients' quality of care as it ensures they receive appropriate medicines including antimicrobials. These new changes to legislation have to be taken into account when researching current knowledge, attitudes and practices in Thailand, since the existing body of evidence was established before the introduction of the CPE mandatory requirements and launch of new public health strategies.

Pharmacy education in Thailand

In addition to introducing new pharmacy laws and regulations, pharmacy education in Thailand has also dramatically changed in 2009 (Pongcharoensuk & Prakongpan, 2012). The newly qualified pharmacists are now expected to have more clinical skill and be able to run clinically focused services in their practice. The new generation community pharmacists now graduate with a Doctor of Pharmacy (PharmD) and theoretically have more clinical knowledge of pharmaceutical care than pharmacists who previously graduated with a Bachelor of pharmacy (BSc in Pharm or BPharm).

Pharmacy education was a 5-year programme at a Bachelor level (BPharm or BSc in Pharm). In 1999, Nareasuan University started the first 6-year Doctor of pharmacy (PharmD) programme. It aims to enhance patient-facing roles and move away from more product-based pharmacy education. This change has been inspired by the American pharmacy education system. As a result of this change, in the period of 1999-2013, there were two degrees of pharmacy in Thailand. This is a further motive to investigate pharmacists' knowledge, attitudes and practices as a result of those education and training changes. It is anticipated that the new graduates would have better knowledge and understanding of the current issues such as antimicrobial resistance and how to tackle them. The following section will discuss the current strategies proposed to tackle the issue of antimicrobial resistance in Thailand.

Antimicrobial resistance combating programme in Thailand

In Thailand, there are some actions to support AMR containment such as the Thailand AMR Containment and Prevention (AMRCP) Programme (Thamlikitkul et.al, 2015). The programme estimates the national burden of antibiotic resistance, antibiotic resistance chain in the country, and devises and promotes strategies for appropriate use of antimicrobials and improved infection prevention and control systems.

Antibiotic Smart Use is a model of practice in hospital and community levels. Sumpradit and colleagues (2012) suggest that the project was introduced as a model to promote rational use of antibiotics. The first phase was a behaviour change intervention in prescribing antibiotics in three conditions that do not require antibiotics: diarrhoea, flu, wounds. The second phase was a scale up attempt to other areas. Both phases changed antibiotic prescription behaviours in hospitals.

National strategic to combat AMR in Thailand

In 2017, Thailand has launched a national strategy in AMR from 2017 to 2021 using an integrated “one Health” approach (MOPH & MOAC, 2017). It aims to reduce AMR morbidity, decrease antimicrobial use in humans and animals, increase public knowledge and awareness and improve capacity of AMR management in the country. There are 6 strategies to achieve these goals: (MOPH & MOAC, 2017)

1. Use one health approach in surveillance system
2. Regulation of antimicrobial distribution
3. Infection prevention and control and antimicrobial stewardship in humans
4. AMR prevention and control and antimicrobial stewardship in agriculture and companion animals
5. Public knowledge on AMR and awareness of appropriate use of antimicrobials and
6. Governance mechanisms to develop and sustain AMR-related actions

However, the strategy does not encourage the need for research and development funding of new antimicrobials given the economic capacity, skills and human resources of the country.

Community pharmacist competency to provide antimicrobial in Thailand

Although Thailand does not yet have guidelines for antimicrobial stewardship in community pharmacy, there is a requirement for of pharmacists to have “competency regarding antimicrobials use” by the pharmacy council of Thailand (The Pharmacy council of Thailand, 2012). Pharmacists must have knowledge in pharmaceutical products in relation to acquisition, preparation and storage. They also need to follow good dispensing practice and rational use of drugs in common diseases. The common diseases that related to infections are HIV infection without opportunistic infection, parasitic infections, sexually transmitted diseases and vaginitis, tuberculosis, upper respiratory infections (common cold, pharyngitis, purulent rhinitis, otitis media and sinusitis), urinary tract infections (cystitis) and immunisation. All pharmacists in Thailand should evaluate medication related problems, analyse prescription and follow good dispensing practice for their patients. Moreover, the pharmacists need to have an underpinning understanding of the health and public health systems in the country (The Pharmacy council of Thailand, 2012). *(See figure 6 for a summary of Thai pharmacists’ competencies)*

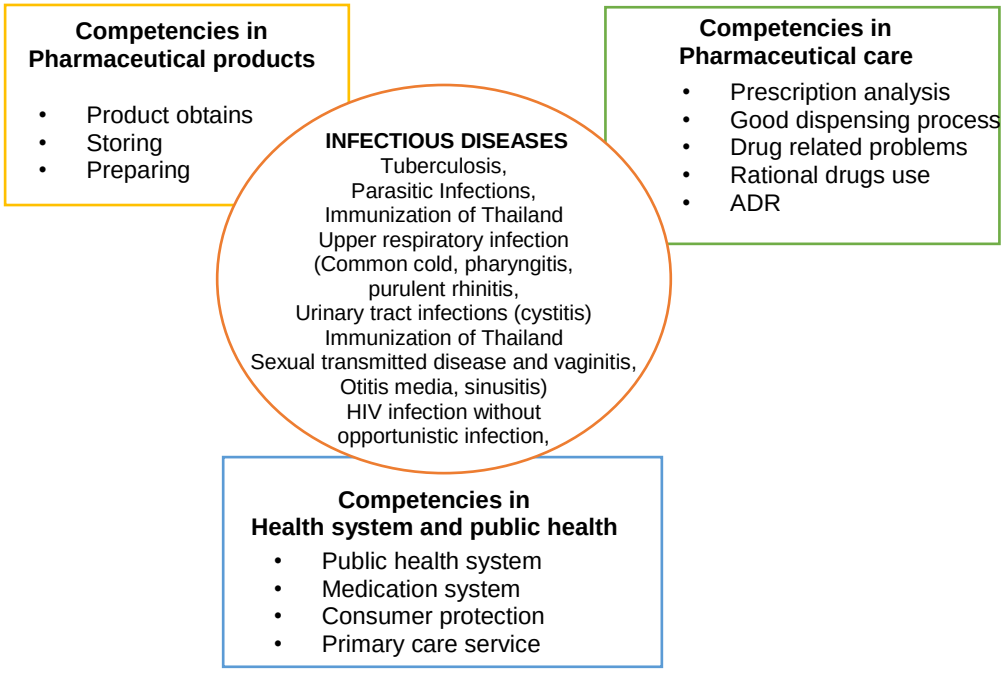


Figure 6: Core competency of Thai pharmacists regarding infection diseases.

Thai pharmacists do not have a specific competency relating to antimicrobial use and resistance. They are expected to follow standards of core competency by Thai pharmacy council. As part of the growing rates of resistance, and the transforming pharmacists’ education, it may be prudent to ensure pharmacists competence in relation to antimicrobials. The pharmacy council and related associations could formulate standards on roles of community pharmacists to combat antimicrobial resistance and increase professional values for patients and general public.

In summary, Thailand is a specific context in relation to antimicrobials use. At a national level, healthcare system is controlled by the ministry of public health. Pharmacies are under supervision of the MOPH legally via public health office in each province, and they vary in type and level of service delivery. Although a legal classification of medicines exists, most antimicrobials are classified as dangerous but can still be dispensed without prescription. Community pharmacists practicing in Thailand may have either a Bachelor or a PharmD degree. In both cases, they are allowed to dispense antimicrobials legally with or without prescription. The pharmacy council of Thailand which regulates pharmacists in the country has launched a core competency framework for pharmacists and good pharmacy practice guidance in community pharmacy to ensure that the pharmacist provide medicines such antimicrobials appropriately. However, antimicrobial stewardship guidelines are yet to be issued despite the introduction of several campaigns to improve antimicrobials use in healthcare settings such as antibiotic smart use programme.

CHAPTER 3
LITERATURE REVIEW

Various factors can lead to the inappropriate use of antimicrobials in community pharmacy. Lack of knowledge, patients demand and financial benefits from pharmaceutical companies have often been reported by healthcare professionals as reasons for the inappropriate provision of antimicrobials (Apisanthanarak et.al 2008; Saengcharoen & Lerkiatbundit, 2010; Puspitasari et.al, 2011). This chapter aims to present relevant evidence of community pharmacists' knowledge, attitudes and practice in relation to antimicrobial use and resistance. Further, antimicrobial stewardship studies in community pharmacy will be discussed, highlighting the current research gaps that will be explored through the proposed study.

The association between pharmacists' knowledge and inappropriate practice

Knowledge of pharmacists can influence their practice in antimicrobials provision. Many researchers argue that inadequate knowledge is associated with inappropriate use of antimicrobials. A study was conducted in Pratumthani province north of Bangkok shows that antibiotic prescribing in pharmacies remains inappropriate. The researchers recommend that pharmacists could be educated on antimicrobial stewardship and resistance problems (Apisarnthanarak et.al, 2008). The same research team found that there are 4 reasons to dispensing inappropriate antibiotics; worrying about complications if they don't treat, lack of knowledge, limited supply of medication and patient's pressure (Apisarnthanarak et.al, 2009). Both studies did not specify if the provision of antibiotics was through pharmacists or technicians. Many studies show that the inappropriate use of antimicrobials in community pharmacy is a result of inadequate knowledge of providers.

Moreover, educational interventions targeting community pharmacists can improve their practice. A randomised control trial (RCT) study to investigate antibiotic dispensing behaviour in Vietnam and Thailand shows that an educational intervention to improve pharmacists' knowledge was effective in reducing low-dose antibiotic dispensing behaviour (Chalker et.al, 2005).

It appears that knowledge of pharmacist would be an influencing factor towards behaviour to dispense antimicrobials. Inadequate knowledge can lead to misuse or overuse of antimicrobials. If pharmacists improve their knowledge of antimicrobial stewardship, they could enhance their practice.

The association between pharmacists' attitudes and their practice

Several studies show that pharmacists attitude towards antimicrobials use and resistance is associated with their practice. A study on the factors influencing dispensing antimicrobial agents in Thai community pharmacists was published in 2008. The researchers used the theory of planned behaviour (TPB) as a framework to investigate the behavior of community pharmacists who provide antibiotics for the treatment of upper respiratory infections (URIs). The research indicates that attitude is the strongest influence on dispensing behavior followed by subject norms and perceived behavior control (Saengcharoen et.al, 2008). Moreover, a study on attitudes and behavior of pharmacy workers who treat childhood diarrohea indicates that lack of history taking, inadequate knowledge and patient satisfaction are factors leading to inappropriate dispensing (Saengcharoen & Lerkiatbundit, 2010).

Similarly, a study in Portugal used a questionnaire to evaluate attitudes of community pharmacists towards antimicrobial use and resistance confirms that attitude can influence pharmacists' tendency to dispense non-prescription antibiotics (Roque et al., 2015).

The evidence seems to support that attitudes are associated with pharmacy practice in community pharmacy. Poor attitude of pharmacists leads to inappropriate dispensing of antimicrobials.

Community pharmacy practice in in relation to antimicrobial provision and stewardship.

A study in Indonesia used simulated patients and scenarios to request antibiotics such as Ciprofloxacin, Tetracycline, Amoxicillin from pharmacies. Results show that antibiotics can be obtained from the pharmacy without an initial assessment and the obtained antibiotics were mostly inappropriate for the condition (Puspitasari et.al, 2011).

A study in Jordan revealed that pharmacies facilitated the inappropriate use antimicrobials even though pharmacists were present at 90% of the participating pharmacies. Antibiotics were provided inappropriately for sore throat, acute sinusitis, otitis media, diarrhoea, and uncomplicated urinary tract infections (UTIs) (Almaaytah et.al, 2015).

However, these is not a strong evidence base to argue that antimicrobial provision through prescription is always better than its provision without a prescription (Morgan et.al, 2011). In a comparative study between General medical practitioners (GPs) and community pharmacists in Malaysia, both parties show poor adherence to appropriate use guidelines. Community pharmacists were worse at diagnosis than GPs, but the GPs prescribed far more unnecessary medicines and antibiotics than pharmacists (Alabid, Ibrahim, & Hassali, 2014)

Antimicrobial stewardship in community pharmacy can be of benefit to healthcare system. Booth and colleagues (2013) conducted their research in community pharmacies in Scotland. The community pharmacists provided pharmacy services and prescribed antibiotic for uncomplicated urinary tract infections (UTIs) following clinical guidelines. The results show that through involving community pharmacists, patients could easily access treatment without increasing appointment time on GP practices (Both et al., 2013).

However, the existing evidence shows that community pharmacists have to improve their stewardship practices particularly in collaboration with other healthcare providers. Khan and colleague (2016) conducted a cross-sectional study in Malaysia to examine perception and practice of community pharmacists. The results show that pharmacists have positive perception of antimicrobial stewardship by improving patient care. However, the results indicate that community pharmacist in Malaysia need to improve their stewardship practice through integration of antimicrobial stewardship programmes in pharmacies and collaboration with other healthcare providers such as physician.

The existing literature suggests links between pharmacists' knowledge, attitudes and their practice. However, the nature of these relationships needs to be further explored. Further, in Thailand, there is no current information on pharmacists' knowledge, attitudes, and practice in relation to antimicrobials use and resistance.

Further, the variety of background/ context of each country might affect research results. The KAP study in community pharmacy about antibiotic dispensing in Saudi Arabia was conducted in 2016. The research indicates that most pharmacists were not aware that dispensing non-prescription antibiotics was illegal and their practice was not appropriate (Hadi et al., 2016). This context is different to Thailand where provision of antibiotics without prescription is legal.

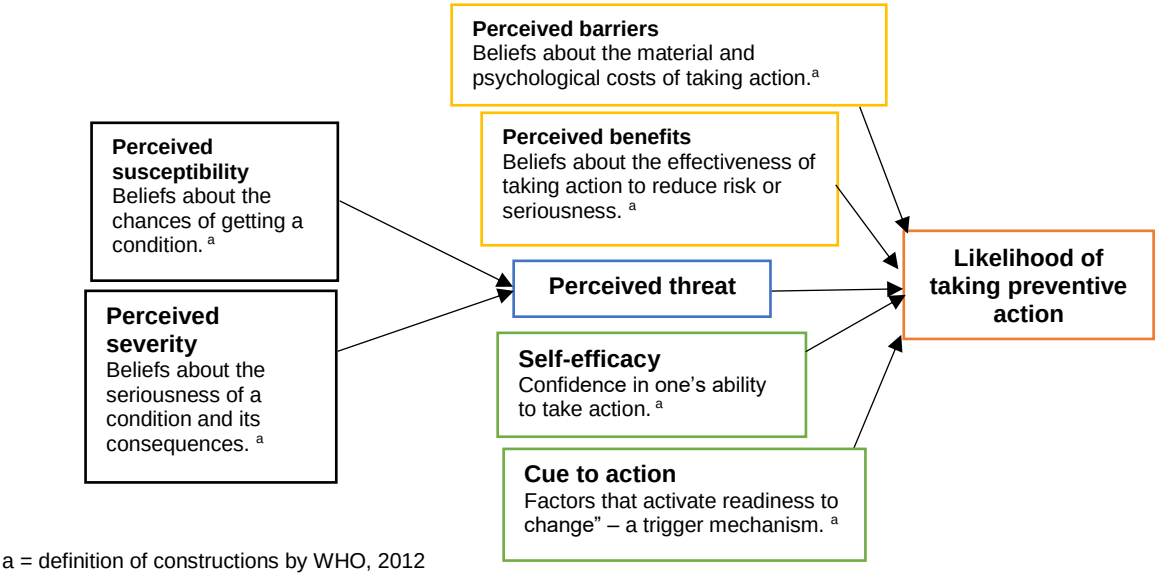
This research is an assessment community pharmacists' knowledge, attitude and their practice in Thailand regarding antimicrobial use and resistance. The relationship between these three factors will be examined, and the findings can potentially enhance our understanding of antimicrobial stewardship practices in community pharmacy in Thailand, and highlight areas of improvement.

Theoretical framework

There are several health behaviour models that describe the factors affecting behaviour. Researchers use various models to describe individual behaviours of both healthcare professionals and the general public. These include the health belief model (HBM), the theory of planned behaviour (TPB) model and the Knowledge-Attitude-Practice (KAP) model. These models will be discussed in the following paragraphs.

Health Belief Model (HBM)

Health belief model explains health decision making and health behaviour. It was developed by the U.S Public health service in 1950s (LaMorte, 2016). The model aims to understand people's failure in disease prevention. It predicts a person's likelihood of changing their health behaviour based on the person's belief in individual threat and illness and effectiveness of health behaviour or action. There are six constructs in the model (WHO, 2012; LaMorte, 2016). *(See figure 7 for an illustration of the model)*



a = definition of constructions by WHO, 2012

Figure 7: The Health Belief Model
(adapted from Fayanju et.al, 2014 and Sharafkhani et.al, 2016)

For example, Heid et.al (2016) uses the health belief model in their study about the perception of patients of antimicrobial stewardship in out-patient setting in Wisconsin, U.S. The researchers conducted 30 semi-structure interviews with patients who received antimicrobials in hospital. The results show that patients were aware of antibiotic resistance but perceived themselves as being at low susceptibility risk. The patients therefore did not engage well with antimicrobial stewardship initiatives.

The health belief model has limitations in that it cannot provide information on participants 'attitude and beliefs that affect their behaviour. The model assumes that participants have equal information on illness and disease which is not accurate in real life (LaMorte, 2016).

The Theory of Planned Behaviour (TPB)

The TPB model is useful to describe factors that influence behaviours *(See figure 8 for an illustration of the model components).* The model does not only show the attitude toward a behaviour but also the social-norms and the perceived degree of control over that behaviour.

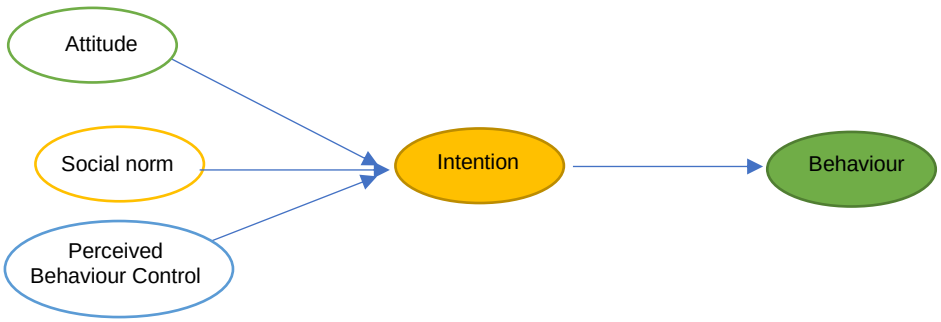


Figure 8: The Theory of Planned Behaviour (TPB) model

Sangchareon and colleague (2008) conducted their research using the theory of planned behaviour framework to examine factors in the model that influence community pharmacists to dispense antibiotics in South of Thailand. The research shows that attitude can strongly influence intention and behaviour to dispense antibiotics while subject norm and perceive behaviour control can mildly affect pharmacists' behaviour to dispense antibiotics. Although the researchers discussed that inadequate knowledge is a factor affecting appropriate use of antibiotics, this is not apparent using the TPB model.

LaMorte (2016) suggests that TPB fails to describe other factors in the model such as fear, threat, mood or previous experience. Also, it cannot explain environmental and economic factors which might influence intention in the model. In addition, according to previous research of Sangchareon and colleagues (2008), it can be assumed that the model cannot show how knowledge of participant relates to attitude and behaviour.

Knowledge, Attitude and practice (KAP) model

The knowledge, Attitude and practice (KAP) model was developed as a tool to investigate what is known, believed and done by participants in a specific topic. The KAP survey was developed for family planning and population studies in 1950s. It is widely used in cross-sectional surveys (Launiala, 2009; Vandamme, 2009). Usually, the KAP model is used to structure interviews and questionnaire. In pharmacy practice research, this survey is a tool to investigate experience, opinion and behaviour. KAP model has been used in research for decades and is a common tool to collect patients' and practitioners' information (Kishore, 2016). Correlation among Knowledge-Attitude-Practice was developed based on cognitive, affective and behaviour theory by Schwartz to study relation of knowledge, attitude and practice of diet (Bano et al., 2013). (*See Figure 9)*

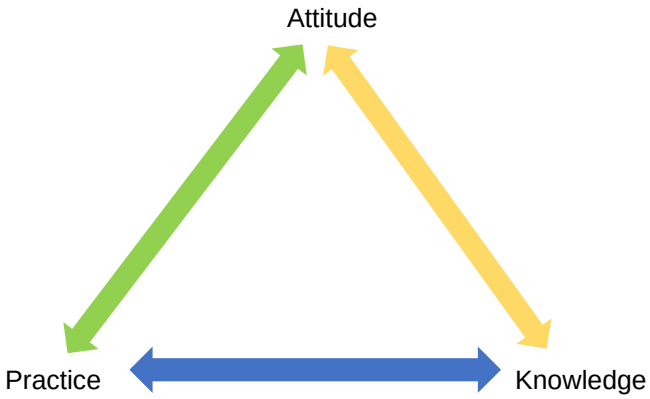


Figure 9: The Knowledge-Attitude-Practice Model (Bano et al., 2013)

Advantage of KAP model

The KAP survey method is easy to conduct. The results of this method are relatively easy to interpret and have a concise presentation (Launiala, 2009). KAP model is a rational model in health education. It is based on the notion that increasing personal knowledge will influence behaviour change (WHO, 2012).

The KAP model can be used to achieve the following objectives: describing current population's knowledge, attitude and practice, problem identification and intervention planning, and assessing outcomes when designing a pre-test and post-test study (Vanndamme, 2009).

Limitations of KAP model

There are limitations to the KAP model. In terms of knowledge, it tends to assess community knowledge of public health concept. Launiala, (2009) argues that KAP model cannot investigate knowledge in anthropology terms such as culture-specific knowledge of illness or knowledge about health system for example referral and quality. The term of knowledge includes local knowledge, belief and biomedical knowledge. Moreover, attitude analysis in the KAP model does not link them to other factors such as belief, emotion and they are positive and negative. Furthermore, the KAP model does not always explain why and how to practice (Launiala, 2009).

In KAP surveys there are three important domains of identification; Knowledge, Attitude and Practice.

Knowledge refers to participant understanding of any given topic (Kaliyaperumal, 2004). Knowledge is ability to receive, retain and use information that is mixed with experience and skills. It can be different to education which is a prerequisite of knowledge. It is an increase of acquired intellectual competency and skill, developed ethical quality and manner (Badran, 1995).

Attitude refers to participants' feelings about the topic (Kaliyaperumal, 2004). Attitude is a propensity to react in a definite way to a certain situation (Badran, 1995).

Practice refers to the way that participants demonstrate their knowledge and attitude (Kaliyaperumal, 2004). In other words, it means the application of rule and knowledge regarding action (Badran, 1995).

According to the previous definition, this research can define meaning of Knowledge, Attitude and practice as follow;

Knowledge is a personal understanding of antimicrobial resistance and antimicrobial use.

Attitude is participants' feelings about positive or negative statements in relation to antimicrobial use and resistance.

Practice is an action of participant towards antimicrobial provision.

