The Adoption of Antimicrobial Stewardship Programmes in Ministry of Health Hospitals in Saudi Arabia

Saleh Alghamdi

Submitted to the University of Hertfordshire in partial fulfilment of the requirements for the degree of Doctor of Philosophy

July 2018

Acknowledgement

Abstract

Aim: This thesis aims to explore and investigate the level and process of adoption of Antimicrobial Stewardship Programmes (ASPs) and factors influencing their implementation in Saudi Ministry of Health (MOH) hospitals. The findings of this study will provide hospitals and policy makers with evidence-based recommendations on how barriers to ASPs adoption can be overcome, which will ultimately improve antimicrobial use and reduce antimicrobial resistance (AMR).

Method: A mixed method approach was carried out using both qualitative and quantitative research methods. Semi-structured interviews were conducted with healthcare professionals in three Saudi hospitals to explore the enablers and barriers to their adoption of ASPs. A survey was then developed based on these findings to investigate the level of hospitals' adoption of ASPs and factors influencing their implementation at a national level. Further, a case study using in-depth interviews was utilised to understand the process of ASP adoption in a Saudi hospital, and how adoption challenges were addressed. Finally, a self-administered questionnaire was used to examine patients' knowledge and perceptions of antimicrobial use and resistance, and to evaluate the institutional role of patient education on antimicrobial use in two Saudi hospitals. The overall methodology of the research is summarised in Figure I.

Results: Despite the introduction of a national ASP strategy, adoption of ASPs in Saudi MOH hospitals remains low. Organisational barriers such as the lack of senior management support, lack of supportive IT infrastructure and the shortage of ASP team members hinder hospitals' efforts to adopt ASPs. Further barriers relate to the lack of formal enforcement by MOH and the physicians fears of patients' complications and clinical liability. Patients admitted to Saudi hospitals lack knowledge and perceptions of AMR, and the adoption of ASPs may improve hospitals' role in patients' education.

Conclusions: Despite the established benefits of ASPs, their adoption in Saudi MOH hospitals remains low. Urgent action is needed to address the strategies priorities associated with AMR, including access to antimicrobials, antimicrobial stewardship

and education and research. Policy makers are urged to consider making ASPs adoption in hospitals a regulatory requirement supported by national guidelines and surveillance programmes. It is essential to increase the provision of ID and infection control residency and training programmes to meet the extreme shortage of ID physicians, pharmacists, microbiologists and infection control practitioners. Higher education institutions and teaching hospitals are required to introduce antimicrobial prescribing and stewardship competencies into undergraduate Medical, Pharmacy, Dental, Nursing and Veterinary curriculum, as well as introduction of AMR topics in order to increase knowledge and awareness of ASPs and AMR. Collaboration between ASPs adopting and non-adopting hospitals is essential to share implementation experience, strategies and solutions to overcome barriers. Healthcare specialised associations are needed to be part of AMR conversation and guide healthcare professionals' training and accreditation.