In this study, the KAP model will be useful to understand pharmacists' behaviour in general. It can describe current knowledge, attitude, and practice of community pharmacists and determine the relationship of each factor with antimicrobials use and resistance. As a feature of the model, it is useful for the identification of problems in order to create effective interventions. Moreover, the KAP model is useful to determine knowledge; which has previously been ignored by other models that were used in previous studies. The KAP model can address this gap to clearly understand how knowledge relates to attitude, and practice towards antimicrobial use and resistance among community pharmacists. It also allows this study to be conducted within the limited financial and time frames.

CHATER 4
RESEARCH METHODOLOGY

Firstly, this chapter will provide details of aim, objectives, and research questions of study. After that research methodology will be described including the study design, sample size calculation, and sampling method. Also, details of the questionnaire development will be, and the validity and reliability of the study will be discussed. Data collection, ethical consideration, and data analysis method will then be addressed.

Aim, objectives and research questions

This study aims to evaluate community pharmacists' knowledge, attitude and practices regarding non-prescription antimicrobials use and antimicrobial resistance. The research uses self-administered questionnaire for assessment in each dimension. Also, it analyses correlation of factors in KAP model to examine their relationships. This research has four objectives:

1. To describe current situation of community pharmacy practice in antimicrobials provision. The questionnaire includes questions about common infections encountered in community pharmacy, most frequently dispensed antimicrobial and reasons for provision of antimicrobials without prescription. The objective can explore by a research question RQ_1,

   RQ1: What is current on the status of antimicrobials provision in community pharmacy?

The participants will answer questions about antimicrobials provision in community pharmacy in terms of encountered infectious diseases, commonly dispensed antimicrobials, and reason to dispense non-prescription antimicrobials. The answers will be coded, descried and presented as percentages.

2. To assess knowledge, attitude, and practice of community pharmacists on antimicrobial use and resistance. This objective can explore by a research question RQ_2

RQ2: What is community pharmacists' knowledge, attitude and practice in antimicrobials use and resistance?

Participants will answer to questions about knowledge, attitude, and practice regarding antimicrobials use and resistance. Score of each dimension will be calculated and analysed normal distribution through Kolmogorov-Smirnov Test. Descriptive statistic such as mean, standard deviation, median, interquartile range, percentage will also be used.

Also, relationship of knowledge, attitude and practice scores will be analysed correlation by Spearman's rho correlation coefficient. There are three hypotheses to explore the relationships can be seen in figure 10:

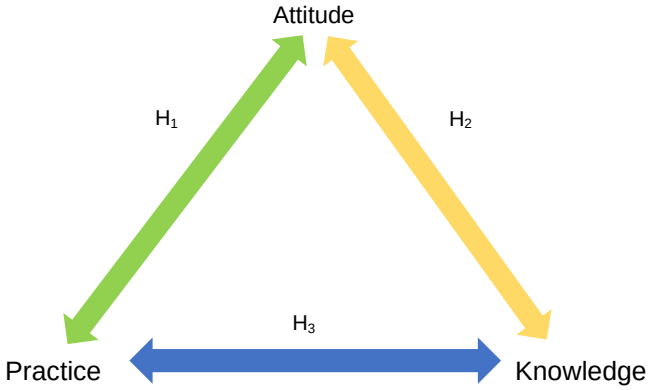


Figure 10: Relationship of knowledge, attitude, and practice framework

H_1: Knowledge of antimicrobial use and resistance correlates with attitude

H_2: Attitude towards antimicrobial use and resistance correlates with pharmacists' practices of antimicrobials provision.

H_3: Practice of antimicrobials provision correlate with Knowledge of antimicrobial use and resistance

3. To determine characterise of community pharmacists related with knowledge, attitude, and practice in antimicrobials use and resistance. The objective can describe by a research question RQ_3.

RQ_3: What are the characteristics of community pharmacists associated to knowledge, attitude and practice in antimicrobials use and resistance?

Participants give their characteristics in age, gender, educations, professional experience, working location and type of their pharmacy by. Mann-Whitney U Test and Kruskal-Wallis H test and Chi-square test will be employed for describing between various of demographics and knowledge, attitude, and practice factors.

Methodology

Study design

A questionnaire is easy to conduct and can involve a large number of participants (Bresee, 2014). It can be designed specifically to address the aim of the research and can be adapted from previous research. (Boynton& Greenhalgh, 2004; Bresee, 2014). However, a questionnaire needs to be valid and reliable before being used (Smith, 1997; Boynton& Greenhalgh, 2004; Draugalis, et.al, 2008; Bresee, 2014).

This research is a cross-sectional descriptive study using a self-administered questionnaire. This method was used because it is relatively easy to conduct in the limited time period and less costly compared to other approaches. Face- to face interviews for example can increase traveling cost, it is difficult to invite people and remunerate them to participate in the research. Online questionnaire was used in this study because it is easy to distribute to potential participants and is convenient to access anytime, anywhere.

Population

Population in this study is community pharmacists working in Bangkok and Chonburi province, Thailand. The area has 5082 Type I pharmacies which covers 33% of pharmacies in Thailand. It is expected to have at least one pharmacist during opening hours.

Sample size

The minimal sample size is 358 participants that calculate by equation

$$n = Z^2 \times P\,(1 - P)/e^2$$

However, this research has small population it could be adjusted by

$$n(\text{adjusted}) = n / 1+(n/N)$$

So, the final equation is

$$n = \frac{(Z^2 \times P(1 - P))/e^2}{1+(Z^2 \times P(1 - P))/e^2\ N}$$ (Sergeant, 2017).

Where, Z= Z value

P = percentage picking a choice

e = margin error

N= population

This research uses 95% Confidence interval, so Z value is 1.96. Proportion expected to respond is 50% or 0.5, margin error use 5% or 0.05 and population is 5082. Consequently, the minimal sample size is 358 participants.

Sampling

Pharmacies name lists were collected from a database on the Thai FDA and Community Pharmacy Association of Thailand (CPA) websites. Also, researcher invited pharmacists through social media, LINE application groups in Chonburi drugstore network and Group of community pharmacy service. Pharmacists on social media groups were invited to participate in the study. Simple random sampling was used to select participants from the pharmacy lists.

Inclusion criteria

1. Participant must be a pharmacist who graduated in pharmacy degree on undergraduate level (BSc in Pharm, BPharm or PharmD).
2. Participant must practice as full-time or part-time community pharmacist in Bangkok and Chonburi provinces.

Exclusion criteria

1. Other pharmacy workers such as assistant pharmacist, pharmacy technician or owners who have not graduated with a pharmacy degree.
2. Participants in the pilot study were excluded from the main study.

Questionnaire Development

A questionnaire was developed from previous literature, and has been validated by experts in antimicrobial stewardship. Also, the questionnaire construction followed the Knowledge, Attitude and Practice study guidelines (Kaliyaperumal, 2004; Vandamme, 2009; Macías & Glasauer, 2014) and recommendations in survey research (Smith, 1997; Boynton & Greenhalgh, 2004; Draugalis, et.al, 2008; Bresee, 2014).

In terms of instrument validity and reliability, researcher invited three experts in antimicrobial stewardship and community pharmacy service to validate questionnaire's content. Reliability was measured by pilot study including 15 pharmacists regarding consistency and reproducibility of the questionnaire. The questionnaire was adjusted based on validation or reliability results before being used in the main study.

Questionnaire design

The first draft of the questionnaire contains thirty- eighth questions. It was divided into four sections to assess the pharmacists 'knowledge, attitude and practice regarding non-prescription antimicrobial use and resistance.

Demographics section

This section was developed to describe characteristics of community pharmacists and confirm inclusion criteria of sampling. Five main questions about personal background, educations, professional experiences, workplace location and type of pharmacy.

- **Personal background (age, gender);** to describe general characteristic of participants and confirm inclusion criteria (age over than 18 years)
- **Education profiles (Pharmacy degree, highest education):** to examine various types of pharmacy degree in Thailand and confirm that the participants have graduated with a pharmacy degree as per inclusion criteria.
- **Professional Experiences**: to examine experiences of community pharmacists that might be influence their knowledge, attitude and practice.
- **Workplace location** to confirm that the participant is working in Bangkok and/ or Chonburi province and can examine the proportion of participants in each province.
- **Type of pharmacy** to examine proportion of pharmacists who work in individual drug store and chain stores in the study areas, Bangkok and Chonburi province.

Knowledge section

According to the survey in public awareness about antibiotic resistance of WHO (2015), knowledge of participants was measured in two topics: knowledge of resistance and knowledge of antimicrobials use. Furthermore, Chuenchom et.al (2016) assessed knowledge of final year medical students in Thailand through clinical scenarios which aim to assess the participant knowledge of antimicrobial use following local guidelines.

This study will assess pharmacists' knowledge in two topics, knowledge of antimicrobial resistance and antimicrobial use. Also, it uses clinical scenarios to measure knowledge in antimicrobial use based on antibiotic smart use guidelines in Thailand (Chongtrakul, 2011).

Five questions assess knowledge of antimicrobial resistance; these relate to the principles of resistance, and antimicrobial stewardship. Five other questions measure knowledge of antimicrobial use relating to pharmacology and rational use of antibiotics through clinical scenario. The scenarios were selected from the antibiotic smart use guideline in Thailand and previous research (Apisarnthanarak et.al, 2008; Chongtrakul, 2011; Chuenchom et.al, 2016).

Question items in knowledge section

Antimicrobial resistance

k1 “Superbugs” are microorganisms which generate antimicrobial resistance that include bacteria, fungal, virus or parasites.

k2 Resistance DNA in bacteria can transfer each other by virus.

k3 Antibiotic consumptions in human are provided in healthcare-setting more than community setting.

k4 The main objective of antimicrobial stewardship is the most effective clinical outcome with less toxicity and adverse reactions.

k5 Antimicrobial stewardship is a role of hospital pharmacist

Antimicrobial Use

k6 Penicillin, cephalosporin, and fluoroquinolone are Beta-lactam (β-lactam antibiotic. It need to consider Beta-lactamase producing bacterial.

k7 Patients who allergic Amoxicillin could avoid using Cephalexin.

k8 Is it appropriate? When, pharmacist dispense amoxicillin 1,500 mg a day, 7 days for a 26-year-old male with allergic rhinitis, had high-grade fever rhinorrhoea, and sore throat? (Chongtrakul, 2011; Chuenchom et.al, 2016)

k9 Is it appropriate? When, pharmacist dispense only mineral powder in case a 2-year-old boy with watery diarrhoea, no mucous, no bloody stool, no fever, no vomiting? (Chongtrakul, 2011; Chuenchom et.al, 2016)

k10 Is it appropriate? When, pharmacist dispense Dicloxacillin 250 mg four time a day for 5 days to prevent infection in case a 24-year old male has had skin abrasion wound on his right arm without exudates for 2 days, limited to subcutaneous layer, mild tenderness, no swelling, no active bleeding, no fever, and not allergic to any antibiotic? (Apisanthanarak, et.al, 2008; Chongtrakul, 2011)

Attitude section

Attitudes section examines community pharmacists’ agreement with antimicrobial use and resistance statements. Ten statements were adapted and adopted from existing qualitative and quantitative research to develop attitude statements on antibiotics dispensing of community pharmacists in Portugal (Roque et.al, 2013; Roque et.al, 2014).

According to Roque et.al (2013), attitude of community pharmacists to provide antimicrobials can be examined through attitudes towards the problem of resistance and attitudes towards antibiotic use. The previous research was used to develop 16 statements to evaluate participants’ attitudes. However, this research uses 10 statements from the previous research to accommodate the Thai context and shorten the length of the questionnaire. The selected statements have high to excellent reliability and an intraclass correlation coefficients (ICC) of more than 0.6 (Roque et.al, 2014). Further, the statements have been divided into two group, attitude towards antimicrobial resistance and attitudes towards antimicrobials use.

Antimicrobial resistance

a1 Antimicrobial resistance is an important public health problem of ours.

a2 The fact of a patient taking an antibiotic increases the risk of developing resistance.

a3 An important cause of appearance of antibiotic resistance is long-term prescription of new molecular entities.

a4 I am convinced that new antimicrobials will be developed to solve the problem of resistance.

a5 The use of antibiotics in animals for human consumption is an important cause of appearance of new resistance to pathogenic agents in humans.

Antimicrobials use

a6 In all cases where antimicrobials are dispensed, it is essential that patients be advised about complying with the treatment.

a7* Antimicrobials are sometimes dispensed without medical prescription because the patient is known to have difficulty in obtaining a medical consultation.

a8 If a patient feels that he/she needs antibiotics, and these are not dispensed, he/she will easily manage to obtain them at another pharmacy.

a9* Antimicrobials are sometimes prescribed without medical prescription because the patient is known to have neither the time nor the money to see a physician

a10 Dispensing antimicrobials without prescription should be more closely controlled

* = negative statement

Practice section

Practice section aims to investigate pharmacists' current actions of antimicrobials dispensing in pharmacy according to their knowledge and attitudes. This section was split into two parts; multiple choices questions and open-ended questions.

Multiple choices questions

Ten statements relating to provision of antimicrobials were selected from existing literature on perceptions and practices of community pharmacists toward antimicrobial stewardship (Khan et.al, 2016). The questionnaire was validated by experts. However, it was adjusted to be appropriate for Thai community pharmacists because the law allows the pharmacists to dispense antimicrobials without a prescription. Further, statements from a WHO survey on the roles of pharmacists in antimicrobial use (2015) were used to develop the research instrument. Ten action statements were included in this questionnaire as follows.

p1 I ask patient's history symptom of their infections before deciding to dispense antimicrobials.

p2 I sought additional clinical information (e.g. drug interaction, ADRs, allergy, etc.) before deciding to dispense the antimicrobials

p3 I screen the antimicrobials in accordance with local guidelines before dispensing

p4 I dispense antimicrobial with complete clinical information

p5 I educate patients on the use of antimicrobials and resistance-related issues

p6* I dispense antimicrobials without a prescription.

p7 I take part in antimicrobial awareness campaigns to promote the optimal use of Antimicrobials

p8* I lack continuing education in antimicrobial use and resistance topics.

p9 I make efforts to prevent or reduce the transmission of infections within the Community

p10 I collaborate with other health professionals for infection control and antimicrobial stewardship

*= negative statement

Open–ended questions

From reviewing the literature, it was found that most community infections are respiratory infections (Apisarnthanarak et.al, 2008, Saengcharoen et.al, 2008) and the top three groups of antibiotics used in Thailand were Penicillin, Fluoroquiniolone and Cehalosporin (CDDEP,2016). Three open-end questionnaires were developed to ask pharmacists about commonly encountered infectious diseases, antimicrobials used and the reason for dispensing non-prescription antimicrobials for patients. These questions aim to explore the current situation of antimicrobials provision in community pharmacy in Thailand. The finding here will not be used to calculate relationships with other factors.

Question items

- What are the top three most common infections encountered in community pharmacy?
- What are the top three antimicrobials most commonly be dispensed in community pharmacy?
- What is the main reason for dispensing antimicrobials without a prescription?

Questionnaire validation and reliability test

Although this questionnaire was developed based on previous research instruments that were validated by experts, the new questionnaire would still need to be validated because of the different setting and type of participants. Smith (1997) suggests that questionnaire which was developed by previous research should be valid and reliable. The new setting, different population and modifications do not guarantee that the questionnaire retains its validity and reliability. Similarly, the new questionnaire that uses only selected items from existing questionnaires should provide evidence of its validity and reliability (Draugalis et.al, 2008).

Questionnaire validation

Method of validation

The questionnaire was validated by an expert panel. Researcher invited three experts in antimicrobial stewardship and community pharmacy service to review the questionnaire. The expert must be a pharmacist with a minimum of an MSc in the relevant field. They must have experience of dealing with antimicrobial resistance and delivering community pharmacy services. Validation form was sent to the panel by e-mail. The result of ratings was calculated using an item-objective congruence (IOC) score for each item. The experts gave scores for each question to -1 (clearly not measure), 0 (the content is unclear) and 1 (clearly to measure). The average IOC score > 0.5 indicates good content validity (Turner & Carlson, 2003). Moreover, the experts were invited to give comments on the questions for improvement. The results of the review were used to finalise the questionnaire before using it in the pilot study.

The panel of expert

Dr. Somying Pumthong (Expert 1) is an assistant professor in the faculty of pharmacy, Srinakharinwirot University in Thailand. She graduated with a doctoral degree in social-pharmacy from University of Nottingham, UK and has research experience in antimicrobial use and resistance in Thailand both in community and hospital setting.

Mrs. Suneerat Kittikun (Expert 2) is a community pharmacist in Chonburi province. She has a professional experience in a drugstore exceeding ten years. She graduated with an MSc degree and her work was on decision-making of consumers in pharmacies. She also received the Certificate of Pharmaceutical Care in Community Pharmacies (Health Promotion and Disease Prevention). She is a teacher practitioner, and she collaborates with the National Health Security project to provide community pharmacy services in primary care.

Dr. Suphannika Prateepjarassaeng (Expert 3) is a clinical pharmacist and teacher practitioner in the department of clinical pharmacy, Burapha University. She graduated with a Doctorate of Pharmacy and Specialised Fellowship in Internal Medicine Pharmacotherapy. Her experience of antimicrobial stewardship includes participation and leadership on integrating the role of pharmacists in antimicrobials use at the internal medicine department. She develops medication profiles for patients' treatment, and infections prevention and control practices training to physicians and nurses.

Reliability test

The validated questionnaire was sent online to fifteen community pharmacists (Surveymonkey®). Cronbach's alpha was used for internal consistency reliability test to confirm that the questionnaire can measure what it intends to measure (Rodrigues et.al, 2016). The acceptable alpha value is more than 0.7 and low value of alpha indicates that the questionnaire should be revised. (Tavakol & Dennick, 2011; Rodrigues et.al, 2016).

Interclass Correlation Coefficients (ICC) was employed for measuring reproducibility reliability (test-retest). The pharmacists responded to the same questionnaire on two separate occasions, one week apart. Statistic two-way mixed ICC analysed repeatability for each question (Koo & Li, 2016). ICC value lower than 0.4 indicates low reproducibility, acceptable rate is 0.4-0.75 meaning fair to good and over 0.75 means high reproducibility (Rodrigues et.al,2016).

However, Cohen's kappa was used for test-retest analysis in the knowledge section because it is recorded as binary data, correct and incorrect (McHugh, 2012; Tan et.al, 2015). The kappa value of more than 0.75 is excellent, 0.40 to 0.75 is moderate to good, and less than 0.4 is poor agreement (Kirkwood & Sterne, 2010).

Pilot sampling

Researcher invited fifteen (n=15) community pharmacists in Thailand to take part in this pilot test; this has been excluded from the main study. The pharmacists responded to the adjusted questionnaire twice online, initially and after one week, between 17 and 26 April 2017.

The results of validation and reliability test was used for improving the questionnaire (See Chapter 5, Results of questionnaire validation and reliability test). The final questionnaire contains 35 questions and divided into 4 section, Demographics, Knowledge, Attitude, and Practice which included three opened-end questions about current status of antimicrobials provision in community pharmacy (*See table 2*).

Items	Questions	References
K1	“Superbugs” are microorganisms which generate antimicrobial resistance. They include bacteria, fungal, virus or parasites.	
K2	Resistance DNA in bacteria can transfer to other bacteria by virus.	
K3	Antimicrobial resistance in hospital setting is higher than community setting.	
K4	The main objective of antimicrobial stewardship is to achieve the most effective clinical outcome with less toxicity and adverse reactions to antimicrobials.	
K5	Penicillin, cephalosporin, and fluoroquinolone are β -lactam antibiotics. It need to consider Beta-lactamase producing bacterial.	
K6	Patients who are allergic to Amoxicillin (Anaphylaxis type) should not use Cephalexin.	
K7	Is it appropriate? When a pharmacist dispenses amoxicillin 1,500 mg a day, 7 days for a 26-year-old male with allergic rhinitis, high-grade fever rhinorrhoea, and sore throat, and no known drug allergy.	Chuenchom et.al, 2016
K8	Is it appropriate? When a pharmacist dispenses only mineral powder for a 2-year-old boy with watery diarrhoea, no mucous/bloody stool, no fever, no vomiting.	Chuenchom et.al, 2016
K9	Is it appropriate? When a pharmacist dispenses dicloxacillin 250 mg four time a day for 5 days to prevent an infection in case of a 24-year old male who has had a skin abrasion wound on his right arm without exudates for 2 days, limited to subcutaneous layer, mild tenderness, no swelling, no active bleeding, no fever, and no known drug allergy.	Apisarnthanarak et.al, 2008.
A1	Antimicrobial resistance is an important public health problem of ours.	Roque et.al, 2014
A2	The fact that a patient is taking an antibiotic increases the risk of developing resistance	Roque et.al, 2014
A3	New antimicrobials development can solve antimicrobial resistance problem.	Roque et.al, 2014
A4	The use of antimicrobials in *livestock animals* is an important cause of appearance of new resistance to pathogenic agents in humans.	Roque et.al, 2014
A5	In all cases where antimicrobials are dispensed, it is essential that patients be advised about complying with the treatment	Roque et.al, 2014
A6	Antimicrobials are sometimes dispensed without medical prescription because the patient is known to have difficulty in obtaining a medical consultation.	Roque et.al, 2014
A7	Antimicrobials are sometimes prescribed without medical prescription because the patient is known to have neither the time nor the money to see a physician.	Roque et.al, 2014
A8	Dispensing antimicrobials without prescription is serious issue.	Roque et.al, 2014
P1	I educate patients on the use of antimicrobials and resistance-related issues.	Khan et.al, 2016
P2	I take part in antimicrobial awareness campaigns to promote the optimal use of antimicrobials	Khan et.al, 2016
P3	I lack continuing education in antimicrobial use and resistance topics.	Khan et.al, 2016
P4	I make efforts to prevent or reduce the transmission of infections within the community.	Khan et.al, 2016
P5	I collaborate with other health professionals for infection control and antimicrobial stewardship	Khan et.al, 2016
P6	I ask patient’s history and symptom of their infections before deciding to dispense antimicrobials.	Khan et.al, 2016
P7	I sought additional clinical information (e.g. drug interaction, ADRs, allergy, etc.) before deciding to dispense the antimicrobials	Khan et.al, 2016
P8	I screen the antimicrobials in accordance with local guidelines before dispensing	Khan et.al, 2016
P9	I dispense antimicrobial with complete clinical information (e.g. drug interaction, ADRs, allergy, etc.)	Khan et.al, 2016
P10	I dispense antimicrobials without a prescription.	Khan et.al, 2016
P11	What are top three most commonly encountered infections in your community pharmacy?	
P12	What are the top three most commonly dispensed antimicrobials in your community pharmacy?	
P13	What is a main reason for dispensing antimicrobials without a prescription?	

Table 2: Lists of Knowledge, Attitude, and Practice items in the final questionnaire.

Data collection

The questionnaire link on Surveymonkey® was published on social media and e-mailed to participants. Five-hundred and twenty-one (521) pharmacists were invited to access an online questionnaire by e-mail list (n=213), LINE application group Chonburi drugstore network (n=195), and Group of community pharmacy service (n=113).

The participants could answer the questionnaire from 9 June 2017 to 7 July 2017, sixty days. Reminder massages were sent to participants every two week.

Ethical consideration

This research follows the University of Hertfordshire Policies and Regulations (UPRs) of Studies Involving the Use of Human Participants. It was granted ethical approval under protocol number: **LMS/PGR/UH/02811**

Data analysis

Variables in the study are demographics, knowledge, attitude and practice of the participants. They can be collected using different scales as shown in table 3.

Variables	Type of scale
Age	Ratio scale; 18-100
Gender	Nominal scale; 0= male, 1= female
Education	Nominal scale; 0= BSc/BPharm (5-year programme), 1 = PharmD (6-year programme)
Experience	Interval scale; 0-60 year(s)
Workplace location	Nominal scale; 0= Bangkok, 1= Chonburi
Type of pharmacy	Nominal scale; 0= Individual, 1= chain-store
Knowledge	Interval scale; 0 – 10 point(s)
Attitude	Ordinal scale; 1=Strongly Disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree and 5=Strongly Agree.
Practice	Ordinal scale; 1= Never, 2=Rarely, 3= Sometimes, 4=Often and 5=Always

Table 3: Variables and collecting scale in study

Though age and gender have been collected as ratio scale, they have been classified into 3 groups of each factor which are ordinal scale Age split into lower than 30 yrs., 30-40 yrs., and over group than 40 yrs. gr Experience divided into lower than 5 yrs., 5-10 yrs., and over than 10 yrs. cluster.

Scoring

Knowledge section: The participant gets 1 point for the correct answer to each question. If they choose "Uncertain" this indicates that they do not know a correct answer. As there are nine items in this section, the total knowledge sore can be between zero to nine points. The participants who score lower and equal to 50% are defined to have poor knowledge (Khan et.al, 2014).

Attitude section: The participant provides their agreement with each agreement on a 5-point Likert scales as; 1= Strongly Disagree, 2= Disagree, 3= Neither agree nor disagree, 4=Agree and 5=Strongly Agree, the midpoint is 3. Also, reverse coding was used for negative statements. Total attitude score from eight items was calculated ranging from 8 to 40. The total midpoint is 24 showing a natural attitude. So, the participants who get a total attitude score of less than the total midpoint (24) mean they disagree with attitudes (Peterson-Clark et.al, 2010). They are classified as having a poor attitude in antimicrobials use and resistance.

Practice section: The participant evaluates their actions in 10 statements on a 5-point frequency Likert scales as; 1= Never, 2= Rarely, 3= Sometimes, 4=Often and 5=Always, the midpoint is 3. Also, reverse coding was used for negative statements. Total practice score from 10 items ranges from 10 to 50. The total midpoint is 30 showing a total natural practice. The participants who get total practice scores less than the total midpoint (30) have a poor practice in antimicrobials use and resistance.

The Statistic Package for the Social Science (SPSS) software version 24 was used for analysis.

1. **Reliability test in pilot study** (see detail in reliability test in questionnaire development section)
    - Internal consistency use Cronbach's alpha analysis
    - Reproducibility reliability measured by Interclass correlation coefficients (ICC).
2. **Descriptive analysis**

Descriptive statistical analysis such as mean, standard division (SD), Chi-square test, Mann-Whitney U Test and Kruskal-Wallis test were used to describe demographics in relation to knowledge, attitude and practice of participants (Khan et.al, 2016).

3. **Correlation analysis**

Spearman's correlation coefficient statistic was used to determine relationships of knowledge-attitude, attitude -practice and practice-knowledge (Huang et.al, 2013)**.**

4. **Qualitative data**

The results of open-end questions were coding using coding technique to interpret respondents' answers and present them as percentages**.**

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CHAPTER 5
STUDY RESULTS

Results of questionnaire validations and reliability test

Questionnaire validation

The average IOC score of each item were calculated by experts rating (*See Table 4*). The questions that have an average IOC score less than 0.5 will be excluded from the questionnaire because they content is not a proper measure (Turner & Carlson, 2003).

Overall, the experts suggested that we provide more information on some questions to enhance clarity. For example, researcher provided further details of amoxicillin allergy as anaphylaxis, gave information about drug allergy profile of patients in clinical scenarios. Also, the practice section was reorganised according to their suggestions regarding definition and context of the research.

In the knowledge section, question k5 “Antimicrobial stewardship is a role of hospital pharmacists” was rejected. The panel suggested that the question might indicate an attitude of participants rather than knowledge. In the attitudes section, item a3 “An important cause of appearance of antimicrobial resistance is long course prescription of new antimicrobials” was rejected because it does not represent Thai pharmacists attitude, and might be misunderstand especially if there is a language barrier. The question A8 “If a patient feels that he/she needs antibiotics, and these are not dispensed, he/she will easily manage to obtain them at another pharmacy” was eliminated because Thailand allows pharmacies to dispense antimicrobial for patients; this means that antimicrobials can easily be purchased in any store depending on the discretion and/or ethic of the provider. Also, the question does not indicate feelings of the participant towards the topic.

According to the experts’ comments, the practice section was reorganised and divided into two groups similar to the knowledge and attitude sections. Questions p5, p7, p8, p9, and p10 were grouped as practice regarding antimicrobial resistance while p1, p2, p3, p4, p6 were defined as practice statements on antimicrobial use. The experts accepted all questions in this section in relation to content, and no questions were rejected here.

After validation, the final questionnaire consisted of thirty-five questions. This was then used in the pilot test involving fifteen pharmacists for reliability measuring.

Table 4: The results of Item-Objective Congruence (IOC) scores from experts

Items	Question/Statement	Item-Objective Congruence (IOC) score					Result	Developed question/ statement after validation
		Expert 1	Expert 2	Expert 3	Total score	Average score		
Knowledge Section								
Knowledge in antimicrobial resistance								
k1	"Superbugs" are microorganisms which generate antimicrobial resistance. They include bacteria, fungal, virus or parasites.	1	1	1	3	**1.00**	Accept	**K1:** "Superbugs" are microorganisms which generate antimicrobial resistance. They include bacteria, fungal, virus or parasites.
k2	Resistance DNA in bacteria can transfer to other bacteria by virus.	1	1	1	3	**1.00**	Accept	**K2:** Resistance DNA in bacteria can transfer to other bacteria by virus.
k3	Antibiotic consumptions in humans is higher in hospital setting compared to community setting.	0	1	1	2	**0.67**	Accept	**K3:** ***Antimicrobial resistance*** in hospital setting is higher than community setting.
k4	The main objective of antimicrobial stewardship is to achieve the most effective clinical outcome with less toxicity and adverse reactions to antimicrobials.	0	1	1	2	**0.67**	Accept	**K4:** The main objective of antimicrobial stewardship is to achieve the most effective clinical outcome with less toxicity and adverse reactions to antimicrobials.
k5	Antimicrobial stewardship is a role of hospital pharmacists.	0	0	1	1	**0.33**	**Reject**	
Knowledge in antimicrobial use								
k6	Penicillin, cephalosporin, and fluoroquinolone are β -lactam antibiotics. It need to consider Beta-lactamase producing bacterial.	1	0	1	2	**0.67**	Accept	**K5:** Penicillin, cephalosporin, and fluoroquinolone are β -lactam antibiotics. It need to consider Beta-lactamase producing bacterial.
k7	Patients who are allergic to Amoxicillin should not use Cephalexin.	1	1	0	2	**0.67**	Accept	**K6:** Patients who are allergic to Amoxicillin ***(Anaphylaxis type)*** should not use Cephalexin.
k8	Is it appropriate? When a pharmacist dispenses amoxicillin 1,500 mg a day, 7 days for a 26-year-old male with allergic rhinitis, high-grade fever rhinorrhoea, and sore throat.	1	1	0	2	**0.67**	Accept	**K7:** Is it appropriate? When a pharmacist dispenses amoxicillin 1,500 mg a day, 7 days for a 26-year-old male with allergic rhinitis, high-grade fever rhinorrhoea, and sore throat, ***and no known drug allergy.***
k9	Is it appropriate? When a pharmacist dispenses only mineral powder for a 2-year-old boy with watery diarrhoea, no mucous/bloody stool, no fever, no vomiting.	1	1	1	3	**1.00**	Accept	**K8:** Is it appropriate? When a pharmacist dispenses only mineral powder for a 2-year-old boy with watery diarrhoea, no mucous/bloody stool, no fever, no vomiting.
k10	Is it appropriate? When a pharmacist dispenses dicloxacillin 250 mg four time a day for 5 days to prevent an infection in case of a 24-year old male who has had a skin abrasion wound on his right arm without exudates for 2 days, limited to subcutaneous layer, mild tenderness, no swelling, no active bleeding, no fever, and no known drug allergy.	1	1	1	3	**1.00**	Accept	**K9:** Is it appropriate? When a pharmacist dispenses dicloxacillin 250 mg four time a day for 5 days to prevent an infection in case of a 24-year old male who has had a skin abrasion wound on his right arm without exudates for 2 days, limited to subcutaneous layer, mild tenderness, no swelling, no active bleeding, no fever, and no known drug allergy.

Items	Question/Statement	Item-Objective Congruence (IOC) score					Result	Developed question/ statement after validation
		Expert 1	Expert 2	Expert 3	Total score	Average score		
Attitude Section								
Attitude in antimicrobial resistance								
a1	Antimicrobial resistance is an important public health problem of ours.	1	1	1	3	**1.00**	Accept	**A1:** Antimicrobial resistance is an important public health problem of ours.
a2	The fact that a patient is taking an antibiotic increases the risk of developing resistance	1	1	1	3	**1.00**	Accept	**A2:** The fact that a patient is taking an antibiotic increases the risk of developing resistance
a3	An important cause of appearance of antimicrobial resistance is long course prescription of new antimicrobials	0	0	0	0	**0**	**Reject**	
a4	I am convinced that new antimicrobials will be developed to solve the problem of resistance.	1	1	1	3	**1.00**	Accept	**A3:** New antimicrobials development can solve antimicrobial resistance problem. - *shorter*
a5	The use of antibiotics in animals for human consumption is an important cause of appearance of new resistance to pathogenic agents in humans.	1	1	1	3	**1.00**	Accept	**A4:** The use of antimicrobials in *livestock animals* is an important cause of appearance of new resistance to pathogenic agents in humans.
Attitude in antimicrobial use								
a6	In all cases where antimicrobials are dispensed, it is essential that patients be advised about complying with the treatment	1	1	1	3	**1.00**	Accept	**A5:** In all cases where antimicrobials are dispensed, it is essential that patients be advised about complying with the treatment
a7	Antimicrobials are sometimes dispensed without medical prescription because the patient is known to have difficulty in obtaining a medical consultation.	1	1	1	3	**1.00**	Accept	**A6:** Antimicrobials are sometimes dispensed without medical prescription because the patient is known to have difficulty in obtaining a medical consultation.
a8	If a patient feels that he/she needs antibiotics, and these are not dispensed, he/she will easily manage to obtain them at another pharmacy.	0	0	1	1	**0.33**	**Reject**	
a9	Antimicrobials are sometimes prescribed without medical prescription because the patient is known to have neither the time nor the money to see a physician.	0	1	1	2	**0.67**	Accept	**A7:** Antimicrobials are sometimes prescribed without medical prescription because the patient is known to have neither the time nor the money to see a physician.
a10	Dispensing antimicrobials without prescription should be more closely controlled	1	1	1	3	**1.00**	Accept	**A8:** Dispensing antimicrobials without prescription is serious issue.

Items	Question/Statement	Item-Objective Congruence (IOC) score					Result	Developed question/ statement after validation
		Expert 1	Expert 2	Expert 3	Total score	Average score		
Practice Section (reorganised)								
Practice in antimicrobial resistance								
p5	I educate patients on the use of antimicrobials and resistance-related issues.	1	1	1	3	**1.00**	Accept	**P1:** I educate patients on the use of antimicrobials and resistance-related issues.
p7	I take part in antimicrobial awareness campaigns to promote the optimal use of antimicrobials.	1	1	1	3	**1.00**	Accept	**P2:** I take part in antimicrobial awareness campaigns to promote the optimal use of antimicrobials
p8	I lack continuing education in antimicrobial use and resistance topics.	1	1	1	3	**1.00**	Accept	**P3:** I lack continuing education in antimicrobial use and resistance topics.
p9	I make efforts to prevent or reduce the transmission of infections within the community.	1	1	1	3	**1.00**	Accept	**P4:** I make efforts to prevent or reduce the transmission of infections within the community.
p10	I collaborate with other health professionals for infection control and antimicrobial stewardship.	1	1	1	3	**1.00**	Accept	**P5:** I collaborate with other health professionals for infection control and antimicrobial stewardship
Practice in antimicrobial use								
p1	I ask patient's history and symptom of their infections before deciding to dispense antimicrobials.	1	1	1	3	**1.00**	Accept	**P6:** I ask patient's history and symptom of their infections before deciding to dispense antimicrobials.
p2	I sought additional clinical information (e.g. drug interaction, ADRs, allergy, etc.) before deciding to dispense the antimicrobials	1	1	1	3	**1.00**	Accept	**P7:** I sought additional clinical information (e.g. drug interaction, ADRs, allergy, etc.) before deciding to dispense the antimicrobials
p3	I screen the antimicrobials in accordance with local guidelines before dispensing	1	1	1	3	**1.00**	Accept	**P8:** I screen the antimicrobials in accordance with local guidelines before dispensing
p4	I dispense antimicrobial with complete clinical information	1	1	0	2	**0.67**	Accept	**P9:** I dispense antimicrobial with complete clinical information ***(e.g. drug interaction, ADRs, allergy, etc.)***
p6	I dispense antimicrobials without a prescription.	1	1	1	3	**1.00**	Accept	**P10:** I dispense antimicrobials without a prescription.
Current situation in practice (open-end questions)								
p11	What are top three most commonly encountered infections in community pharmacy?	1	1	1	3	**1.00**	Accept	**P11:** What are top three most commonly encountered infections in ***your*** community pharmacy?
p12	What are the top three most commonly dispensed antimicrobials in community pharmacy?	1	1	1	3	**1.00**	Accept	**P12:** What are the top three most commonly dispensed antimicrobials in ***your*** community pharmacy?
p13	What is a main reason for dispensing antimicrobials without a prescription?	1	1	1	3	**1.00**	Accept	**P13:** What is a main reason for dispensing antimicrobials without a prescription?

Questionnaire reliability testing

A pilot test was conducted to test if the questionnaire can measure community pharmacists' knowledge, attitude, and practice in the topic with reliability and reproducibility. The participants in the test are Thai community pharmacist with varying types of pharmacy degree, location, and type of drugstore. They could represent opinions of pharmacists who will participate in the main study in the same way. However, age and years of experience may not be representative as it a small number of participants.

Test-retest reliability was applied test reliability and reproducibility of the questionnaire. Researchers designed two occasions in one-week period based on a learning recall effect that could disturb findings in a re-test. The period should be short enough to not change participants' behaviour and long enough to avoid remembering the questions (Rodrigues et.al, 2016).

A total of fifteen (n=15) community pharmacists in the pilot test responded to the validated online questionnaire. The majority of pharmacists were female, 66.7% (n=10) with an average age of 28.98 years. 53.3% (n=8) of participants graduated through the five-year pharmacy programme, and 33.3% (n=5) of the pharmacists held a postgraduate degree at Master level. The participants have practiced in community pharmacy for a mean 3.53 years. 40% (n=6) worked in Bangkok, 20% (n=3) in Chonburi, and others 40% (n=6). Most of pharmacy type was individual pharmacy (66.7%, n=10). (Table 5)

Demographic data	
Age (mean ± SD)	28.98 ± 1.82
Experience (mean ± SD)	3.53 ± 2.56
Gender, n (%) Female Male	 10 (66.7) 5 (33.3)
Pharmacy Degree, n (%) BPharm/BSc in Pharm PharmD	 8 (53.3) 7 (46.7)
Postgraduate Degree, n (%) None Master degree	 10 (66.7) 5 (33.3)
Location, n (%) Bangkok Chonburi Others	 6 (40.0) 3 (20.0) 6 (40.0)
Type of Pharmacy, n (%) Individual store Chain store	 10 (66.7) 5 (33.3)

Table 5: Demographic profile of participants in pilot test

Internal consistency reliability test

Cronbach's alpha was applied for analysis of internal consistency reliability test. The alpha values were 0.769, 0.783, and 0.742 in knowledge-, attitude- and practice section, respectively in early test. Moreover, alpha values in re-test were calculated and present at 0.731, 0.718, and 0.723 as show in Table 6. The results of alpha values show that questions can measure each variable factor because the values are acceptable, more than 0.7 (Tavakol & Dennick, 2011; Rodrigues et.al, 2016).

Section	Number of Items	Cronbach's Alpha Pre-test	Cronbach's Alpha Retest
Knowledge	9	0.769	0.731
Attitude	8	0.783	0.718
Practice	10	0.742	0.723

Table 6: Cronbach's alpha value in each section in reliability test.

Reproducibility test

Test-retest reliability can examine that a measurement is reproducible over time.

Regarding reproducibility test, Cohen's kappa (k). Kappa values range from -1 to +1 to indicate agreement between test and retest (McHugh, 2012, Tan et.al, 2015). The kappa value of more than 0.75 is excellent, 0.40 to 0.75 is moderate to good, and less than 0.4 is poor agreement (Kirkwood & Sterne, 2010; McHugh, 2012). The results in Table 7 show that the lowest value is question K7 (k=0.444) indicating a fair agreement between two occasions test and the highest value was in question K2 and K8 (k=0.762) showing an excellent agreement in the test. The questions in the knowledge section are acceptable based on the kappa values and this means that these are reproducible.

Items	Kappa	p-value
Knowledge Section		
K1: "Superbugs" are microorganisms which generate antimicrobial resistance. They include bacteria, fungal, virus or parasites.	0.615	0.01
K2: Resistance DNA in bacteria can transfer to other bacteria by virus.	0.762	0.002
K3: Antimicrobial resistance in hospital setting is higher than community setting.	0.634	0.008
K4: The main objective of antimicrobial stewardship is to achieve the most effective clinical outcome with less toxicity and adverse reactions to antimicrobials.	0.634	0.008
K5: Penicillin, cephalosporin, and fluoroquinolone are beta -lactam antibiotics. It need to consider Beta-lactamase producing bacterial	0.634	0.008
K6: Patients who are allergic to Amoxicillin (Anaphylaxis type) should not use Cephalexin.	0.634	0.008
K7: Is it appropriate? When a pharmacist dispenses amoxicillin 1,500 mg a day, 7 days for a 26-year-old male with allergic rhinitis, high-grade fever rhinorrhoea, and sore throat, and no known drug allergy.	0.444	0.038
K8: Is it appropriate? When a pharmacist dispenses only mineral powder for a 2-year-old boy with watery diarrhoea, no mucous/bloody stool, no fever, no vomiting.	0.762	0.002
K9: Is it appropriate? When a pharmacist dispenses dicloxacillin 250 mg four time a day for 5 days to prevent an infection in case of a 24-year old male who has had a skin abrasion wound on his right arm without exudates for 2 days, limited to subcutaneous.	0.650	0.003

Table 7: The kappa coefficient value in knowledge section

Intraclass correlation coefficient (ICC) analysis was used; this is generally used in test-retest (Koo & Li, 2016). According to Koo and Li guideline in 2016, the researcher employed two-way mixed model to calculate ICC value in test because it used selected participants of interest; fifteen pharmacists took part, a measurement at two different times, and there was no random sampling. The ICC value indicates reproducibility that <0.4 is low, acceptable rate of 0.75-0.4 means fair to good and >0.75 means high reproducibility (Rodrigues et.al, 2016).

Overall, statements in attitude and practice sections show that there is an acceptable rate agreement between test and retest (Table 8). Attitude section showed the lowest ICC values in statement A1 (0.471) with acceptable reproducibility through to excellent reproducibility in A7 (0.840). Practice section presented lowest agreement but acceptable in P10 (0.448) up to P10 (0.921) as excellent agreement. It means that statements in the questionnaire in attitude and practice sections are reproducible on different occasions.

Items	ICC	95% CI	p-value
Knowledge Section			
K1: "Superbugs" are microorganisms which generate antimicrobial resistance. They include bacteria, fungal, virus or parasites.	0.667	0.253-0.874	0.002
K2: Resistance DNA in bacteria can transfer to other bacteria by virus.	0.774	0.450-0.918	<0.001
K3: Antimicrobial resistance in hospital setting is higher than community setting.	0.650	0.226-0.867	0.003
K4: The main objective of antimicrobial stewardship is to achieve the most effective clinical outcome with less toxicity and adverse reactions to antimicrobials.	0.650	0.226-0.867	0.003
K5: Penicillin, cephalosporin, and fluoroquinolone are beta -lactam antibiotics. It need to consider Beta-lactamase producing bacterial	0.650	0.226-0.867	0.003
K6: Patients who are allergic to Amoxicillin (Anaphylaxis type) should not use Cephalexin.	0.650	0.226-0.867	0.003
K7: Is it appropriate? When a pharmacist dispenses amoxicillin 1,500 mg a day, 7 days for a 26-year-old male with allergic rhinitis, high-grade fever rhinorrhoea, and sore throat, and no known drug allergy.	0.480	-0.023-0.789	0.003
K8: Is it appropriate? When a pharmacist dispenses only mineral powder for a 2-year-old boy with watery diarrhoea, no mucous, no bloody stool, no fever, no vomiting.	0.774	0.450-0.918	<0.001
K9: Is it appropriate? When a pharmacist dispenses dicloxacillin 250 mg four time a day for 5 days to prevent an infection in case of a 24-year old male who has had a skin abrasion wound on his right arm without exudates for 2 days, limited to subcutaneous.	0.650	0.226-0.867	0.003
Attitude section			
A1: Antimicrobial resistance is an important public health problem of ours.	0.471	-0.035-0.784	0.033
A2: The fact that a patient is taking an antimicrobial increases the risk of developing resistance.	0.619	0.176-0.854	0.005
A3: New antimicrobials development can solve antimicrobial resistance issue.	0.655	0.234-0.869	0.003
A4: The use of antimicrobials in livestock animals is an important cause of appearance of new resistance to pathogenic agents in humans.	0.526	0.039-0.811	0.018
A5: In all cases where antimicrobials are dispensed, it is essential that patients be advised about complying with the treatment.	0.636	0.203-0.861	0.004
A6: Antimicrobials are sometimes dispensed without medical prescription because the patient is known to have difficulty in obtaining a medical consultation.	0.485	-0.016-0.791	0.028
A7: Antimicrobials are sometimes prescribed without medical prescription because the patient is known to have neither the time nor the money to see a physician.	0.840	0.589-0.943	<0.001
A8: Dispensing antimicrobials without prescription should be more closely controlled.	0.770	0.443-0.917	<0.001
Practice section			
P1: I educate patients on the use of antimicrobials and resistance-related issues	0.577	0.112-0.835	0.010
P2: I take part in antimicrobial awareness campaigns to promote the optimal use of antimicrobials	0.921	0.782-0.973	<0.001
P3: I lack continuing education in antimicrobial use and resistance topics.	0.520	0.031-0.808	0.019
P4: I make efforts to prevent or reduce the transmission of infections within the community	0.710	0.328-0.892	0.001
P5: I collaborate with other health professionals for infection control and antimicrobial stewardship	0.556	0.082-0.825	0.013
P6: I ask patient's history and symptom of their infections before deciding to dispense antimicrobials.	0.583	0.121-0.838	0.009
P7: I sought additional clinical information (e.g. drug interaction, ADRs, allergy, etc.) before deciding to dispense the antimicrobials	0.735	0.374-0.902	0.001
P8: I screen the antimicrobials in accordance with local guidelines before dispensing	0.509	0.16-0.803	0.022
P9: I dispense antimicrobial with complete clinical information (e.g. patient's history, drug interaction, ADRs, allergy, etc.)	0.491	-0.008-0.794	0.027
P10: I dispense antimicrobials without a prescription.	0.448	-0.064-0.773	0.041

*p <0.05 ** p<0.01 *** p <0.001

Table 8: The results of Interclass Correlation Coefficients (ICC) in each question.