Multiple stakeholders should be actively part of the conversations around tacking AMR. Primary care, secondary care, community pharmacies and policy makers should strive to create a shared culture of responsibility among all healthcare partners to improve antimicrobial therapy and reduce risks of AMR.
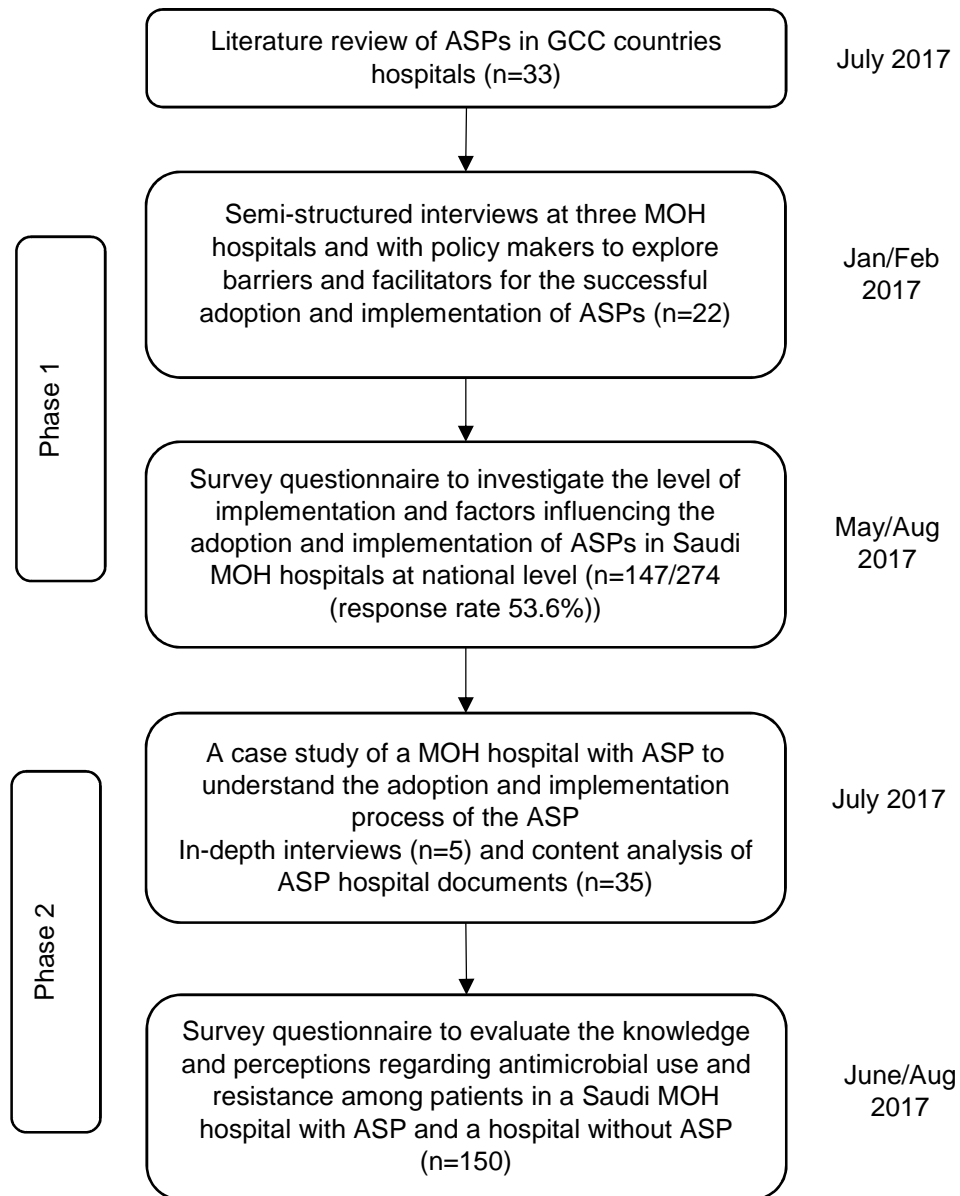
Literature review of ASPs in GCC countries hospitals (n=33)	July 2017
Semi-structured interviews at three MOH hospitals and with policy makers to explore barriers and facilitators for the successful adoption and implementation of ASPs (n=22)	Jan/Feb 2017
Survey questionnaire to investigate the level of implementation and factors influencing the adoption and implementation of ASPs in Saudi MOH hospitals at national level (n=147/274 (response rate 53.6%))	May/Aug 2017
A case study of a MOH hospital with ASP to understand the adoption and implementation process of the ASP In-depth interviews (n=5) and content analysis of ASP hospital documents (n=35)	July 2017
Survey questionnaire to evaluate the knowledge and perceptions regarding antimicrobial use and resistance among patients in a Saudi MOH hospital with ASP and a hospital without ASP (n=150)	June/Aug 2017

Phase 1

Phase 2

Figure I: Overall methodology of the research

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List of Abbreviations

AMR	Antimicrobial Resistance
ARAC	Antimicrobial Resistance Action Committee
ARHAI	Antimicrobial Resistance and Healthcare-Associated Infection
ASG	Antimicrobial Stewardship Subgroup
ASP	Antimicrobial Stewardship Programme
BERA	British Education Research Association
BSAC	British Society for Antimicrobial Chemotherapy
CCGs	Clinical Commissioning Groups
COREQ	Consolidated criteria for reporting qualitative studies
CCU	Coronary Care Unit
C. difficile	*Clostridium difficile*
CDC	Centers for Disease Control and Prevention
CEO	Chief Executive Officer
CDDEP	Center For Disease Dynamics and Policy
CMS	Centers for Medicare and Medicaid Services
CoP	Condition of Participation
CQUIN	Commissioning for Quality and Innovation
CRE	Carbapenem-Resistant Enterobacteriaceae
CSICU	Cardiac Surgery Intensive Care Unit
DDD	Defined Daily Dose
DoH	Department of Health
DOT	Days of Therapy
DHSSPS	Department of Health, Social Services and Public Safety
Defra	Food and Rural Affairs
EAAD	European Antibiotic Awareness Day
EARSS	European Antimicrobial Resistance Surveillance System
EARS-Net	European Antimicrobial Resistance Surveillance Network
ECDC	European Centre for Disease Prevention and Control
EPI	Expanded Programme for Immunisation
ERS	Electronic Reporting System
ESBL	Extended-spectrum B-lactamase