Results of data collection

Community pharmacists in Bangkok and Chonburi province in Thailand were invited to participate an online questionnaire totally 521 persons. Invitation massages was posted in social media groups of LINE® application which famous social media in Thai pharmacists. There are 195 members in Chonburi Drugstores Network groups, and 113 members in Community Pharmacy Service in Bangkok group. Direct e-mail was sent to invite 213 community pharmacists who were random selected from database websites of Thai FDA, and Community Pharmacy Association of Thailand. 378 persons participated the questionnaire, however, there are 6 participants were rejected because they cannot justify inclusion criteria. Finally, 372 community pharmacists who met requirements were collected data and gain 71.4% of respond rate.

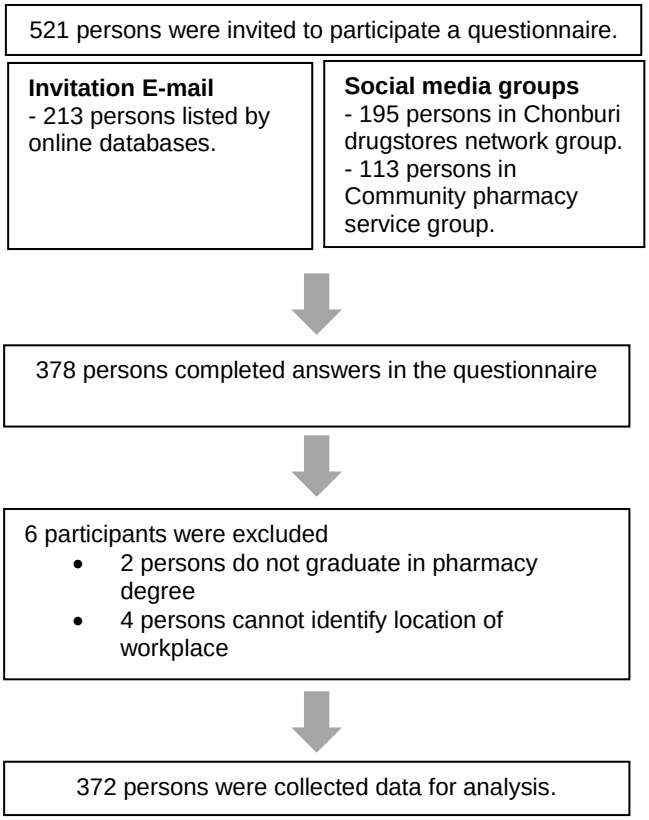


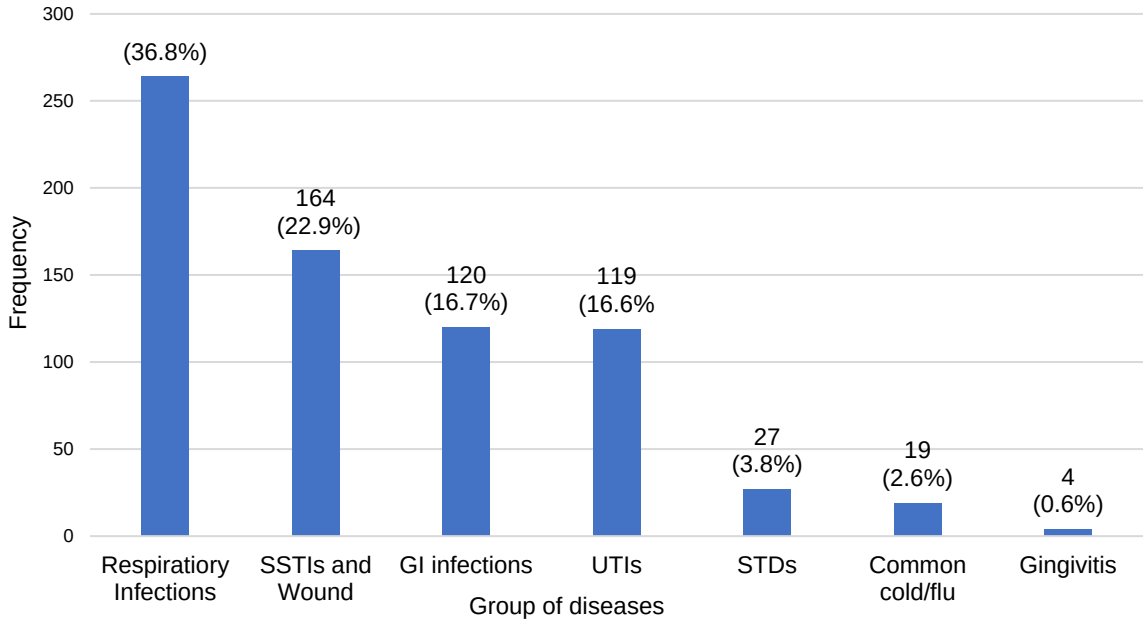
Figure 11: Flow chart of participants who included in study.

Results of current situation in community pharmacy practice in antimicrobials provision

Open-end questions were included in the questionnaire to explore the current antimicrobial provision in community pharmacy in Thailand. The participants confirmed the most commonly encountered infections in their pharmacy, frequently used antimicrobials and reasons for providing antimicrobials without a prescription.

Encountered infections

There were 717 responses from the pharmacists. These were grouped as shown in figure 12. Respiratory infections were the most common (36.8%), followed by Skin and soft tissue infections (SSTIs) including wounds (22.9%). The results show that urinary tract infections (UTIs) and gastric infections including diarrhoea have a similar frequency of16.6% and 16.7% respectively.

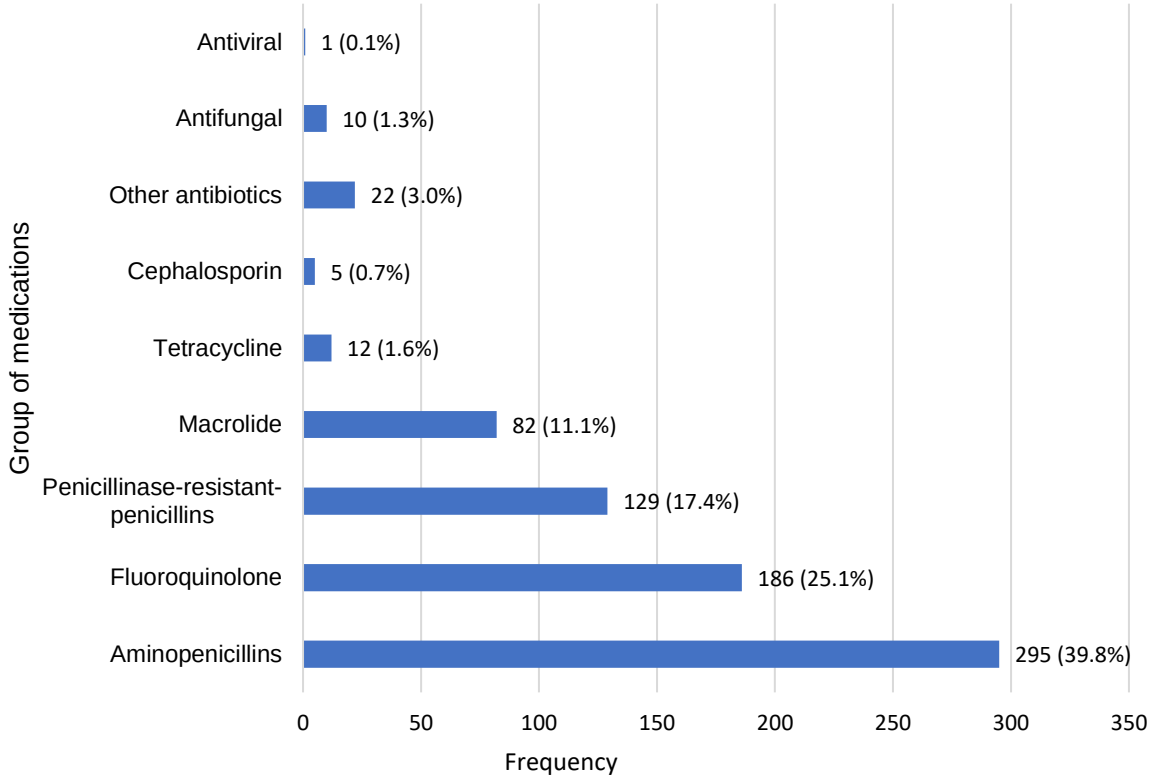


Respiratory Infections term included lower respiratory infections, upper respiratory infections, bronchitis, nasopharyngitis, otitis media, pharyngitis, rhinitis, sinusitis, sore throat, and tonsillitis.
SSTIs and wound term included abscess, acne, bacterial skin infection, cellulitis, conjunctivitis, hordeolum, herpes simplex, impetigo, and tinea.
UTIs included term included cystitis.
GI infections term included diarrhoea.
STDs term included candidiasis, chlamydia, vaginitis, and gonorrhoea.

Figure 12: The commonly encountered infections in community pharmacy.

Dispensed antimicrobials

We collected 742 responses of the most commonly dispensed antimicrobials in community pharmacy. The answers were coded and classified by medicine classification as demonstrated in figure 13. Antibacterial agents were most commonly dispensed, while antifungals (1.3%) and antiviral agents (0.1%) were rarely provided. Aminopenicillin group is the most common class of antibiotics provided in community pharmacy (39.8%) followed by Fluoroquinolone (25.1%) and Penicillinase-resistance penicillin (17.4%).

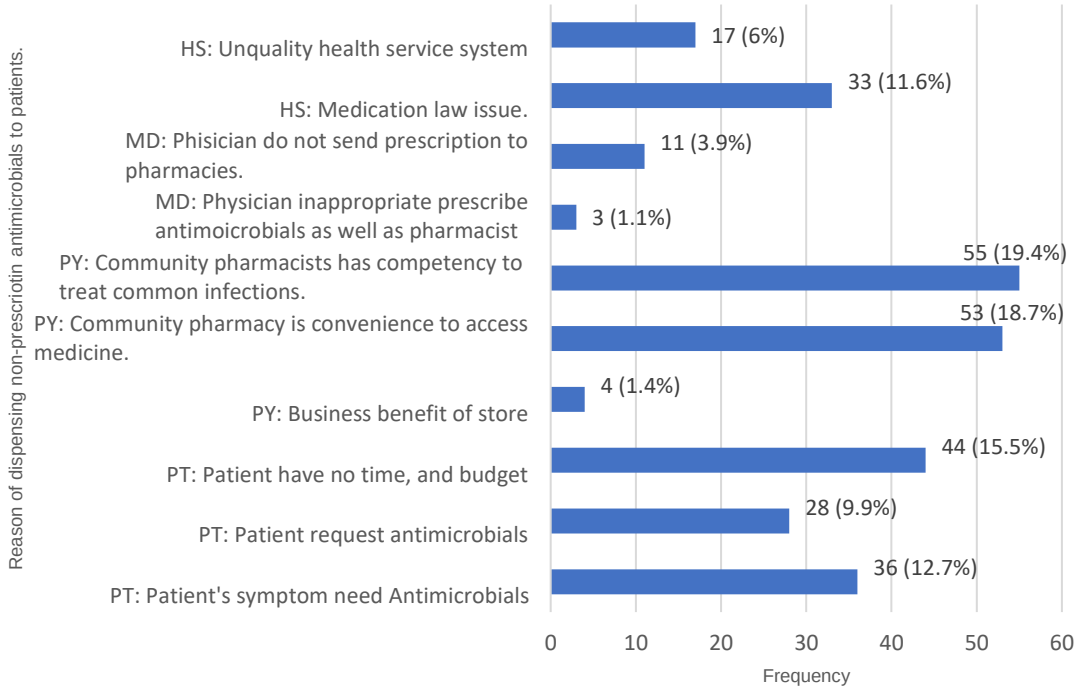


Aminopenicillin; Amoxicillin (n=242), Amoxicillin/Clavulanic acid (n=52), and Ampicillin (n=1)
Fluoroquinolone; Norfloxacin (n=146), Ciprofloxacin (n=28), Ofloxacin (n=12)
Penicillinase-resistant-penicillin; Dicloxacillin (n=122), Cloxacillin (n=7)
Macrolide; Roxithromycin (n=61), Azithromycin (n=20), Erythromycin (n=1)
Tetracycline; Doxycycline (n=9), Tetracycline (n=3)
Cephalosporin; Cephalexin (3), Cefuroxime (n=1), Cephalosporin (n=1)
Other Antibiotics; Clindamycin (n=11), Co-trimoxazole (n=1), Metronidazole (n=1)
Antifungal; Clotrimazole (n=4), Ketoconazole (n=3), Fluconazole (n=2), antifungal cream (n=1)
Antiviral; Acyclovir (n=1)

Figure 13: The commonly dispensed antimicrobials in community pharmacy.

Reasons for dispensing non-prescription antimicrobials.

The community pharmacists gave the following reasons for dispensing antimicrobials without a prescription: they have the ability to treat common infections in their store (19.4%), and drug store is convenient to access medicine (18.7%), patients have neither time nor money to meet a physician (15.5%) and the patients present symptom that need to be treat by antimicrobials (12.7%). In terms of the system, the law allows pharmacist to provide antimicrobials 11.6%). Results are shown in figure 14.



HS= Health system issue, MD= Medical issue, PY = Pharmacy issue, PT= Patient issue

Figure 14: The reasons for dispensing antimicrobials without a prescription.

Results of community pharmacists' Knowledge, attitude and practice in antimicrobial resistance and use

Knowledge in antimicrobial use and resistance

Knowledge of community pharmacists in antimicrobial resistance and use were evaluated in the knowledge section of the questionnaire. Table 9 shows percentages of correct, incorrect, and uncertain answer in each item.

Items	Correct		Incorrect		Uncertain	
	n	%	n	%	n	%
K1: "Superbugs" are microorganisms which generate antimicrobial resistance. They include bacteria, fungal, virus or parasites.	176	47.3	98	26.3	98	26.3
K2: Resistance DNA in bacteria can transfer to other bacteria by virus.	207	55.6	113	30.4	52	14.0
K3: Antimicrobial resistance in hospital setting is higher than community setting.	278	74.7	50	13.4	44	11.8
K4: The main objective of antimicrobial stewardship is to achieve the most effective clinical outcome with less toxicity and adverse reactions to antimicrobials.	283	76.1	80	21.5	9	2.4
K5: Penicillin, cephalosporin, and fluoroquinolone are β - lactam antibiotics. It need to consider Beta-lactamase producing bacterial.	262	70.4	107	28.8	3	0.8
K6: Patients who are allergic to Amoxicillin (Anaphylaxis type) should not use Cephalexin.	332	89.2	30	8.1	10	2.7
K7: Is it appropriate? When a pharmacist dispenses amoxicillin 1,500 mg a day, 7 days for a 26-year-old male with allergic rhinitis, high-grade fever rhinorrhoea, and sore throat, and no known drug allergy.	297	79.8	61	16.4	14	3.8
K8: Is it appropriate? When a pharmacist dispenses only mineral powder for a 2-year-old boy with watery diarrhoea, no mucous/bloody stool, no fever, no vomiting. and no known drug allergy.	330	88.7	35	9.4	7	1.9
K9: Is it appropriate? When a pharmacist dispenses dicloxacillin 250 mg four time a day for 5 days to prevent an infection in case of a 24-year old male who has had a skin abrasion wound on his right arm without exudates for 2 days, limited to subcutaneous layer, mild tenderness, no swelling, no active bleeding, no fever, and no known drug allergy.	256	68.8	81	21.8	35	9.4

Table 9: Frequency of correct, incorrect, and uncertain answer in knowledge section.

Overall, the majority of participants gave correct answers to the knowledge questions and obtained percentages of correct ranging from 47.4% (K1) to 89.2% (K6). The question K1 has the lowest percentage of correct responses. It can indicate that most participants were unsure of the term of "superbugs" because 26.3% of participants selected and uncertain choice. Also, they were unsure about resistance mechanism in question K2 which has only 55.6% as correct and 14% gave uncertain answer. Otherwise, results show that the pharmacists have a good understanding of the prevalence of antimicrobial resistance in health and community setting (K3) with 70.4% as correct, and aim of antimicrobial stewardship (K4) which achieved 76.1%.

In terms of antimicrobial use, the participants show that they can identify the appropriate use of antimicrobials through clinical scenario questions. The pharmacists selected correct answer at 88.7% in the diarrhoea case (K6), 79.8% in the respiratory case (K7), and 68.8% in the wound scenario (K9).

Knowledge score in antimicrobial use and resistance

Table 10 shows descriptive statistic of total knowledge score. The total knowledge score of the participants ranged from 3 points to 9 points, with an average score of 6.48 (±1.258), and a median score is 7.00 (±1).

Knowledge total score (K1-K9)	
Minimum	3
Maximum	9
Mean	6.48
Std. Deviation	1.258
Median	7.00
Interquartile Range	1

Table 10: Knowledge score of participants in antimicrobial use and resistance

According to one-sample Kolmogorov-Smirnov test, it has a hypothesis that distribution of data is normal. The results can be interpreted that total knowledge score of participants in this study do now have a normal distribution at p-value < 0.001 (Table 11). So, non-parametric statistic is suitable for analysis in this study.

	Kolmogorov-Smirnov		
	Statistic	df	Sig.
Knowledge total score (K1-K9)	.165	372	.000

Table 11: Kolmogorov-Smirnov Test of total knowledge score normal distribution

Attitude regarding antimicrobial use and resistance

Community pharmacists generally agreed with positive attitude statements in relation to appropriate use of antimicrobials and resistance issue but most of them agreed with negative statements on antimicrobial use as well. Table 12 shows results of agreement of participants with each attitude statement.

Items	Strongly disagree n (%)	Disagree n (%)	Neither agree or disagree n (%)	Agree n (%)	Strongly Agree n (%)	Median (IQR)
A1: Antimicrobial resistance is an important public health problem of ours.	1 (0.3)	1 (0.3)	2 (0.5)	107 (28.8)	261 (70.2)	5 (1)
A2: The fact that a patient is taking an antibiotic increases the risk of developing resistance	5 (1.3)	26 (7.0)	38 (10.2)	200 (53.8)	103 (27.7)	4 (1)
A3: New antimicrobials development can solve antimicrobial resistance problem.	37 (9.9)	96 (25.8)	83 (22.3)	111 (29.8)	45 (12.1)	3 (2)
A4: The use of antimicrobials in *livestock animals* is an important cause of appearance of new resistance to pathogenic agents in humans.	5 (1.3)	20 (5.4)	68 (18.3)	177 (47.6)	102 (27.4)	4 (2)
A5: In all cases where antimicrobials are dispensed, it is essential that patients be advised about complying with the treatment	1 (0.3)	3 (0.8)	12 (3.2)	96 (25.8)	260 (69.9)	5 (1)
A6: Antimicrobials are sometimes dispensed without medical prescription because the patient is known to have difficulty in obtaining a medical consultation.	12 (3.2)	40 (10.8)	91 (24.5)	179 (48.1)	50 (13.4)	4 (1)
A7: Antimicrobials are sometimes prescribed without medical prescription because the patient is known to have neither the time nor the money to see a physician.	14 (3.8)	51 (13.7)	97 (26.1)	171 (46.0)	39 (10.5)	4 (1)
A8: Dispensing antimicrobials without prescription is serious issue.	31 (8.3)	85 (22.8)	88 (23.7)	113 (30.4)	55 (14.8)	4 (1)

Table 12: Results of participants' agreeing in each attitude statement.

In terms of positive statements, the participants strongly agreed (median=5) that antimicrobial resistance is an important public health issue (A1). They agreed that taking of antibiotics in human (A2) and animals (A4) can increase the risk of resistance (median=4). However, the pharmacists were neutral regarding new antimicrobials solving the resistance problem (A3) which a median of 3. More than 69% of participants (median=5) strongly agreed that patients who take antimicrobials need to be advised (A5). Also, they agreed with A8 statement that non-prescription dispensing of antimicrobials is serious (median=4) but results of “agree” and “strongly agree” account for only 30.4% and 14.8%.

Apart from negative statements (A6, A7), the participants should disagree, but they mostly agreed with the items. They agreed that antimicrobials can be dispensed without prescription because patient may find it difficult to afford medical service (agree 48.2%, strongly agree13.4%, median=4), and have no time and no budget to meet a physician (agree 46.0%, strongly agree10.5%, median=4). This point is interesting and will be considered later in the discussion chapter.

Attitude score in antimicrobial use and resistance

Table 13 shows descriptive statistics of the total attitude score. The total attitude score of the participants were between 19 and 37 points, average score is 28.52 (±3.450), and median score is 28.00 (±5).

Attitude total score (A1-A8)	
Minimum	19
Maximum	37
Mean	28.52
Std. Deviation	3.450
Median	28.00
Interquartile Range	5

Table 13: Attitude score of participants in antimicrobial use and resistance

To confirm that the attitude score needs to be analysed by non-parametric statistics, one-sample Kolmogorov-Smirnov test was used for analysing the hypothesis that attitude score has a normal distribution (Table 14). Results of the test show that p-value of the test < 0.001, which is a significant difference for the hypothesis. So, it can be interpreted that total attitude score does not have a normal distribution. It confirms the need to use non-parametric statistical analysis for comparing factors as well as the total knowledge score.

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Total attitude score (A1-A8)	.078	372	.000

Table 14: Kolmogorov-Smirnov Test of total attitude score normal distribution

Practice in antimicrobial use and resistance

Community pharmacists mostly demonstrate good practice in antimicrobials resistance and use, but they routinely dispense antimicrobials without a prescription. Table 15 shows the frequency of practice of participants in relation to reducing antimicrobial resistance and prudent use of antimicrobial agents.

Items	Never n (%)	Several n (%)	Fairly often n (%)	Usually n (%)	Always n (%)	Median (IQR)
P1: I educate patients on the use of antimicrobials and resistance-related issues.	-	14 (3.8)	51 (13.7)	153 (41.1)	154 (41.4)	4 (1)
P2: I take part in antimicrobial awareness campaigns to promote the optimal use of antimicrobials	2 (0.5)	38 (10.2)	102 (27.4)	147 (39.5)	83 (22.3)	4(1)
P3: I lack continuing education in antimicrobial use and resistance topics.	79 (21.2)	196 (52.7)	75 (20.2)	18 (4.8)	4 (1.1)	2(1)
P4: I make efforts to prevent or reduce the transmission of infections within the community.	2 (0.5)	20 (5.4)	90 (24.2)	184 (49.5)	76 (20.4)	4(1)
P5: I collaborate with other health professionals for infection control and antimicrobial stewardship	81 (21.8)	104 (28.0)	67 (18.0)	85 (22.8)	35 (9.4)	3 (2)
P6: I ask patient's history and symptom of their infections before deciding to dispense antimicrobials.	-	3 (0.8)	7 (1.9)	111 (29.8)	251 (67.5)	5 (1)
P7: I sought additional clinical information (e.g. drug interaction, ADRs, allergy, etc.) before deciding to dispense the antimicrobials	1 (0.3)	56 (15.1)	59 (15.9)	157 (42.2)	99 (26.6)	4 (2)
P8: I screen the antimicrobials in accordance with local guidelines before dispensing	-	5 (1.3)	57 (15.3)	186 (50.0)	124 (33.3)	4(1)
P9: I dispense antimicrobial with complete clinical information (e.g. drug interaction, ADRs, allergy, etc.)	1 (0.3)	20 (5.4)	75 (20.2)	176 (47.3)	100 (26.9)	4 (2)
P10: I dispense antimicrobials without a prescription.	1 (0.3)	18 (4.8)	69 (18.5)	124 (33.3)	160 (43.0)	4(1)

Table 15: Results of participants' frequency actions in each practice statement.

The community pharmacists are likely to educate their patients on antimicrobial resistance awareness (P1) (usually= 41.1%, always=41.4%). Also, more than 60% (of the pharmacists (usually=39.5%, always=22.3%) participate in combatting antimicrobial resistance campaigns (P2) and attempt to prevent and reduce resistance in community (P4), (usually=49.5%, always=20.4%). However, the pharmacists responded that they have no chance to collaborate with other health

professionals (P5) such as physicians for infections control and antimicrobial stewardship (never=21.8%, several=28.0%).

In terms of antimicrobials provision, over 97% (usually=29.8%, always=67.5%) of the pharmacists practice history taking regarding infections with their patients (P6). Also, most participants (usually=42.2%, always=26.6%) seek clinical information such as drug interaction, allergic profile (P7), usually=42.2%, always=26.6%) and dispensing antimicrobials following evidence (P9), usually=47.3%, always=26.9%). Furthermore, over 83% (usually=50.0%, always=33.3%) of the pharmacists confirmed that they dispense antimicrobials following local guidelines (P8).

In relation to negative practices, around 6% (usually=4.8 %, always=1.1%) of the participants reported lack of continuing education on antimicrobials use and resistance topics. The question relating to dispensing antimicrobials without prescription (P10) generated responses of usually 33.3%, and always 43.0%.

Practice score in antimicrobial use and resistance

Table 16 shows descriptive statistic of total practice score. The total pratice score of the participants were between 21 and 49 points, average score is 36.76 (±4.993), and median score is 37.00 (±5).

Practice total score (P1-P10)	
Minimum	21
Maximum	49
Mean	36.76
Std. Deviation	4.993
Median	37.00
Interquartile Range	6

Table 16: Practice score of participants in antimicrobial use and resistance

To confirm that the practice score needs to be analysed using non-parametric statistics, one-sample Kolmogorov-Smirnov test was used for the hypothesis that the practice score is of normal distribution *(See table 17).* Results of the test show that p-value of the test < 0.001, so, it can be interpreted that total practice score is not of normal distribution. It confirms the need to use non-parametric statistical analysis to compare factors.

	Kolmogorov-Smirnov		
	Statistic	df	Sig.
Practice total score (P1-P10X	.068	372	.000

Table 17: Kolmogorov-Smirnov Test of total practice score normal distribution

Relationship between knowledge, attitude, and practice score

Consistent with the knowledge, attitude, and practice or KAP model, it is expected that each of the dimensions could be related. Spearman's rho correlation was used to show the relationship between knowledge, attitude, and practice scores. Table 18 shows results of correlation by Spearman's rho test.

	Spearman's rho	p-value
Knowledge - Attitude	0.100	0.053
Attitude - Practice	0.149	**0.004****
Knowledge - Practice	0.071	0.174

**=significant at p value < 0.01 level

Table 18: Correlation of Knowledge-, Attitude-, and Practice score

The results indicate that there is no relationship between knowledge and attitude and knowledge and practice; correlation coefficient of attitude and practice is 0.149 and p-value is 0.004 at 0.01 level or 99% confident interval. It can be assumed that there is a weak correlation between attitude and practice dimensions.

Results of community pharmacists' characteristics associated to knowledge, attitude and practice in antimicrobials use and resistance.

Characteristic of community pharmacists

The average age of participants was 32.02 (± 5.81) years and most of them were grouped into a range between 30 and 40 years (n=185, 49.7%). The majority of participants were female (n=260, 69.9%), graduated with Bachelor of pharmacy 5-years programme (n-=287, 77.2%), and worked in individual drugstore (n=233, 62.6%). An average of experience in community pharmacy was 5.46 (± 4.31) years. The participants who work in Bangkok account for 69.4% (n=258,), and for 34.6% in Chonburi (n=114). The demographic data of participants is presented in Table 19.

Demographic data	
Age (mean ± SD)	32.02 ± 5.81
Lower than 30 yrs.**,** n (%) 30-40 yrs. Over than 40 yrs.	145 (39.0) 185 (49.7) 42 (11.3)
Experience (mean ± SD)	5.46 ± 4.31
Lower than 5 yrs.**,** n (%) 5-10 yrs. Over than 10 yrs.	180 (48.4) 152 (40.9) 40 (10.8)
Gender, n (%) Male Female	 112 (30.1) 260 (69.9)
Pharmacy Degree, n (%) BPharm/BSc in Pharm PharmD	 287 (77.2) 85 (22.8)
Postgraduate Degree, n (%) None Master degree Doctoral degree	 276 (74.2) 91 (24.5) 5 (1.3)
Location, n (%) Bangkok Chonburi	 258 (69.4) 114 (30.6)
Type of Pharmacy, n (%) Individual store Chain store	 233 (62.6) 139 (37.4)

Table 19: Demographic data of participants

Relationship between characteristics

Age: Senior pharmacists tend to have extensive experience and hold postgraduate qualifications. While young pharmacists were PharmD graduates, and were more likely to work in chain pharmacies. The results of p-value in Chi-square test show in Table 20.

Demographics		Age			p-value
		< 30 yrs. (n =145)	30-40 yrs. (n=185)	> 40 yrs. (n=42)	
Gender	Male (n=112)	43	54	15	0.730
	Female (n=260)	102	131	27	
Postgraduate degree	None (n=276)	123	131	22	**0.000*** **
	Postgraduate (n=96)	22	54	20	
Pharmacy Degree	BPharm (n=287)	81	164	42	**0.000*** **
	PharmD (n=85)	64	21	0	
Locations	Bangkok (n=258)	107	124	27	0.308
	Chonburi (n=114)	38	61	15	
Pharmacy type	Chain (n=139)	75	59	5	**0.000*** **
	Individual (n=233)	70	126	37	
Experience	< 5 yrs. (n=180)	115	63	2	**0.000*** **
	5 to 10 yrs. (n=152)	30	111	11	
	> 10 yrs. (n=40)	0	11	29	

***=significant at p-value <0.01

Table 20: Relationship of age among other demographics

Postgraduate degree: Pharmacists over 40 years of age are more likely to have a postgraduate qualification (20 pharmacists or 45.45% of the group). This is followed by pharmacists between 30 and 40 years of age (29.19%), and pharmacists younger than 30 years of age (15.17% of participants in this group).

Pharmacy degree: The young pharmacists are more likely to hold a Doctor of Pharmacy (PharmD). There are 64 PharmD pharmacists, or 44.14% in the lower age range, followed by 21 PharmD, or 11.35% of pharmacists aged between 30 to 40 years, and no PharmD graduates older than 40 years of age since it is a relatively new programme.

Pharmacy type: Individual pharmacy (in the UK this is known as independent pharmacies) is the most common type of workplace (n=233). The young pharmacists are more likely to work in chain pharmacies (51.72% of them n=75), while the other two age groups are more likely to work in independent pharmacies (68.11% of 30-40 years and 88.10% for over 40 years).

Experience: 115 pharmacists (79.31%) who aged lower than 30 years are experience less than 5 years in community pharmacy. Similarly, in middle age range, 111 people or 60% of them are experience between 5 and 10 years, and 69% of the senior pharmacists (n=29), are extensive experience (over than 10 years) in community pharmacy setting.

Experience

Participants who have extensive experience are more likely to hold a postgraduate qualification. Most Bangkok participants had a lower experience while most of participants in Chonburi had 5-10 years' experience. The results of p-value Chi-square test are shown in Table 21.

Demographics		Experience			p-value
		< 5 yrs. (n=180)	5 to 10 yrs. (n=152)	> 10 yrs. (n=40)	
Gender	**Male (n=112)**	53	46	13	0.947
	Female (n=260)	127	106	27	
Postgraduate degree	**None (n=276)**	145	111	20	**0.000*** **
	Postgraduate (n=96)	35	41	20	
Pharmacy Degree	**BPharm (n=287)**	109	138	40	**0.000*** **
	PharmD (n=85)	71	14	0	
Locations	**Bangkok (n=258)**	132	96	30	**0.097***
	Chonburi (n=114)	48	56	10	
Pharmacy type	**Chain (n=139)**	80	53	6	**0.002*** **
	Individual (n=233)	100	99	34	

*=significant at p-value <0.1, ***=significant at p-value <0.01

Table 21: Relationship of experience among other demographics

Postgraduate degree: 50% of the participants who have extensive experience (more than 10 years) hold a postgraduate degree, followed by 26.97% of pharmacists with 5 to 10 years in and 19.44% of pharmacists with less than 5 years' experience.

Pharmacy degree: 39.44% of participants hold a PharmD; these also tend to be the least experienced pharmacists.

Pharmacy type: 44.44% of pharmacists with less than 5 years' experience work in a chain pharmacy, followed by 34.87% of pharmacists with 5-10 years' experience, and only 15% of experienced pharmacists.

Location: 65.35% of all participants work in Bangkok. Most of Bangkok pharmacists have low experience in community pharmacy (51.16%) followed by 37.21% of pharmacists with 5-10 years' experience and 11.63% with extensive experience. 30.65% of pharmacists work in Chonburi province. Most of them have 5-10 years' experience (49.12%), followed by 42.10% of pharmacists with less than 5 years' experience and 8.77% with more than 10 years' experience.

Pharmacists' qualifications

The information in table 22 shows that PharmD graduates prefer to work in Bangkok and in chain stores.

Demographics		Pharmacy Degree			Postgraduate Degree		
		BPharm (n=287)	PharmD (n=85)	p-value	None (n=276)	Postgraduate degree (n=96)	p-value
Gender	Male (n=112)	79	33	**0.059***	82	30	0.797
	Female (n=260)	208	52		194	66	
Locations	Bangkok (n=258)	190	68	**0.016****	191	67	1.000
	Chonburi (n=114)	97	17		85	29	
Pharmacy type	Chain (n=139)	94	45	**0.001*****	111	28	**0.066***
	Individual (n=233)	193	40		165	68	
Postgraduate degree	None (n=276)	196	80	**0.000*****			
	PG (n=96)	91	5				

*=significant at p-value <0.1, **=significant at p-value <0.05, ***=significant at p-value <0.01

Table 22: Relationship of pharmacy qualification among other demographics

Gender: The participants who graduate with BPharm are typically female (n=208, 55.9%). Male pharmacists represent 38% (n=33) of the PharmD pharmacists.

Location: The proportion of PharmD pharmacists who work in Bangkok is higher than those who work in Chonburi. There are 68 pharmacists who work in Bangkok holding a PharmD degree (26.36 %) whereas Chonburi has only 17 PharmD pharmacists, or 14.91% of participating pharmacists from the province.

Pharmacy type: PharmD pharmacists are likely to work in chain store pharmacies. 32.75% of BPham pharmacists (n=94) work in chain stores but more than 52% of PharmD pharmacist work in this pharmacy type. As a result of postgraduate degree, 29.18% (n=68) of pharmacists who work in stand-alone pharmacies hold postgraduate degree, this higher than pharmacists who work in chain pharmacies (20.14%, n=28).

Postgraduate degree: Pharmacists who graduate with a BPharm are more likely to pursue a postgraduate qualification compared to PharmD pharmacists. There are 91 BPharm pharmacists (31.7%) with a postgraduate qualification but only 5 PharmD pharmacists (5.89%) have a postgraduate degree. However, as results of statistical analysis, gender, location and pharmacy type are not statistically different in relation to postgraduate qualifications.

Pharmacy type and location

The results show that Bangkok has more chain store pharmacies than Chonburi province. Gender representation does not vary with pharmacy type and the location. Results are shown in table 23.

Demographics		Pharmacy Type			Location		
		Chain (n=139)	Individual (n=233)	p-value	Bangkok (n=258)	Chonburi (n=114)	p-value
Gender	Male (n=112)	41	71	0.907	79	33	0.807
	Female (n=260)	98	162		179	81	
Locations	Bangkok (n=258)	111	147	**0.001*** **			
	Chonburi (n=114)	28	86				

***=significant at p-value <0.01

Table 23: Relationship of pharmacy type and location among other demographics

Location: Though pharmacists typically work at individual pharmacies in the both cities, the reported proportion of chain stores in each city is different. Bangkok respondents show 111 pharmacists working in chain stores (that is 43% of Bangkok pharmacists) while, in Chonburi, only 24.56% of respondents (n=28) work in work in chain stores. However, location of pharmacy has no statistical different in comparison to gender.

Characteristics and knowledge score

Results show that PharmD degree and chain store pharmacist have better knowledge than another compared group. Knowledge score and demographic data were compared to examine demographic factors that would influence knowledge of pharmacists in antimicrobial use and resistance. Results of each demographic and knowledge score are shown in table 24.

Demographics	Knowledge score		
	Median (IQR)	mean rank	p-value
Gender [a]			
Male (n=112) Female (n=260)	7 (2) 6 (1)	197.49 181.77	0.183
Age [b]			
lower than 30 yrs. (n=145) 30-40 yrs. (n=185) over than 40 yrs. (n=42)	7 (2) 6 (1) 7 (1)	196.18 179.96 181.90	0.358
Age [a]			
lower than 30 yrs. (n=145) 30-40 yrs. (n=185)	7 (2) 6 (1)	173.51 159.22	0.165
lower than 30 yrs. (n=145) over than 40 yrs. (n=42)	7 (2) 7 (1)	95.67 88.25	0.421
30-40 yrs. (n=185) over than 40 yrs. (n=42)	6 (1) 7 (1)	113.74 115.15	0.896
Degree [a]			
B Pharm (n=287) PharmD (n=85)	6 (1) 7 (2)	180.96 205.22	**0.060***
Postgrad [a]			
None (n=276) PG degree (n=96)	7 (1) 6 (1)	190.06 176.26	0.265
Experience [b]			
less than 5 yrs. (n=180) 5-10 yrs. (n=152) more than 10yrs. (n=40)	6.5 (2) 6 (1) 6.5 (1)	183.24 189.92 188.24	0.840
Experience [a]			
less than 5 yrs. (n=180) 5-10 yrs. (n=152)	6.5 (2) 6 (1)	163.69 169.82	0.551
less than 5 yrs. (n=180) more than 10yrs. (n=40)	6.5 (2) 6.5 (1)	110.05 112.54	0.818
5-10 yrs. (n=152) more than 10yrs. (n=40)	6 (1) 6.5 (1)	96.600 96.11	0.959
Location [a]			
BKK (n=258) CHON (n=114)	7 (1) 6 (1)	189.10 180.61	0.470
Type [a]			
Chain (n=139) Individual (n=233)	7 (2) 6 (1)	199.18 178.94	**0.071***

a = Mann- Whitney U test, b= Kruskal Wallis H test, *=significant at p-value < 0.1

Table 24: Relationship of knowledge score and demographic data.

Pharmacy degree: PharmD degree graduates demonstrate a higher knowledge score (meanrank=205.22) compared to BPharm degree graduation (mean rank=180.96). It is a statistically significant difference at p-value=0.060.

Type of pharmacy: Chain store pharmacists (mean rank=199.18) have better knowledge compared to individual store pharmacists (mean rank=178.94). It is a statistically significant difference at p-value=0.071.

Characteristics and knowledge type

350 of participant were judged as having a good knowledge in antimicrobial resistance and use (94% of participants). The results indicate that pharmacists' characteristics (demographics) do not affect participants' knowledge. The total knowledge score of each participant was classified into two types, poor- and good knowledge in antimicrobial resistance. Chi- square test was employed for analysis with 95% Confidence Interval. The results are shown in table 25.

Demographics	Knowledge type		p-value
	Poor (n)	Good (n)	
	22	350	
Gender			
Male (n=112)	6	106	0.817
Female (n=260)	16	244	
Age			
lower than 30 yrs. (n=145)	12	133	
30-40 yrs. (n=185)	7	178	0.238
over than 40 yrs. (n=42)	3	39	
Pharmacy Degree			
B Pharm (n=287)	16	271	0.794
PharmD (n=85)	6	79	
Postgraduate degree			
None (n=276)	18	4	0.464
PG degree (n=96)	258	92	
Experience			
less than 5 yrs. (n=180)	13	167	
5-10 yrs. (n=152)	6	146	0.412
more than 10yrs. (n=40)	3	37	
Location			
BKK (n=258)	17	241	0.482
CHON (n=114)	5	109	
Type			
Chain (n=139)	6	133	0.370
Individual (n=233)	16	217	

Table 25: Relationship of knowledge types and demographic data.

Characteristics and attitude score

Results demonstrate that type of pharmacy degree, pharmacy ownership, and experience seem to affect the attitude score. PharmD graduates, chain store pharmacists and experienced pharmacists have a better attitude.

Demographic data and attitude score were analysed by Mann-Whitney U test and Kruskal-Wallis H test for comparing a various group of demographics. It can examine how various demographic data relate to the attitude score (Table 26).

Demographics	Attitude score		
	Median (IQR)	mean rank	p-value
Gender [a]			
Male (n=112) Female (n=260)	29 (5) 28 (5)	185.50 186.93	0.905
Age [b]			
lower than 30 yrs. (n=145) 30-40 yrs. (n=185) over than 40 yrs. (n=42)	29 (4) 28 (5) 29 (6)	196.18 178.63 199.12	0.350
Age [a]			
lower than 30 yrs. (n=145) 30-40 yrs. (n=185)	29 (4) 28 (5)	172.89 159.71	0.211
lower than 30 yrs. (n=145) over than 40 yrs. (n=42)	29 (4) 29 (6)	93.00 97.45	0.637
30-40 yrs. (n=185) over than 40 yrs. (n=42)	28 (5) 29 (6)	111.92 123.17	0.314
Degree [a]			
B Pharm (n=287) PharmD (n=85)	28 (4) 30 (2)	177.77 215.99	**0.004*** **
Postgrad [a]			
None (n=276) PG degree (n=96)	29 (5) 28 (5)	187.12 184.71	0.849
Experience [b]			
less than 5 yrs. (n=180) 5-10 yrs. (n=152) more than 10yrs. (n=40)	28 (4) 28 (5) 31 (5)	182.90 178.96 231.34	**0.019** **
Experience [a]			
less than 5 yrs. (n=180) 5-10 yrs. (n=152)	28 (4) 28 (5)	168.38 164.28	0.697
less than 5 yrs. (n=180) more than 10yrs. (n=40)	28 (4) 31 (5)	105.02 135.14	**0.007*** **
5-10 yrs. (n=152) more than 10yrs. (n=40)	28 (5) 31 (5)	91.18 116.70	**0.01** **
Location [a]			
BKK (n=258) CHON (n=114)	28 (5) 29 (5)	188.84 181.21	0.528
Type [a]			
Chain (n=139) Individual (n=233)	29 (4) 28 (5)	206.16 174.77	**0.006*** **

a = Mann- Whitney U test, b= Kruskal Wallis H test
=significant at p-value <0.05, *=significant at p-value <0.01

Table 26: Relationship of attitude score and demographic data.

Results of a median score in each various group show that most participants in each group have a total attitude score over the midpoint (24). Most participants have a good attitude in antimicrobial resistance and use. Moreover, there are significant differences in relation to pharmacy degree types, experience range, and type of pharmacies.

Pharmacy degree: There is a significant statistical difference in attitude score between participants with BPharm and PharmD (p-value 0.004). The results show that mean rank of PharmD group is 215.99, which is higher than BPharm group (mean rank=177.77). As well as the median score, BPharm participants have a median score of 28 while PharmD graduates obtained a score of 30. It can be seen that the pharmacists who graduated with PharmD degree had a better attitude compared to pharmacists with BPharm.

Experience: Experience affects the attitude score of participants. The H test shows that there is a difference in the attitude score of all experience ranges by p=value =0.019. When the data were analysed by the U test in each two groups, it shows that people with extensive experience differ from others. The long experience group (mean rank=135.14) has a better attitude compared to least experienced group (mean rank=105.02) by p-value= 0.007. Also, the long experience group (mean rank=116.70) has a better attitude score when compared with pharmacists with 5-10 years' experience (mean rank=91.18) by p-value = 0.01.

Pharmacy type: The pharmacists who work in different type of pharmacies are significantly different in their total attitude score. People who work in individual pharmacy (mean rank=174.77) have a lower attitude score than chain store workers (mean rank=206.16) by p-value= 0.006.

Characteristics and attitude type

93.28% (n=347) of participants were classified as having a good/ positive attitude in antimicrobial use and resistance. Age, pharmacy degree, location and pharmacy type affect the attitude score of participants in antimicrobials use and resistance. The young pharmacists, PharmD graduates, working in Bangkok and chain store have a good/ positive attitude compared to others.

To clearly describe the relationship between attitude and demographics, Chi-square test was used to analyse the attitude towards antimicrobials use and resistance in relation to diverse demographic data. The results are presented in table 27.

Demographics	Attitude type		
	Poor (n)	Good (n)	p-value
	25	347	
Gender			
Male (n=112) Female (n=260)	9 16	103 244	0.653
Age			
lower than 30 yrs. (n=145) 30-40 yrs. (n=185) over than 40 yrs. (n=42)	5 13 7	140 172 35	**0.011****
Pharmacy Degree			
B Pharm (n=287) PharmD (n=85)	24 1	263 84	**0.023****
Postgraduate degree			
None (n=276) PG degree (n=96)	15 10	261 86	0.101
Experience			
less than 5 yrs. (n=180) 5-10 yrs. (n=152) more than 10yrs. (n=40)	9 12 4	171 140 36	0.413
Location			
Bangkok (n=258) Chonburi (n=114)	13 12	245 102	**0.070***
Type			
Chain (n=139) Individual (n=233)	5 20	134 213	**0.085***

*=significant at p-value <0.1, **=significant at p-value <0.05

Table 27: Relationship of attitude types and demographic data.

Age: Age groups significantly differ in their attitude score with p-value = 0.11. It appears that the younger the pharmacist, the better their attitude score.

Pharmacy degree: Pharmacists graduating with PharmD are more likely to have a better attitude towards antimicrobial use and resistance compared to BPharm graduates.