ESPAUR	English Surveillance Programme for Antimicrobial Utilisation and Resistance
E. coli	*Escherichia coli*
FDA	Food and Drug Administration
FMEA	Failure Mode and Effects Analysis
GLASS	Global Antimicrobial Surveillance System
GCC	Gulf Cooperation Council
GCC-IC	Gulf Cooperation Council Center for Infection Control
GIF	Generic Implementation Framework
GP	General Practice
HAI	Healthcare-associated Infection
HSB	Health Seeking Behaviour
IV	Intravenous
ICU	Intensive Care Unit
ICP	Infection Control Practitioner
ID	Infectious Diseases
IT	Information Technology
IDSA	Infectious Diseases Society of America
JCI	Joint Commission International
K. oxytoca	*Klebsiella oxytoca*
K. pneumoniae	*Klebsiella pneumoniae*
LOS	Length of Stay
LTCFs	Long-Term Care Facilities
MOH	Ministry of Health
MDRO	Multidrug Resistant Organisms
MRSA	*Methicillin-resistant staphylococcus aureus*
NARMS	National Antimicrobial Resistance Monitoring System
NHS	National Health Service
NICE	National Institute and Care Excellence
NHSBSA	NHS Business Services Authority
NHSN	National Healthcare Safety network
NTS	Nontyphoidal *Salmonella*

P. aeruginosa	*Pseudomonas aeruginosa*
PNT	Pharmacy and Therapeutic Committee
PHC	Primary Healthcare Centre
PHE	Public Health England
PRISMA	Preferred Reporting Items for Systematic Review and Meta-Analysis
QP	Quality Premium
S. aureus	*Staphylococcus aureus*
SACAR	Specialist Advisory Committee on Antimicrobial Resistance
SGSS	Second Generation Surveillance System
SHEA	Society for Healthcare Epidemiology of America
S. pneumoniae	*Streptococcus pneumoniae*
ScotMARAP	Scottish Management of Antimicrobial Resistance Action Plan
TARGET	Treat Antibiotics Responsibly, Guidance, Education, Tools
UAE	United Arab Emirates
UK	United Kingdom
UKCPA	United Kingdom Clinical Pharmacy Association
UNICEF	United Nations Children's Fund
USA	United States of America
USDA	USA Department of Agriculture
World Health Organisation	WHO

Chapter 1: Introduction

1.1 Antimicrobial resistance (AMR)

The world Health Organisation (WHO) defines Antimicrobial resistance (AMR) as "*the ability of a microorganism (like bacteria, viruses, and some parasites) to stop an antimicrobial (such as antibiotics, antivirals and antimalarials) from working against it. As a result, standard treatments become ineffective, infections persist and may spread to others*" (World Health Organisation, 2014, 2016a).

When microorganisms are exposed to antimicrobials for an inappropriate period of time or repeatedly at ineffective doses, they develop resistance mechanisms to drugs. The microorganisms or bacteria that develop drug resistance are sometimes referred to as superbugs. AMR is one of the biggest threats to public health, and there is an urgent need for different government sectors and societies to take appropriate actions towards preventing AMR spread (World Health Organisation, 2016b).

It is essential to note that without appropriate measures to treat infectious diseases, therapeutic procedures like organ transplantation, diabetes management, cancer chemotherapy and major surgery such as hip replacements and caesarean sections will be high risk interventions to be undertaken. The cost incurred in taking care of an individual with AMR is higher than the cost incurred to treat a person with no AMR due to additional tests, accompanied by expensive drugs and a longer period of care (World Health Organisation, 2016b).

According to the Centers for Disease Control and Prevention (CDC), there are two million illnesses and 23,000 deaths in the United States (U.S.) alone due to AMR every year. These illnesses account for as much as $20 billion in direct healthcare costs and up to $35 billion in lost working hours due to the patients being unproductive during their sick days leave and hospitalisation (Centers for Disease Control and Prevention, 2013b).

In Europe, it is estimated that infection is present in 5-12% of hospital patients, resulting 400,000 patients with AMR and leading to 25,000 deaths with a total cost of

€1.5 billion annually (European Medicines Agency, 2016; World Health Organisation, 2014, 2016f).

A prior study that evaluated the outcomes of failure in antibiotic therapy for patients with skin infections through a large USA multihospital database, found that inappropriate antibiotic regimen was associated with a 3-fold rise in mortality rates. It also resulted in patients receiving intravenous (IV) antibiotic therapy for 5.7 additional days, with additional hospitalisation of 5.4 days and a mean of $5,285 in additional inpatient costs (Edelsberg, Berger, Weber, et al., 2008). Using a large U.S. multi-institutional database, it was also shown that failure of initial empiric antibiotic therapy for hospitalised patients with intra-abdominal infections led to 5.6 additional days of IV antibiotic therapy and 4.6 additional hospital stay with additional inpatient cost of $6,368 (Edelsberg, Berger, Schell, et al., 2008). A more recent study, in 11 tertiary-care hospitals in South Korea, found that failure of initial antibiotic therapy to treat community-onset intra-abdominal infections caused an additional 2.9 days of IV antibiotic therapy and patients being hospitalised for an additional 5.3 days leading to an additional inpatient cost of $3,287 (Chong et al., 2015).