Location: Pharmacists working in Bangkok have a significantly different (and better) attitude compared to their colleagues in Chonburi with a p value of p-value 0.070.

Type of pharmacy: 96.4% (n=134) of chain store pharmacists were have a good attitude towards antimicrobial use and resistance compared to pharmacists working in individual/ independent pharmacies.

Characteristics and practice score

Male gender and PharmD qualification are characteristics that relate to a higher practice score, while experience between 5 to 10 years relates to a lower practice score. Results of median score and p-value of Mann-Whitney U test and Kruskal- Wallis H test to compare practice score in each group of demographics are shown in table 28.

Demographics	Practice score		
	Median (IQR)	mean rank	p-value
Gender [a]			
Male (n=112) Female (n=260)	38 (7) 36 (6)	204.97 173.54	**0.029****
Age [b]			
lower than 30 yrs. (n=145) 30-40 yrs. (n=185) over than 40 yrs. (n=42)	36 (6) 37 (6) 36 (8)	189.59 188.66 166.29	0.430
Age [a]			
lower than 30 yrs. (n=145) 30-40 yrs. (n=185)	36 (6) 37 (6)	165.97 165.14	0.937
lower than 30 yrs. (n=145) over than 40 yrs. (n=42)	36 (6) 36 (8)	96.63 84.93	0.216
30-40 yrs. (n=185) over than 40 yrs. (n=42)	37 (6) 36 (8)	116.53 102.86	0.222
Degree [a]			
B Pharm (n=287) PharmD (n=85)	37 (7) 37 (6)	180.86 205.55	0.062*
Postgrad [a]			
None (n=276) PG degree (n=96)	37 (6) 36 (7)	188.41 181.01	0.560
Experience [b]			
less than 5 yrs. (n=180) 5-10 yrs. (n=152) more than 10yrs. (n=40)	37 (7) 36 (6) 36 (7)	198.93 178.96 231.34	0.091*
Experience [a]			
less than 5 yrs. (n=180) 5-10 yrs. (n=152)	37 (7) 36 (6)	175.85 155.43	0.053*
less than 5 yrs. (n=180) more than 10yrs. (n=40)	37 (7) 36 (7)	113.58 96.64	0.127
5-10 yrs. (n=152) more than 10yrs. (n=40)	36 (6) 36 (7)	97.25 93.64	0.714
Location [a]			
Bangkok (n=258) Chonburi (n=114)	37 (6) 37 (7)	189.04 180.75	0.492
Type [a]			
Chain (n=139) Individual (n=233)	36 (5) 37 (7)	180.36 190.16	0.394

a = Mann- Whitney U test, b= Kruskal Wallis H test
*=significant at p-value <0.05

Table 28: Relationship of practice score and demographic data.

Gender: Male pharmacists obtained a higher practice score (mean rank= 204.97) compared to female pharmacists (mean rank =173.54) at a statistically significant p-value of 0.029.

Pharmacy degree: PharmD degree group (mean rank= 205.55) has a higher practice score than the BPharm group (mean rank= 180.86) with statistically significant difference at p-value of 0.062.

Experience: The Kruskal- Wallis H test shows that there is at least one group with a statistically significant difference among the three groups at p-value= 0.091. It demonstrates that the group of 5 to 10 years' experience has the lowest mean rank = 178.96. The Mann-Whiteney U test was employed to explore the relationship between the groups. The results show that there is significant difference between the least experienced group (mean rank= 175.85) and the 5-10 years' experience group (mean rank= 155.43) at p-value= 0.053.

Characteristics and practice type

More than 93% of pharmacists have a good practice in antimicrobial use and resistance. According to the chi-square test, it shows that there is no significant difference between practice type and demographics as p-value >0.05. The results are shown in table 29.

Demographics	Practice type		
	Poor (n)	Good (n)	p-value
	25	347	
Gender			
Male (n=112)	6	106	0.515
Female (n=260)	19	241	
Age			
lower than 30 yrs. (n=145)	6	139	0.263
30-40 yrs. (n=185)	16	169	
over than 40 yrs. (n=42)	3	39	
Pharmacy Degree			
B Pharm (n=287)	21	266	0.471
PharmD (n=85)	4	81	
Postgraduate degree			
None (n=276)	18	258	0.814
PG degree (n=96)	7	89	
Experience			
less than 5 yrs. (n=180)	10	170	0.310
5-10 yrs. (n=152)	10	142	
more than 10yrs. (n=40)	5	35	
Location			
BKK (n=258)	17	241	1.000
CHON (n=114)	8	106	
Type			
Chain (n=139)	6	133	0.200
Individual (n=233)	19	214	

Table 29: Relationship of practice types and demographic data.

CHAPTER 6
DISCUSSION AND CONCLUSION

Antimicrobial resistance is a major threat to public health. Community pharmacists, among other healthcare professionals are expected to provide antimicrobials appropriately and take apart in antimicrobial stewardship initiatives. This study aims to assess community pharmacists' knowledge, attitudes, and practice regarding non-prescription antimicrobial use and resistance in Thailand, where antimicrobial resistance levels are high, and evidence of antimicrobial stewardship practices are scarce. This research was conducted using a self-administrated online questionnaire to community pharmacists in Bangkok and Chonburi province. This research is the first study of antimicrobial stewardship in community pharmacists since the launch of the national strategy to combat antimicrobial resistance and its implementation in this sector. The main findings indicate that community pharmacists have a good knowledge, attitude, and practice regarding antimicrobial use and resistance. Although antimicrobial agents can legally be dispensed without a prescription in Thailand, almost all participating pharmacists reported can providing antimicrobials appropriately. Pharmacists further stated that the main reason for providing antimicrobials without prescription is due to pharmacists' confidence in their competence. Furthermore, encountered infectious disease and commonly dispensed antimicrobials in pharmacies are important surveillance data of resistant pathogens in the country. This study demonstrates that community pharmacists are essential in initiatives to combat antimicrobial resistance. They are competent to provide quality service to patient as well as other healthcare professionals, however, antimicrobial stewardship in community pharmacy requires improvement.

This chapter will discuss and provide evidence to support the findings of this research. Pharmacists' knowledge, attitude and practice regarding antimicrobial use and resistance will be examined firstly. Then, a discussion of pharmacist attitude in antimicrobial resistance will be presented. Circumstances in community pharmacy to dispense antimicrobials without prescription will be discussed as well as pharmacists' stewardship practices. Suggestions and implications of this research will also be discussed, and the study limitations will be highlighted.

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Current situation of antimicrobial provision in community pharmacy

Encountered infections and dispensed antimicrobials in community pharmacy

This research indicates that most encountered infectious case is respiratory infections, skin and soft tissue infection included wounds, and urinary infection. It seems that the pharmacists report bacterial infections as common and occasionally reported in viral or fungal infections. Associated with results of dispended antimicrobial, the most antimicrobial that dispensed in pharmacy is antibiotics while less than 2% of pharmacists replied to antivirals and antifungals. It is clear that pharmacists familiar with bacterial infections than other infections. It might be a reason of uncertain in in terms of “Superbugs”. The results in knowledge section show that more than 50% of pharmacists were not sure that resistant microorganisms could include bacteria, fungal, viral and parasite (WHO, 2015b; WHO, 2016). This is consistent with existing evidence support that community pharmacy reports being mostly faced with bacterial infections (Morgan et.al, 2011; Roque et.al, 2015; Yakimova, 2015).

However, knowledge of fungal, parasite and viral infections needs to be improved. Malaria, HIV and TB infections have a serious prevalence of resistance to their medicine (WHO, 2016) though it not commonly presented in community pharmacy. Also, resistance in Influenza can exist in community pharmacy which appears as common cold or flu case. Hence, awareness of community pharmacists to antimicrobial resistance needs to span beyond bacterial infections. Other resistant diseases such HIV, TB, malaria, and influenzas can be prevented through stewardship practices of community pharmacists. They could educate patients who are at risk, or refer patients to suitable healthcare service.

Antimicrobial consumption in pharmacies

The results of dispensed antimicrobials in community pharmacies show that aminopenicillin, fluoroquinolone, and penicillinase resistance penicillin are generally provided in Thailand. The results are similar to information on database of CDDEP and national surveillance data (CDDEP, 2016; NARST, 2016). However, the database shows that cephalosporin is usual use in Thailand, but this study shows it was dispensed only 0.7%. Penicillin and cephalosporin are similar in structure and indication and have cross interaction of roughly 10% (Campagna et.al, 2012). Most pharmacists aware this problem as shown in the knowledge section of the questionnaire. This might be a reason why pharmacists are no longer dispensing it.

Reason of dispense non-prescription antimicrobials

This research investigates reasons of dispensing antimicrobials without prescription and show that medication law in country is one of reasons to affect them to practice. Furthermore, the community pharmacists responded that they have competency to treat common infection and their pharmacy is convenience to access healthcare service. It is not amazements in Thailand where have no prescription law and pharmacists can dispense medications by legal). The main role of community pharmacist is dispensing medications to patients both prescription and non-prescription and pharmacist perform triage and provide medication to patients. (Saramunee et. al, 2011; Chiyakunapruck, et.al, 2016).

Business pressures may influence pharmacists' provision of antimicrobials without a prescription (Khan et.al, 2016). 1.4% of participants replied that they dispense antimicrobials because of business benefit. However, the Good Pharmacy Practice (GPP) law has strictly controlled community pharmacy since 2014 in Thailand (Wuttipanich & Kitisopee, 2015). The law and professional ethics obligate appropriate practice. Furthermore, this study finds that more than 90% of pharmacists have good knowledge, attitude, and practice in relation to antimicrobial resistance and use.

Community pharmacists' knowledge, attitude, and practice to combat antimicrobial resistance.

Knowledge and practice of community pharmacists towards antimicrobial use and resistance

Community pharmacists in this study have a good knowledge, attitude, and practice to combat antimicrobial resistance and provision. These results concur with other studies that exist in many countries which indicates community pharmacists have proper knowledge, positive attitude, and appropriate practice in antimicrobial use and resistance (Saengchareon et.al,2008; Roque et.al, 2015; Khan et.al,2016). Nevertheless, these results are different from earlier findings in Thailand which used similar scenarios to evaluate community pharmacist's knowledge and practice (Apisarnthanarak et.al, 2008; (Saengchareon et.al, 2010). A study of Apisarnthanarak and colleagues about antibiotic use in Thai pharmacies was conducted in 2008. The study results show that most pharmacies provided inappropriate antibiotics to patients. Also, around 24% of pharmacists were identified as having inadequate knowledge (Apisarnthanarak et.al, 2008). Similarly, a study of childhood diarrhoea management in pharmacies in Thailand indicates that practice and attitude of pharmacy workers were inappropriate (Saengchareon et.al, 2010). However, the research discussed that pharmacies where performed by pharmacist had better management and service than others. History taking and low adherence with local guideline have been highlighted as major problems in the previous study. In contrast with the prior studies, nearly all pharmacists in this research show that they take patient's history and explore clinical information before dispensing antimicrobials as well as follow local antimicrobials guideline. Also, the pharmacists could identify appropriate use of antimicrobials in non-bacterial respiratory infections, wound treatment, and diarrhoea. Appropriate antimicrobial use campaigns in Thailand have been

overwhelming for several years. Community pharmacists can access many resources to improve their knowledge on antimicrobial resistance and use. The pharmacists can access continuing education through conferences, workshops as well as online education. In this study, the participants replied that they do not lack education in this area. Moreover, a campaign to improve antibiotic use in community pharmacy has been launched since 2012 (CPA, 2012). Although the campaign is only a pilot project, many resources such as literature, leaflets, and guidelines have been widely available. It can support pharmacists to improve their knowledge and practice.

Attitude and practice of community pharmacists towards antimicrobial use and resistance

The pharmacists agree that resistance affects public health, and antimicrobial use in human and animals can increase the risk of resistance which is similar to findings by Roque et al., 2015. However, they do not believe that new antimicrobial agents will solve the resistance issue. The pharmacists do not expect developing new drugs because Thailand cannot generate new medicine given lack of resources and skills. Also, new antimicrobials might also face resistance once used in the country. Here, developing new antimicrobials might not be a priority for the pharmacists to combat antimicrobial resistance.

Although the pharmacists agree that dispensing antimicrobials without prescription is significant issue, most of them accept to prescribe it in practice. Most participants agree with negative attitude statements that antimicrobials sometime could dispense to patient because patients have neither time nor money to meet physician and medical service is difficult to obtain. It similar as pharmacists in previous study in Portugal to dispense antibiotic without prescription to patient because of these problems (Rogue et.al, 2015). However, in practice assessment, the pharmacists present their good practice in both antimicrobial stewardship and provision. The results of these can show that community pharmacist in Thailand perform appropriated use and awareness in resistance of antimicrobials in practical although have no prescription system in Thailand. It follows a statement of International Pharmaceutical Federation (FIP) regarding antimicrobial stewardship in community pharmacy (FIP, 2015)

Interdisciplinary collaboration could to improve antimicrobials combating

In term of healthcare collaboration, over than 50% of participants reported that they have no chance collaborate with other health professional for antimicrobial stewardship. It is difference with study in Malaysian pharmacists in previous study (Khan et.al, 2016). It would be an outcome of prescription system do not imply in Thailand while Malaysia more strictly control. As result, the pharmacists refer that physician dose not send prescription to pharmacies and influence them to dispense antimicrobials without prescription. This situation can reduce relationship between pharmacist and physician. It might affect to quality of service and patients' safety. However, there are some activities can increase collaboration between community pharmacists and other healthcare profession. Model of community pharmacy in health promotion and disease prevention can use to increase collaboration with other healthcare providers (Tunpichart et.al, 2012; Chiyakunapruck et.al, 2016). Community pharmacists could have collaborated with physician to

discuss patients' problems and referral. Moreover, participating with public health campaign to combat antimicrobial resistance can induce opportunity to work with other healthcare providers.

Relationship of community pharmacists'' knowledge, attitude and practice in antimicrobial use and resistance.

The correlation results show that knowledge score and attitude score of the pharmacists do not correlate and there is a weak relationship between attitude and practice scores. This is consistent with a previous study in pharmacy students which showed none and/ or a slight relationship between the three dimensions (Khan et.al, 2014). However, other influencing factors outside the KAP model could affect to pharmacists' practice, including medication regulations, health system and patients' pressure. Although, the KAP model dose not explain pharmacists' behaviour, it is a useful tool to measure pharmacists practice (Vandamme, 2009).

Relationship between characteristic and Knowledge, attitude, and practice of community pharmacists on antimicrobial use and resistance.

Pharmacy degree associate with antimicrobial use and resistance

This study finds that pharmacy qualification influences of knowledge, attitude, and practice score increasing in the pharmacists, but it is significant in type of positive attitude only. According to socio-economic data of community pharmacists in this research, the increase in the new generation of pharmacists (PharmD) is a result of pharmacy education programme reforms in Thailand, changing from a 5 years programme, bachelor's degree to 6 years programme in a doctor of pharmacy programme. They are expected to be professionally "more" competent in clinical practice (Pongcharoensuk & Prakongpan, 2012; Chanakit et.al, 2015). A prior study in Thailand shows that changing of pharmacy curriculum does not affect to pharmacists practice in antimicrobial use for diarrhoea treatment. (Saengchareon et.al,2010). However, the curriculum revision in the previous research was a five-year programme (BPharm) curriculum but this research considers between BPharm and PharmD programme which comes with enhanced clinical practicing in final year of study. These results are similar to previous research comparing BPharm and PharmD students in India. The research indicates that PharmD students have a more positive attitude towards antibiotic use compared to non-PharmD students (Ahmad et.al, 2015). Nevertheless, the results show that PharmD and BPharm degree pharmacists do not differ in type of knowledge and practice in antimicrobial use and provision. They both could provide antimicrobials appropriately to their patients.

Pharmacy ownership associate with antimicrobial use and resistance

Type of pharmacy ownership associated with knowledge, and attitude. The results show that pharmacists who in chain store have more knowledge and attitude scores than others. It seems similar with pharmacy degree because newly graduated pharmacists who mostly hold a PharmD degree are more likely to practice in a chain-store. Proportion of pharmacy workforces in chain and independent stores has changed for over the years. It is the outcome of chain-store pharmacies growth particularly in urban areas. Chain store pharmacies made up around 3% all pharmacies in 2011 (Saramunee et.al,2011), and this has increased to10% in 2015 (Kasikorn Research Center, 2015). However, urban areas such as Bangkok would have a higher proportion of chain pharmacies compared to other cities. This research indicates that 29.8% of pharmacists work in chain-stores in Bangkok compared to 7.5 % in Chonburi. This may be attributed to lack of experience and lack of financial budgets to support opening their independent pharmacies.

Although there are other factors can influence attitude and practice score but it not significant in practical. Extensive experience of participants shows better attitude and practice score than others, and male group shows significant practice score than female. Yet, they are not significantly when classified type into good or poor attitude and/or practice. So, pharmacists who extensive experience and male pharmacists could provide proper practice in antimicrobial provision.

Implications

The results of this research confirm that although community pharmacists provide antimicrobials without a prescription, they are competent to ensure appropriate use of antimicrobials and reduce resistance. However, there are issues that need to be considered in future studies in relation to inter-professional collaboration and adherence to antimicrobial stewardship guideline. The results would be advantageous at many levels including individual, organisation and policy levels.

Individual level: Although this study shows that most community pharmacists have good knowledge, attitude, and practice, they still need to be evaluated to ensure up-to-date knowledge, sustain competence in practice, and ensure a positive attitude towards appropriate antimicrobial use and resistance. Findings of this study recommends that community pharmacist.

- Improve their understanding of antimicrobial use and resistance issues through training, multi-professional workshops, continuing education, and online resources
- Update surveillance data and resistance issues in country
- Adhere to local antimicrobial guidelines
- Educate and motivate patients to increase awareness of appropriate antimicrobial use and resistance
- Participate in local and national campaigns regarding antimicrobial resistance
- Collaborate with other healthcare providers to improve services such as referral and clinical consultations.

Organisation level: Pharmacy association is an important player, with the responsibility to improve, support and motivate their pharmacy members to engage in antimicrobial resistance combatting. The association could generate activities to support members through:

- Providing training, workshops, continuing education in appropriate antimicrobial use and resistance, and antimicrobial stewardship programmes for pharmacists.
- Support research in antimicrobial use and resistance in community pharmacy through funding, databases access, and research training.
- Support resources such as booklets, e-resources and campaign literature to promote appropriate antimicrobial use and resistance.
- Reward pharmacist(s) who act as role models to improve antimicrobial use and resistance in community pharmacy.
- Produce professional guidelines in antimicrobial stewardship for community pharmacy that take into account the role of pharmacists and pharmacy workers.
- Promote campaigns to improve public awareness in antimicrobial resistance and support antimicrobial provision in community pharmacy.
- Collaborate with other healthcare professional associations and public communities to improve healthcare service and management in term of infection control and the issue of antimicrobial resistance.

National level: National strategies and policies directly affect community pharmacy practice. Government and policy makers could support pharmacists' role to ensure appropriate use of antimicrobials and combat resistance through:

- Providing national strategies and an action plan to combat antimicrobial resistance that is relevant and accessible to the public and healthcare professionals
- Supporting national research grants and funding to explore and follow up the situation of antimicrobials use and resistance.
- Supporting and maintaining currency of national surveillance programme and antimicrobial use databases.
- Communicating with healthcare professionals including community pharmacists to develop or improve strategies regarding antimicrobial use and resistance and set up plans to move these efforts forward.
- Debating the non-prescription use of antimicrobial use and amend current regulations to reduce inappropriate use of antimicrobials and reduce the spread of resistance in the country.

Strengths and Limitations

The strength of this research is that it fulfils understanding of antimicrobial stewardship in community pharmacy in Thailand. It can be baseline evidence for future research which will be conducted after the implementation of the national strategic plan on antimicrobial resistance from 2017 to 2021 (MOPH & MOAC, 2017).

This study employed multiple choices questions to explore current knowledge, attitude, and practice of pharmacists combined with open-ended questions to explore the current situation in community pharmacies. It would beneficial to examine causes and effects of knowledge, attitude, and practice of participants. Moreover, relationship within knowledge, attitude, and practice (KAP) model were calculated to assure theory of the model.

There may be other factors that could influence pharmacists' actual practice besides their knowledge and attitude which is captured through the KAP model. Regulations and policies could affect pharmacists practice in antimicrobial provision. Further, accessing educational resource might affect their knowledge, attitude, and practice. This could be explored in future studies to understand the impact of training and pharmacists KAP.

Although Bangkok and Chonburi province cover around 30% of pharmacies in country, it may not represent the current situation in other provinces especially in rural areas. The rural areas could be different in terms of the encountered infections, the dispensed antimicrobials, and the reasons to dispense antimicrobials without a prescription. They would have other reasons in relation to affordability of medicines that need to consider. However, all community pharmacists are expected by law to have a good knowledge, a good positive attitude, and appropriate practice in antimicrobial use and resistance. The expectations are not specific to geography/ location, or practice area, thus, the two provinces could represent an overview of community pharmacists in Thailand in relation to this issue.

This study recruited participants through online communities, email and social media. Some of the potential participants might not have been invited to participate if they cannot access online platforms, particular the older participants.

Further, this study does not assess antimicrobials dispensing such as appropriateness of dosage regimens and patient counselling in pharmacy practice. This may need to be measured in future studies.

Conclusion

Antimicrobial resistance is increasing worldwide especially that antimicrobials consumption continues to escalate. This problem can damage public health and increase economic burden. (WHO,2016). It is estimated that around 700,000 people a year die as a result of infections and this might rise to 10 million people in 2050, and a loss of $60 to $100 trillion (O'Nell et.al,2014). In Thailand, antimicrobial resistance infections cause 3.24 million additional hospitalisation days and 38,481 deaths annually (Pumart et.al, 2012).

Community pharmacists are expected to ensure appropriate use of medicines and health information for patients, carers and the general public (FIP,2015). They are very important to push forward antimicrobial resistance containment and reduce antimicrobial resistance emergence in primary care (FIP,2015). Previous studies indicate that community pharmacists had inadequate knowledge, poor attitude, and malpractice in antimicrobial use and resistance (Apisanthanarak et.al 2008; Saengcharoen & Lerkiatbundit, 2010; Puspitasari et.al, 2011). However, these studies were conducted several years ago before policies, professional standards, and education in community pharmacy transformed; these recent changes include changing the pharmacy education system, introducing the good pharmacy practice law, and various national strategies to combat antimicrobial resistance. Further, prior research in Thailand discussed the need for pharmacists' knowledge to improve without actually assessing their knowledge.

This research aimed to assess knowledge, attitude and practice of community pharmacists in Thailand regarding non-prescription antimicrobial use and resistance through the knowledge, attitude and practice model. This research is a cross-sectional descriptive study using a self-administered questionnaire. The population in this study is community pharmacists working in Bangkok and Chonburi province in Thailand which have 5082 pharmacies and cover 33% of pharmacies in Thailand. The sample size calculation required a minimum of 358 participants. This research was granted ethical approval by the University of Hertfordshire under protocol number: LMS/PGR/UH/02811

The self- administrative questionnaire was developed from a literature review and constructed using the knowledge, attitudes and practice model. The questionnaire was divided into 4 sections; demographic data, knowledge, attitude and practice which included open-end questions about the current situation of antimicrobial provision in community pharmacy. It was validated by three experts in antimicrobial stewardship and community pharmacy services. Also, its reliability was assessed in relation to consistency and reproducibility in a pilot test with 15 community pharmacists. The results of validation and reliability testing show that the questionnaire can be an appropriate measurement tool. The final questionnaire contains 35 items.

The Statistic Package for the Social Science (SPSS) software version 24 was used for analysis. Descriptive statistical analysis was done through the mean, standard diviation (SD), median, inter quartile (IQR). Mann-Whitney U Test and Kruskal-Wallis H test were applied for comparison of knowledge, attitude, and practice score with characteristics. Chi-square test was used to compare factors. Relationship of the three dimensions of the KAP model was analysed through Spearman rho correlation coefficient analysis. The open-end questions were analysed using coding technique and were presented as percentages.

521 community pharmacists were invited to access an online questionnaire between 9 May 2017 and 7 July 2017 (60 days). 372 pharmacists completed the questionnaire and met the inclusion criteria, achieving 71% response rate. The age average of participants was 32.02 (± 5.81) years and the experience average was 5.46 (± 4.31) years. The majority of participants were female (69.9%), graduated with a Bachelor of pharmacy (77.2%), and 62.6% of them worked in an individual/ independent pharmacy.

The results of the study show that respiratory infections are the most commonly encountered infections while Aminopenicillin is the most commonly dispensed antimicrobial in community pharmacy. Pharmacist provided competence, patient's convenience, and legality of practice as the main reasons for dispensing antimicrobials without a prescription.

More than 90% of community pharmacists were judged as having good knowledge, attitude, and practice in antimicrobial use and resistance. Moreover, the results indicate that Doctor of Pharmacy qualification, working in a chain store pharmacy, extensive experience can positively influence pharmacists' knowledge, attitude, and practice score. However, these factors are not relevant when classifying KAP as either good or bad, especially in relation to practice. This research confirms that Thai community pharmacists have good knowledge, attitude and practice in antimicrobial use and resistance.

This research examined the current situation in community pharmacy practice in relation to antimicrobial provision. Moreover, this study is an initial assessment of community pharmacists regarding antimicrobial use and resistance immediately following the launch of Thailand's national strategy on AMR in early 2017. This research can be useful to develop future intervention for community pharmacist such as continuing professional development (CPD) courses and antimicrobial stewardship training. Future interventions could take into account the current knowledge, attitude and practice of pharmacists, and aim to enhance pharmacists' role in ensuring appropriate antimicrobial use and reducing/ containing antimicrobial resistance.

In terms of the relationship between knowledge, attitude and practice in the KAP model, there is a weak correlation between attitude and practice scores and no relationship between knowledge and attitude scores, and knowledge and practice scores. However, other influencing factors such as regulations and policies could also affect pharmacists' knowledge, attitude, and practice, and these need to be explored in future studies.

These findings confirm that most pharmacists in Thailand provide antimicrobials without a prescription, but this practice is supported by good knowledge, positive attitude and appropriate practice. However, antimicrobial stewardship in community pharmacy needs to improve. Antimicrobial stewardship strategy and guideline need to be produced, and interdisciplinary collaboration between sectors of healthcare is urgently required. Although pharmacists routinely undertake continuing education programmes regarding antimicrobials use, further education and CPD training is necessary. Future research could employ various behaviour models to investigate pharmacists and patients' behaviour in relation to antimicrobial use and resistance. The next step would be to design and evaluate a suitable intervention in community pharmacy to improve patients' antimicrobials use and awareness of resistance.

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Appendixes

Appendix 1: Ethical Approval

University of Hertfordshire UH

HEALTH SCIENCES ENGINEERING & TECHNOLOGY ECDA

ETHICS APPROVAL NOTIFICATION

TO: Budh Siltrakool

CC: Dr Ilhem Berrou

FROM: Dr Simon Trainis,Health,Sciences,Enginering &Technology ECDA Chair

DATE: 04/05/2017

Protocol number: LMS/PGR/UH/02811

Title of study: Assessment of community pharmacists' knowledge,attitudes and practices regarding non-prescription antimicrobial use and resistance in Thailand

Your application for ethics approval has been accepted and approved by the ECDA for your School and includes work undertaken for this study by the named additional workers below:

This approval is valid:

From: 04/05/2017

To: 30/06/2018

Additional workers: no additional workers named.

Please note:

If your research involves invasive procedures you are required to complete and submit an EC7 Protocol Monitoring Form, and your completed consent paperwork to this ECDA once your study is complete.

Approval applies specifically to the research study/methodology and timings as detailed in your Form EC1. Should you amend any aspect of your research, or wish to apply for an extension to your study, you will need your supervisor's approval and must complete and submit form EC2. In cases where the amendments to the original study are deemed to be substantial, a new Form EC1 may need to be completed prior to the study being undertaken.

Should adverse circumstances arise during this study such as physical reaction/harm, mental/emotional harm, intrusion of privacy or breach of confidentiality this must be reported to the approving Committee immediately. Failure to report adverse circumstance/s would be considered misconduct.

Ensure you quote the UH protocol number and the name of the approving Committee on all paperwork, including recruitment advertisements/online requests, for this study.

Students must include this Approval Notification with their submission.

Appendix 2: Participant Information Sheet

UNIVERSITY OF HERTFORDSHIRE

ETHICS COMMITTEE FOR STUDIES INVOLVING THE USE OF HUMAN PARTICIPANTS ('ETHICS COMMITTEE')

FORM EC6: PARTICIPANT INFORMATION SHEET

1 **Title of study**

Assessment of community pharmacists' knowledge, attitude and practice regarding non-prescription antimicrobial use and resistance in Thailand.

2 **Introduction**

You are being invited to take part in a study. Before you decide whether to do so, it is important that you understand the research that is being done and what your involvement will include. Please take the time to read the following information carefully and discuss it with others if you wish. Do not hesitate to ask us anything that is not clear or for any further information you would like to help you make your decision. Please do take your time to decide whether or not you wish to take part. The University's regulations governing the conduct of studies involving human participants can be accessed via this link:

http://sitem.herts.ac.uk/secreg/upr/RE01.htm

Thank you for reading this.

3 **What is the purpose of this study?**

This study aims to assessment community pharmacists' attitudes, knowledge and practices regarding non-prescription antimicrobials prescribing and antimicrobial resistance

4 **Do I have to take part?**

It is completely up to you whether or not you decide to take part in this study. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. Agreeing to join the study does not mean that you have to complete it. You are free to withdraw at any stage without giving a reason. A decision to withdraw at any time, or a decision not to take part at all, will not affect any treatment/care that you may receive (should this be relevant).

5 **Are there any age or other restrictions that may prevent me from participating?**

You are not be eligible participate if you are age under 18 years old and not be a registered pharmacists by the pharmacy council of Thailand.

6 **How long will my part in the study take?**

If you decide to take part in this study, you will be involved in it for answering the questionnaire around 10 minutes.

7 **What will happen to me if I take part?**

The first thing to happen the researcher will be provide a questionnaire to you. The questionnaire is divided into four sections. The first section ask your personal background and general topic in your community pharmacy working. The second section is a self-assessment of your know ledged in antimicrobial use and resistance. The third section will provide statements in antimicrobial use and resistance issue then you will give agreement to them. Last section is self-assessment about your activities to provide antimicrobial medicine in real practice. You will carefully read instruction of each part and answer the questions as possible as you can.

8 **What are the possible disadvantages, risks or side effects of taking part?**

In case you feel inconvenience to answers in some questions, you can skip the questions. Also, you are free to answer as little or a much as you want to in order to avoid you feeling uncomfortable and to withdraw yourself at any time.

9 **What are the possible benefits of taking part?**

The researcher expected that you may benefit from contributing this research. The research propose to understand current community pharmacists' knowledge, attitude and practice regarding non-prescription antimicrobial use and resistance in Thailand. It will be useful for our pharmacy professional and health services improvement in the future.

10 **How will my taking part in this study be kept confidential?**

You will be asked about personal background in the first part or the questionnaire. However, it not ask any details or identification data. All responded questionnaire will be recorded in coding system. They will be stored separately to the consent form to protect your anonymity. It will be kept with secure conditions. It can be accessed only the researcher and their supervisors.

11 **Audio-visual material**

This research will NOT record any audio-visual material.

12 **What will happen to the data collected within this study?**

All responded questionnaire will be recorded in code system. They will be stored separately to the consent form to protect your anonymity. It will be kept with secure conditions. It can be accessed only the researcher and their supervisors. Storage and usage of personal information will be undertaken in accordance with the Data Protection Act 1998 and the EU Directive 95/46 on Data Protection.

12.1 The data collected will be stored electronically, in a password-protected environment, for 36 months, after this study completed it will be destroyed under secure conditions.

12.2 The data will be anonymised prior to storage.

13 **Will the data be required for use in further studies?**

For dissemination through publication in peer-reviewed journals, posters or oral presentations at conferences, this data will be used in future studies.

13.1 You are consenting to the re-use or further analysis of the data collected in a future ethically-approved study;

13.2 The data collected will be stored electronically, in a password-protected environment, for 36 months, after this study completed it will be destroyed under secure conditions;

14 **Who has reviewed this study?**

This study has been reviewed by:
The University of Hertfordshire Health and Human Sciences Ethics Committee with Delegated Authority

The UH protocol number is *LMS/PGR/UH/02811*

15 **Factors that might put others at risk**

Please note that if, during the study, any medical conditions or non-medical circumstances such as unlawful activity become apparent that might or had put others at risk, the University may refer the matter to the appropriate authorities.

16 **Who can I contact if I have any questions?**

If you would like further information or would like to discuss any details personally, please get in touch with me, in writing, by phone or by email:

Mr.Budh Siltrakool
+4475-3590-7099, budh.sil@gmail.com

Although we hope it is not the case, if you have any complaints or concerns about any aspect of the way you have been approached or treated during the course of this study, please write to the University's Secretary and Registrar.

Thank you very much for reading this information and giving consideration to taking part in this study.

Appendix 3: Questionnaire

Assessment of community pharmacists' knowledge, attitude and practice regarding non-prescription antimicrobial use and resistance in Thailand.

PARTICIPANT INFORMATION SHEET

This study aims to assessment community pharmacists' attitudes, knowledge and practices regarding non-prescription antimicrobials prescribing and antimicrobial resistance.

For full information of participant information please read goo.gl/7AsRHS

If you decide to take part in this study, you will be involved in it for answering the questionnaire around 10 minutes.

The first thing to happen the researcher will be provide a questionnaire to you.
The questionnaire is divided into four sections. The first section ask your personal background and general topic in your community pharmacy working. The second section is a self-assessment of your know ledged in antimicrobial use and resistance. The third section will provide statements in antimicrobial use and resistance issue then you will give agreement to them. Last section is self-assessment about your activities to provide antimicrobial medicine in real practice. You will carefully read instruction of each part and answer the questions as possible as you can.

This study has been reviewed by: The University of Hertfordshire Health and Human Sciences Ethics Committee with Delegated Authority
The UH protocol number is LMS/PGR/UH/02811

If you would like further information or would like to discuss any details personally, please get in touch with me, in writing, by phone or by email: Mr.Budh Siltrakool,+4475-3590-7099, bs16aai@herts.ac.uk

Thank you very much for reading this information and giving consideration to taking part in this study.

Assessment of community pharmacists' knowledge, attitude and practice regarding non-prescription antimicrobial use and resistance in Thailand.

CONSENT FORM

You are being invited to participate in a research study titled Assessment of community pharmacists' knowledge, attitude and practice regarding non-prescription antimicrobial use and resistance in Thailand. This study is being done by Budh Slitrakool from the University of Hertfordshire.
This study aims to assess pharmacists' knowledge, attitude and practice regarding antimicrobial use over the counter and antimicrobial resistance in Thailand, and will take you approximately 10-15minutes to complete.
Your participation in this study is entirely voluntary and you can withdraw at any time.
We believe there are no known risks associated with this research study; however, as with any online related activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential.
We assure you that all data collected will be anonymous. All data will be stored electronically on password protected media for a maximum of three years. All data collection, storage and processing will comply with the principles of the Data Protection Act 1998 and the EU Directive 95/46 on Data Protection.

* By completing this survey please click AGREE to indicate that:
You are a pharmacist aged 18 years or older
You practice as full-time or part-time in a community pharmacy in Bangkok/ Chonburi provinces
You have read the participant information sheet associated with this study

◯ Agree

Assessment of community pharmacists' knowledge, attitude and practice regarding non-prescription antimicrobial use and resistance in Thailand.

Section 1:Demographic

Please tick the relevant box or write your answer when appropriate

What is your gender?

- ◯ Female
- ◯ Male

Please write your age. (years)

Your pharmacy degree

- ◯ B.Sc in Pharm/ B.Pharm (5-year programme)
- ◯ PharmD (6-year programme)
- ◯ Other (please specify)

Postgraduate degree (if any)

- ◯ Master degree or equivalent
- ◯ Doctoral degree or equivalent

Experience in community pharmacy practice (years)

Location of pharmacy that you work

- ◯ Bangkok
- ◯ Chonburi
- ◯ Other (please specify)

Type of pharmacy

- ◯ Individual store
- ◯ Chain store

Assessment of community pharmacists' knowledge, attitude and practice regarding non-prescription antimicrobial use and resistance in Thailand.

Section 2: Knowledge

Please tick one option on each question

Superbugs" are microorganisms which generate antimicrobial resistance. They include bacteria, fungal, viruses or parasites .

- ◯ Yes
- ◯ No
- ◯ Uncertain

Resistance DNA in bacteria can transfer to other bacteria by virus.

- ◯ Yes
- ◯ No
- ◯ Uncertain

Antimicrobial resistance in hospital setting is higher than community setting.

- ◯ Yes
- ◯ No
- ◯ Uncertain

The main objective of antimicrobial stewardship is an achievement the most effective clinical outcome with less toxicity and adverse reactions.

- ◯ Yes
- ◯ No
- ◯ Uncertain

Penicillin, cephalosporin, and fluoroquinolone are Beta-lactam (β-lactam antibiotic). It need to consider Beta-lactamase producing bacterial.

- ◯ Yes
- ◯ No
- ◯ Uncertain

Patients who are allergy to Amoxicillin (Anaphylaxis type) should not use Cephalexin.

- ◯ Yes
- ◯ No
- ◯ Uncertain

Is it appropriate?
When a pharmacist dispenses amoxicillin 1,500 mg a day, 7 days for a 26-year-old male with allergic rhinitis, has high-grade fever rhinorrhoea, and sore throat, and no known drug allergies.

- ◯ Appropriate
- ◯ Not appropriate
- ◯ Uncertain

Is it appropriate?
When a pharmacist dispenses only mineral powder in case of a 2-year-old boy with watery diarrhoea, no mucous/bloody stool, no fever, no vomiting, no known drug allergies.

- ◯ Appropriate
- ◯ Not appropriate
- ◯ Uncertain

Is it appropriate?
When a pharmacist dispenses dicloxacillin 250 mg four time a day for 5 days to prevent infection in case of a 24-year old male who has had skin abrasion wound on his right arm without exudates for 2 days, limited to subcutaneous layer, mild tenderness, no swelling, no active bleeding, no fever, and no known drug allergy.

- ◯ Appropriate
- ◯ Not appropriate
- ◯ Uncertain

Assessment of community pharmacists' knowledge, attitude and practice regarding non-prescription antimicrobial use and resistance in Thailand.

Section 3: Attitude

Please tick one option on each row

	1 Strogly disagree	2 Disagree	3 Neither agree or disagree	4 Agree	5 Strongly agree
Antimicrobial resistance is an important public health problem of ours.	○	○	○	○	○
The fact that a patient is taking an antibiotic increases the risk of developing resistance.	○	○	○	○	○
New antimicrobials development can solve antimicrobial resistance problem.	○	○	○	○	○
The use of antimicrobials in livestock animals is an important cause of appearance of new resistance to pathogenic agents in humans.	○	○	○	○	○
In all cases where antimicrobials are dispensed, it is essential that patients be advised about complying with the treatment.	○	○	○	○	○
Antimicrobials are sometimes dispensed without medical prescription because the patient is known to have difficulty in obtaining a medical consultation.	○	○	○	○	○
Antimicrobials are sometimes prescribed without medical prescription because the patient is known to have neither the time nor the money to see a physician.	○	○	○	○	○
Dispensing antimicrobials without prescription is serious issue.	○	○	○	○	○

Assessment of community pharmacists' knowledge, attitude and practice regarding non-prescription antimicrobial use and resistance in Thailand.

Section 4: Practice

Please tick one option on each row.

	1 Never	2 Several	3 Fairly often	4 Usually	5 Always
I educate patients on the use of antimicrobials and resistance-related issues.	○	○	○	○	○
I take part in antimicrobial awareness campaigns to promote the optimal use of antimicrobials.	○	○	○	○	○
I lack continuing education in antimicrobial use and resistance topics.	○	○	○	○	○
I make efforts to prevent or reduce the transmission of infections within the community.	○	○	○	○	○
I collaborate with other health professionals for infection control and antimicrobial stewardship.	○	○	○	○	○
I ask patient's history and symptom of their infections before deciding to dispense antimicrobials.	○	○	○	○	○
I sought additional clinical information (e.g. drug interaction, ADRs, allergy, etc.) before deciding to dispense the antimicrobials.	○	○	○	○	○
I screen the antimicrobials in accordance with local guidelines before dispensing.	○	○	○	○	○
I dispense antimicrobial with complete clinical information (e.g. drug interaction, ADRs, allergy, etc.)	○	○	○	○	○
I dispense antimicrobials without a prescription.	○	○	○	○	○

Assessment of community pharmacists' knowledge, attitude and practice regarding non-prescription antimicrobial use and resistance in Thailand.

Current situation in practice

What are top three most commonly encountered infections in your community pharmacy?

What are the top three most commonly dispensed antimicrobials in your community pharmacy?

What is a main reason for dispensing antimicrobials without a prescription?

THANK YOU FOR YOUR ANSWERS

Appendix 4: Statistical analysis data

Chi square test - Demographic data

1. Age * Gender

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.716[a]	2	.699	.730		
Likelihood Ratio	.696	2	.706	.730		
Fisher's Exact Test	.776			.702		
Linear-by-Linear Association	.271[b]	1	.603	.605	.331	.060
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.65.

b. The standardized statistic is -.521.

2. Age * Postgraduate degree

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	20.106[a]	2	.000	.000		
Likelihood Ratio	19.843	2	.000	.000		
Fisher's Exact Test	19.808			.000		
Linear-by-Linear Association	19.858[b]	1	.000	.000	.000	.000
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.84.

b. The standardized statistic is 4.456.

3. Age * Pharmacy degree

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	63.590[a]	2	.000	.000		
Likelihood Ratio	69.943	2	.000	.000		
Fisher's Exact Test	65.887			.000		
Linear-by-Linear Association	58.452[b]	1	.000	.000	.000	.000
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.60.

b. The standardized statistic is -7.645.

4. Age* Location

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.323[a]	2	.313	.308		
Likelihood Ratio	2.343	2	.310	.305		
Fisher's Exact Test	2.384			.296		
Linear-by-Linear Association	2.172[b]	1	.141	.144	.083	.023
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.87.

b. The standardized statistic is 1.474.

5. Age* Pharmacy type

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	26.775[a]	2	.000	.000		
Likelihood Ratio	28.548	2	.000	.000		
Fisher's Exact Test	27.775			.000		
Linear-by-Linear Association	26.703[b]	1	.000	.000	.000	.000
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.69.

b. The standardized statistic is 5.167.

6. Age * Experiences

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	238.570[a]	4	.000	.000		
Likelihood Ratio	189.614	4	.000	.000		
Fisher's Exact Test	183.498			.000		
Linear-by-Linear Association	149.120[b]	1	.000	.000	.000	.000
N of Valid Cases	372					

a. 1 cells (11.1%) have expected count less than 5. The minimum expected count is 4.52.

b. The standardized statistic is 12.211.

7. Experience * Gender

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.148[a]	2	.929	.947		
Likelihood Ratio	.147	2	.929	.947		
Fisher's Exact Test	.199			.908		
Linear-by-Linear Association	.131[b]	1	.717	.737	.389	.062
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.04.

b. The standardized statistic is -.362.

8. Experience * Postgraduate degree

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	16.142[a]	2	.000	.000		
Likelihood Ratio	14.821	2	.001	.001		
Fisher's Exact Test	14.935			.001		
Linear-by-Linear Association	13.899[b]	1	.000	.000	.000	.000
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.32.

b. The standardized statistic is 3.728.

9. Experience * Pharmacy degree

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	56.006[a]	2	.000	.000		
Likelihood Ratio	64.969	2	.000	.000		
Fisher's Exact Test	60.749			.000		
Linear-by-Linear Association	51.459[b]	1	.000	.000	.000	.000
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.14.

b. The standardized statistic is -7.173.

10. Experience * Location

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	4.687[a]	2	.096	.097		
Likelihood Ratio	4.655	2	.098	.096		
Fisher's Exact Test	4.561			.104		
Linear-by-Linear Association	.674[b]	1	.412	.451	.230	.047
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.26.
b. The standardized statistic is .821.

11. Experience * Pharmacy type

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	12.808[a]	2	.002	.002		
Likelihood Ratio	13.991	2	.001	.001		
Fisher's Exact Test	13.441			.001		
Linear-by-Linear Association	11.980[b]	1	.001	.001	.000	.000
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.95.
b. The standardized statistic is 3.461.

12. Pharmacy degree * Gender

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	3.977[a]	1	.046	.059	.033	
Continuity Correction[b]	3.459	1	.063			
Likelihood Ratio	3.853	1	.050	.059	.033	
Fisher's Exact Test				.059	.033	
Linear-by-Linear Association	3.967[c]	1	.046	.059	.033	.015
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 25.59.
b. Computed only for a 2x2 table
c. The standardized statistic is -1.992.

13. Pharmacy degree * Location

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.874[a]	1	.015	.016	.010	
Continuity Correction[b]	5.243	1	.022			
Likelihood Ratio	6.229	1	.013	.016	.010	
Fisher's Exact Test				.016	.010	
Linear-by-Linear Association	5.858[c]	1	.016	.016	.010	.005
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 26.05.
b. Computed only for a 2x2 table
c. The standardized statistic is -2.420.

14. Pharmacy degree * Pharmacy type

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	11.420[a]	1	.001	.001	.001	
Continuity Correction[b]	10.574	1	.001			
Likelihood Ratio	11.144	1	.001	.001	.001	
Fisher's Exact Test				.001	.001	
Linear-by-Linear Association	11.390[c]	1	.001	.001	.001	.000
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 31.76.
b. Computed only for a 2x2 table
c. The standardized statistic is -3.375.

15. Postgraduate degree * Gender

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.080[a]	1	.777	.797	.436	
Continuity Correction[b]	.024	1	.877			
Likelihood Ratio	.080	1	.777	.797	.436	
Fisher's Exact Test				.797	.436	
Linear-by-Linear Association	.080[c]	1	.777	.797	.436	.098
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 28.90.
b. Computed only for a 2x2 table
c. The standardized statistic is -.283.

16. Postgraduate degree * Location

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.012[a]	1	.914	1.000	.511	
Continuity Correction[b]	.000	1	1.000			
Likelihood Ratio	.012	1	.914	1.000	.511	
Fisher's Exact Test				1.000	.511	
Linear-by-Linear Association	.012[c]	1	.914	1.000	.511	.102
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 29.42.
b. Computed only for a 2x2 table
c. The standardized statistic is -.108.

17. Postgraduate degree * Pharmacy type

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	3.716[a]	1	.054	.066	.034	
Continuity Correction[b]	3.259	1	.071			
Likelihood Ratio	3.807	1	.051	.066	.034	
Fisher's Exact Test				.066	.034	
Linear-by-Linear Association	3.707[c]	1	.054	.066	.034	.015
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 35.87.
b. Computed only for a 2x2 table
c. The standardized statistic is 1.925.

18. Pharmacy degree * Postgraduate degree

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	22.842[a]	1	.000	.000	.000	
Continuity Correction[b]	21.514	1	.000			
Likelihood Ratio	28.263	1	.000	.000	.000	
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	22.781[c]	1	.000	.000	.000	.000
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 21.94.
b. Computed only for a 2x2 table
c. The standardized statistic is -4.773.

19. Pharmacy type * Gender

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.039[a]	1	.843	.907	.469	
Continuity Correction[b]	.007	1	.935			
Likelihood Ratio	.039	1	.843	.907	.469	
Fisher's Exact Test				.907	.469	
Linear-by-Linear Association	.039[c]	1	.843	.907	.469	.091
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 41.85.
b. Computed only for a 2x2 table
c. The standardized statistic is -.198.

20. Pharmacy type * Location

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	11.515[a]	1	.001	.001	.000	
Continuity Correction[b]	10.739	1	.001			
Likelihood Ratio	11.963	1	.001	.001	.000	
Fisher's Exact Test				.001	.000	
Linear-by-Linear Association	11.484[c]	1	.001	.001	.000	.000
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 42.60.
b. Computed only for a 2x2 table
c. The standardized statistic is 3.389.

21. Location * Gender

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.105[a]	1	.746	.807	.423	
Continuity Correction[b]	.041	1	.840			
Likelihood Ratio	.106	1	.745	.807	.423	
Fisher's Exact Test				.807	.423	
Linear-by-Linear Association	.105[c]	1	.746	.807	.423	.093
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 34.32.
b. Computed only for a 2x2 table
c. The standardized statistic is .324.

Mann Whitney Test

1. Gender: Male and Female

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Knowledge total score (K1-K9)	Male	112	197.49	22118.50
	Female	260	181.77	47259.50
	Total	372		
Attitude total score (A1-A8)	Male	112	185.50	20775.50
	Female	260	186.93	48602.50
	Total	372		
Practice total score (P1-P10)	Male	112	204.97	22957.00
	Female	260	178.54	46421.00
	Total	372		

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Mann-Whitney U	13329.500	14447.500	12491.000
Asymp. Sig. (2-tailed)	.183	.905	.029

2 Age:

2.1 Lower than 30 and 30-40yrs.

Ranks				
	Age by range	N	Mean Rank	Sum of Ranks
Knowledge total score (K1-K9)	lower than 30	145	173.51	25159.50
	30-40 yrs.	185	159.22	29455.50
	Total	330		
Attitude total score (A1-A8)	lower than 30	145	172.89	25069.00
	30-40 yrs.	185	159.71	29546.00
	Total	330		
Practice total score (P1-P10X	lower than 30	145	165.97	24065.00
	30-40 yrs.	185	165.14	30550.00
	Total	330		

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Mann-Whitney U	12250.500	12341.000	13345.000
Asymp. Sig. (2-tailed)	.165	.211	.937

2.2 Age: lower than 30 yrs. and over than 40yrs.

Ranks				
	Age by range	N	Mean Rank	Sum of Ranks
Knowledge total score (K1-K9)	lower than 30	145	95.67	13871.50
	over than 40	42	88.25	3706.50
	Total	187		
Attitude total score (A1-A8)	lower than 30	145	93.00	13485.00
	over than 40	42	97.45	4093.00
	Total	187		
Practice total score (P1-P10X	lower than 30	145	96.63	14011.00
	over than 40	42	84.93	3567.00
	Total	187		

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Mann-Whitney U	2803.500	2900.000	2664.000
Asymp. Sig. (2-tailed)	.421	.637	.216

2.3 Age: 30-40 yrs. and over than 40yrs.

Ranks				
	Age by range	N	Mean Rank	Sum of Ranks
Knowledge total score (K1-K9)	30-40 yrs.	185	113.74	21041.50
	over than 40	42	115.15	4836.50
	Total	227		
Attitude total score (A1-A8)	30-40 yrs.	185	111.92	20705.00
	over than 40	42	123.17	5173.00
	Total	227		
Practice total score (P1-P10X	30-40 yrs.	185	116.53	21558.00
	over than 40	42	102.86	4320.00
	Total	227		

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Mann-Whitney U	3836.500	3500.000	3417.000
Asymp. Sig. (2-tailed)	.896	.314	.222

3. Pharmacy degree: BPharm and PharmD.

Ranks				
	Phamacy degree	N	Mean Rank	Sum of Ranks
Knowledge total score (K1-K9)	BPharm	287	180.95	51934.00
	PharmD	85	205.22	17444.00
	Total	372		
Attitude total score (A1-A8)	BPharm	287	177.77	51019.00
	PharmD	85	215.99	18359.00
	Total	372		
Practice total score (P1-P10)	BPharm	287	180.86	51906.00
	PharmD	85	205.55	17472.00
	Total	372		

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Mann-Whitney U	10606.000	9691.000	10578.000
Asymp. Sig. (2-tailed)	.060	.004	.062

4. Postgraduate degree: None and Postgraduate degree

Ranks				
	Posgraduated degree	N	Mean Rank	Sum of Ranks
Knowledge total score (K1-K9)	None	276	190.06	52457.00
	Postgraduated degree	96	176.26	16921.00
	Total	372		
Attitude total score (A1-A8)	None	276	187.12	51646.00
	Postgraduated degree	96	184.71	17732.00
	Total	372		
Practice total score (P1-P10X	None	276	188.41	52001.50
	Postgraduated degree	96	181.01	17376.50
	Total	372		

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Mann-Whitney U	12265.000	13076.000	12720.500
Asymp. Sig. (2-tailed)	.265	.849	.560

5. Experience

5.1 lower than 5yrs. and 5-10 years

Ranks				
	Experience by range	N	Mean Rank	Sum of Ranks
Knowledge total score (K1-K9)	lower than 5	180	163.69	29465.00
	5-10 yrs.	152	169.82	25813.00
	Total	332		
Attitude total score (A1-A8)	lower than 5	180	168.38	30308.00
	5-10 yrs.	152	164.28	24970.00
	Total	332		
Practice total score (P1-P10)	lower than 5	180	175.85	31652.50
	5-10 yrs.	152	155.43	23625.50
	Total	332		

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Mann-Whitney U	13175.000	13342.000	11997.500
Asymp. Sig. (2-tailed)	.551	.697	.053

5.2 lower than 5yrs. and over than 10 years.

Ranks

	Experience by range	N	Mean Rank	Sum of Ranks
Knowledge total score (K1-K9)	lower than 5	180	110.05	19808.50
	over than 10	40	112.54	4501.50
	Total	220		
Attitude total score (A1-A8)	lower than 5	180	105.03	18904.50
	over than 10	40	135.14	5405.50
	Total	220		
Practice total score (P1-P10)	lower than 5	180	113.58	20444.50
	over than 10	40	96.64	3865.50
	Total	220		

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Mann-Whitney U	3518.500	2614.500	3045.500
Asymp. Sig. (2-tailed)	.818	.007	.127

5.3 5-10 yrs. and over than 10 years.

Ranks

	Experience by range	N	Mean Rank	Sum of Ranks
Knowledge total score (K1-K9)	5-10 yrs.	152	96.60	14683.50
	over than 10	40	96.11	3844.50
	Total	192		
Attitude total score (A1-A8)	5-10 yrs.	152	91.18	13860.00
	over than 10	40	116.70	4668.00
	Total	192		
Practice total score (P1-P10)	5-10 yrs.	152	97.25	14782.50
	over than 10	40	93.64	3745.50
	Total	192		

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Mann-Whitney U	3024.500	2232.000	2925.500
Asymp. Sig. (2-tailed)	.959	.010	.714

6. Location: Bangkok and Chonburi

Ranks

	Location	N	Mean Rank	Sum of Ranks
Knowledge total score (K1-K9)	Bangkok	258	189.10	48788.50
	Chonburi	114	180.61	20589.50
	Total	372		
Attitude total score (A1-A8)	Bangkok	258	188.84	48720.50
	Chonburi	114	181.21	20657.50
	Total	372		
Practice total score (P1-P10)	Bangkok	258	189.04	48772.00
	Chonburi	114	180.75	20606.00
	Total	372		

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Mann-Whitney U	14034.500	14102.500	14051.000
Asymp. Sig. (2-tailed)	.470	.526	.492

7. Type of pharmacy: Chain store and Individual store

Ranks				
	Type of pharmacies	N	Mean Rank	Sum of Ranks
Knowledge total score (K1-K9)	Chain store	139	199.18	27685.50
	Individual store	233	178.94	41692.50
	Total	372		
Attitude total score (A1-A8)	Chain store	139	206.16	28656.50
	Individual store	233	174.77	40721.50
	Total	372		
Practice total score (P1-P10)	Chain store	139	180.36	25070.00
	Individual store	233	190.16	44308.00
	Total	372		

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Mann-Whitney U	14431.500	13460.500	15340.000
Asymp. Sig. (2-tailed)	.071	.006	.394

Kruskal-Wallis Test

1. Age

Ranks			
	Age by range	N	Mean Rank
Knowledge total score (K1-K9)	lower than 30	145	196.18
	30-40 yrs.	185	179.96
	over than 40	42	181.90
	Total	372	
Attitude total score (A1-A8)	lower than 30	145	192.89
	30-40 yrs.	185	178.63
	over than 40	42	199.12
	Total	372	
Practice total score (P1-P10)	lower than 30	145	189.59
	30-40 yrs.	185	188.66
	over than 40	42	166.29
	Total	372	

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10)
Chi-Square	2.053	2.100	1.687
df	2	2	2
Asymp. Sig.	.358	.350	.430

2. Experience

Ranks			
	Experience by range	N	Mean Rank
Knowledge total score (K1-K9)	lower than 5	180	183.24
	5-10 yrs.	152	189.92
	over than 10	40	188.15
	Total	372	
Attitude total score (A1-A8)	lower than 5	180	182.90
	5-10 yrs.	152	178.96
	over than 10	40	231.34
	Total	372	
Practice total score (P1-P10X	lower than 5	180	198.93
	5-10 yrs.	152	176.18
	over than 10	40	169.78
	Total	372	

Test Statistics

	Knowledge total score (K1-K9)	Attitude total score (A1-A8)	Practice total score (P1-P10X
Chi-Square	.349	7.970	4.792
df	2	2	2
Asymp. Sig.	.840	.019	.091

Chi-square test, Knowledge types and demographics

Knowledge type * Gender

Crosstab

Count

		Gender		
		Male	Female	Total
Knowledge type	Poor	6	16	22
	Good	106	244	350
Total		112	260	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.089[a]	1	.765	.817	.488	
Continuity Correction[b]	.004	1	.953			
Likelihood Ratio	.091	1	.763	.817	.488	
Fisher's Exact Test				1.000	.488	
Linear-by-Linear Association	.089[c]	1	.765	.817	.488	.185
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.62.

b. Computed only for a 2x2 table

c. The standardized statistic is -.298.

Knowledge type * Age by range

Crosstab

Count

		Age by range			
		lower than 30	30-40 yrs.	over than 40	Total
Knowledge type	Poor	12	7	3	22
	Good	133	178	39	350
Total		145	185	42	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	3.076[a]	2	.215	.238		
Likelihood Ratio	3.127	2	.209	.219		
Fisher's Exact Test	3.275			.191		
Linear-by-Linear Association	.957[b]	1	.328	.401	.210	.085
N of Valid Cases	372					

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 2.48.

b. The standardized statistic is .978.

Knowledge type * Pharmacy degree

Crosstab

Count

		Phamacy degree		
		BPharm	PharmD	Total
Knowledge type	Poor	16	6	22
	Good	271	79	350
Total		287	85	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.260[a]	1	.610	.794	.387	
Continuity Correction[b]	.061	1	.804			
Likelihood Ratio	.250	1	.617	.794	.387	
Fisher's Exact Test				.604	.387	
Linear-by-Linear Association	.259[c]	1	.611	.794	.387	.172
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.03.

b. Computed only for a 2x2 table

c. The standardized statistic is -.509.

Knowledge type * Postgraduate degree

Crosstab

Count

		Posgraduated degree		
		None	Postgraduated degree	Total
Knowledge type	Poor	18	4	22
	Good	258	92	350
Total		276	96	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.710[a]	1	.399	.464	.286	
Continuity Correction[b]	.350	1	.554			
Likelihood Ratio	.762	1	.383	.464	.286	
Fisher's Exact Test				.615	.286	
Linear-by-Linear Association	.708[c]	1	.400	.464	.286	.151
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.68.
b. Computed only for a 2x2 table
c. The standardized statistic is .841.

Knowledge type * Experience by range

Crosstab

Count

		Experience by range			
		lower than 5	5-10 yrs.	over than 10	Total
Knowledge type	Poor	13	6	3	22
	Good	167	146	37	350
Total		180	152	40	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	1.791[a]	2	.408	.412		
Likelihood Ratio	1.876	2	.391	.390		
Fisher's Exact Test	1.988			.349		
Linear-by-Linear Association	.317[b]	1	.573	.628	.351	.114
N of Valid Cases	372					

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 2.37.
b. The standardized statistic is .563.

Knowledge type * Location

Crosstab

Count

		Location		
		Bangkok	Chonburi	Total
Knowledge type	Poor	17	5	22
	Good	241	109	350
Total		258	114	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.690[a]	1	.406	.482	.284	
Continuity Correction[b]	.351	1	.554			
Likelihood Ratio	.727	1	.394	.482	.284	
Fisher's Exact Test				.482	.284	
Linear-by-Linear Association	.688[c]	1	.407	.482	.284	.142
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.74.
b. Computed only for a 2x2 table
c. The standardized statistic is .829.

Knowledge type * Type of pharmacies

Crosstab

Count

		Type of pharmacies		
		Chain store	Individual store	Total
Knowledge type	Poor	6	16	22
	Good	133	217	350
Total		139	233	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	1.018[a]	1	.313	.370	.220	
Continuity Correction[b]	.611	1	.434			
Likelihood Ratio	1.063	1	.303	.370	.220	
Fisher's Exact Test				.370	.220	
Linear-by-Linear Association	1.015[c]	1	.314	.370	.220	.114
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.22.

b. Computed only for a 2x2 table

c. The standardized statistic is -1.007.

Chi-square test, Attitude types and demographics

Attitude type * Gender

Crosstab

Count

		Gender		
		Male	Female	Total
Attitude type	Negative Attitude	9	16	25
	Positive Attitude	103	244	347
Total		112	260	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.442[a]	1	.506	.653	.323	
Continuity Correction[b]	.193	1	.660			
Likelihood Ratio	.429	1	.513	.653	.323	
Fisher's Exact Test				.504	.323	
Linear-by-Linear Association	.441[c]	1	.507	.653	.323	.138
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.53.

b. Computed only for a 2x2 table

c. The standardized statistic is .664.

Attitude type * Age by range

Crosstab

Count

		Age by range			
		lower than 30	30-40 yrs.	over than 40	Total
Attitude type	Negative Attitude	5	13	7	25
	Positive Attitude	140	172	35	347
Total		145	185	42	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	9.132[a]	2	.010	.011		
Likelihood Ratio	7.831	2	.020	.022		
Fisher's Exact Test	8.099			.013		
Linear-by-Linear Association	7.991[b]	1	.005	.007	.004	.003
N of Valid Cases	372					

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 2.82.

b. The standardized statistic is -2.827.

Attitude type * Pharmacy degree

Crosstab

Count

		Pharmacy degree		
		BPharm	PharmD	Total
Attitude type	Negative Attitude	24	1	25
	Positive Attitude	263	84	347
Total		287	85	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	5.402[a]	1	.020	.023	.011	
Continuity Correction[b]	4.316	1	.038			
Likelihood Ratio	7.365	1	.007	.014	.011	
Fisher's Exact Test				.023	.011	
Linear-by-Linear Association	5.387[c]	1	.020	.023	.011	.010
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.71.
b. Computed only for a 2x2 table
c. The standardized statistic is 2.321.

Attitude type * Postgraduate degree

Crosstab

Count

		Posgraduated degree		
		None	Postgraduated degree	Total
Attitude type	Negative Attitude	15	10	25
	Positive Attitude	261	86	347
Total		276	96	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.820[a]	1	.093	.101	.078	
Continuity Correction[b]	2.081	1	.149			
Likelihood Ratio	2.586	1	.108	.153	.078	
Fisher's Exact Test				.101	.078	
Linear-by-Linear Association	2.812[c]	1	.094	.101	.078	.046
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.45.
b. Computed only for a 2x2 table
c. The standardized statistic is -1.677.

Attitude type * Experience by range

Crosstab

Count

		Experience by range			
		lower than 5	5-10 yrs.	over than 10	Total
Attitude type	Negative Attitude	9	12	4	25
	Positive Attitude	171	140	36	347
Total		180	152	40	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	1.871[a]	2	.392	.413		
Likelihood Ratio	1.848	2	.397	.413		
Fisher's Exact Test	2.148			.355		
Linear-by-Linear Association	1.848[b]	1	.174	.217	.115	.048
N of Valid Cases	372					

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 2.69.

b. The standardized statistic is -1.359.

Attitude type * Location

Crosstab

Count

		Location		
		Bangkok	Chonburi	Total
Attitude type	Negative Attitude	13	12	25
	Positive Attitude	245	102	347
Total		258	114	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	3.798[a]	1	.051	.070	.046	
Continuity Correction[b]	2.973	1	.085			
Likelihood Ratio	3.539	1	.060	.070	.046	
Fisher's Exact Test				.070	.046	
Linear-by-Linear Association	3.788[c]	1	.052	.070	.046	.028
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.66.

b. Computed only for a 2x2 table

c. The standardized statistic is -1.946.

Attitude type * Type of pharmacies

Crosstab

Count

		Type of pharmacies		
		Chain store	Individual store	Total
Attitude type	Negative Attitude	5	20	25
	Positive Attitude	134	213	347
Total		139	233	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	3.453[a]	1	.063	.085	.046	
Continuity Correction[b]	2.704	1	.100			
Likelihood Ratio	3.769	1	.052	.085	.046	
Fisher's Exact Test				.085	.046	
Linear-by-Linear Association	3.444[c]	1	.063	.085	.046	.031
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.34.

b. Computed only for a 2x2 table

c. The standardized statistic is -1.856.

Chi-square test, Practice types and demographics

Practice type * Gender

Crosstab

Count

		Gender		
		Male	Female	Total
Practice type	Inappropriate Practice	6	19	25
	Appropriate Practice	106	241	347
Total		112	260	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.475[a]	1	.491	.515	.330	
Continuity Correction[b]	.215	1	.643			
Likelihood Ratio	.495	1	.482	.515	.330	
Fisher's Exact Test				.653	.330	
Linear-by-Linear Association	.474[c]	1	.491	.515	.330	.148
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.53.

b. Computed only for a 2x2 table

c. The standardized statistic is -.688.

Practice type * Age by range

Crosstab

Count

		Age by range			
		lower than 30	30-40 yrs.	over than 40	Total
Practice type	Inappropriate Practice	6	16	3	25
	Appropriate Practice	139	169	39	347
Total		145	185	42	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.652[a]	2	.266	.263		
Likelihood Ratio	2.796	2	.247	.257		
Fisher's Exact Test	2.714			.259		
Linear-by-Linear Association	1.544[b]	1	.214	.267	.139	.058
N of Valid Cases	372					

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 2.82.

b. The standardized statistic is -1.243.

Practice type * Pharmacy degree

Crosstab

Count

		Pharmacy degree		
		BPharm	PharmD	Total
Practice type	Inappropriate Practice	21	4	25
	Appropriate Practice	266	81	347
Total		287	85	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.713[a]	1	.398	.471	.284	
Continuity Correction[b]	.358	1	.550			
Likelihood Ratio	.769	1	.380	.471	.284	
Fisher's Exact Test				.471	.284	
Linear-by-Linear Association	.711[c]	1	.399	.471	.284	.149
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.71.

b. Computed only for a 2x2 table

c. The standardized statistic is .843.

Practice type * Postgraduate degree

Crosstab

Count

		Postgraduate degree		
		None	Postgraduate degree	Total
Practice type	Inappropriate Practice	18	7	25
	Appropriate Practice	258	89	347
Total		276	96	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.067[a]	1	.795	.814	.477	
Continuity Correction[b]	.001	1	.982			
Likelihood Ratio	.066	1	.797	.814	.477	
Fisher's Exact Test				.814	.477	
Linear-by-Linear Association	.067[c]	1	.796	.814	.477	.176
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.45.

b. Computed only for a 2x2 table

c. The standardized statistic is -.259.

Practice type * Experience by range

Crosstab

Count

		Experience by range			
		lower than 5	5-10 yrs.	over than 10	Total
Practice type	Inappropriate Practice	10	10	5	25
	Appropriate Practice	170	142	35	347
Total		180	152	40	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.526[a]	2	.283	.310		
Likelihood Ratio	2.146	2	.342	.351		
Fisher's Exact Test	2.565			.268		
Linear-by-Linear Association	1.848[b]	1	.174	.217	.115	.048
N of Valid Cases	372					

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 2.69.

b. The standardized statistic is -1.359.

Practice type * Location

Crosstab

Count

		Location		
		Bangkok	Chonburi	Total
Practice type	Inappropriate Practice	17	8	25
	Appropriate Practice	241	106	347
Total		258	114	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	.023[a]	1	.879	1.000	.519	
Continuity Correction[b]	.000	1	1.000			
Likelihood Ratio	.023	1	.880	1.000	.519	
Fisher's Exact Test				.827	.519	
Linear-by-Linear Association	.023[c]	1	.879	1.000	.519	.173
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.66.

b. Computed only for a 2x2 table

c. The standardized statistic is -.152.

Practice type * Type of pharmacies

Crosstab

Count

		Type of pharmacies		
		Chain store	Individual store	Total
Practice type	Inappropriate Practice	6	19	25
	Appropriate Practice	133	214	347
Total		139	233	372

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.046[a]	1	.153	.200	.110	
Continuity Correction[b]	1.479	1	.224			
Likelihood Ratio	2.175	1	.140	.200	.110	
Fisher's Exact Test				.200	.110	
Linear-by-Linear Association	2.040[c]	1	.153	.200	.110	.064
N of Valid Cases	372					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.34.

b. Computed only for a 2x2 table

c. The standardized statistic is -1.428.