It is estimated that worldwide mortality due to AMR will be the highest at 10 million people a year, followed by cancer at 8.2 million, and other causes of death such as diabetes, diarrhoeal diseases, road traffic accidents, measles, cholera, and tetanus following at a distance respectively in the year 2050 (Figure 1.1). This will cause a decrease of about 2% to 3.5 % in gross domestic product by 2050, and it will cost the world up to $100 trillion (O'Neill, 2014, 2016).
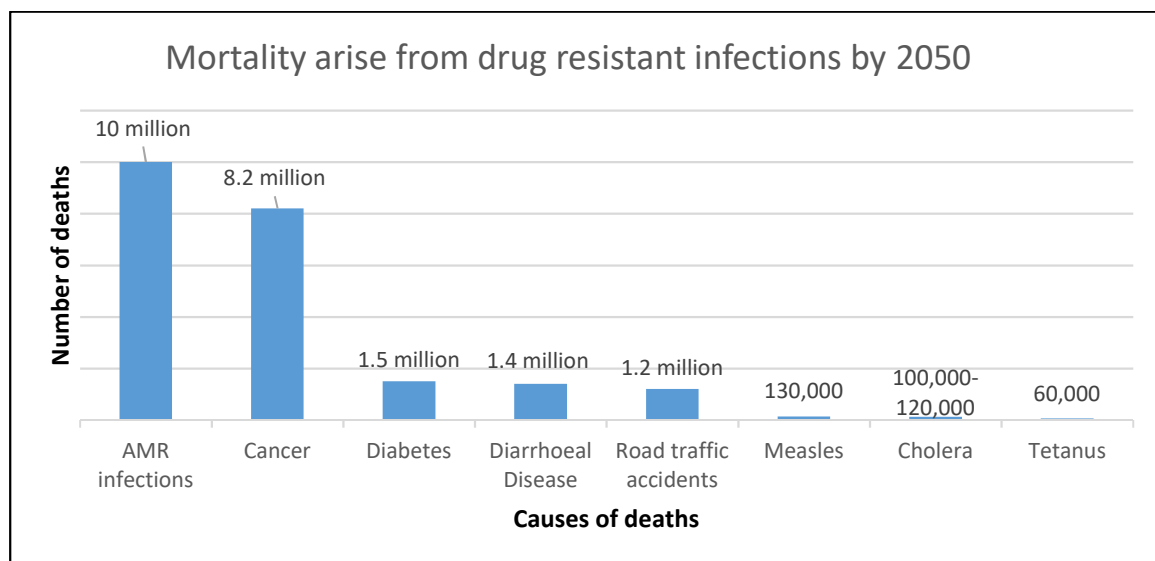
Figure 1.1: Worldwide deaths from AMR infection and other causes in 2050

1.2 AMR Surveillance

The WHO stressed the need to put in place a global surveillance system to support the global action plan and research on AMR, and to strengthen the evidence base on AMR and support national, regional and global actions (WHO, 2014). In response to this call, the Global Antimicrobial Surveillance System (GLASS) was launched in October 2015 working in collaboration with centres and existing AMR surveillance networks (World Health Organisation, 2014, 2015b).

According to WHO (2018) report, *Escherichia coli (E. coli), Klebsiella pneumoniae (K. pneumoniae), Staphylococcus aureus (S. aureus)* and *Streptococcus pneumoniae (S. pneumoniae)* were reported as the greatest concerns in relation to hospital and community acquired infections (WHO, 2018). In that, it was reported by some countries that *E. coli* resistance is more than 50% to third-generation cephalosporins and fluoroquinolones in 5 out of the 6 WHO regions, *K. pneumoniae* had more than 30% resistance rates to third generation cephalosporins in most WHO countries and exceeded 60% in some countries, and *Methicillin-resistant staphylococcus aureus* (MRSA) resistance rates exceeded 20% in all WHO regions, and was reported to be more than 80% in some regions.

These high rates of AMR can be due to the increasing rates of antimicrobial consumption worldwide. The rate of the global antimicrobial consumption increased by 36% between 2000 and 2010. Cephalosporins and penicillins were responsible for more than 60% of the total amount of antimicrobial consumption in 2010, which is an increase of 41% when compared to 2000 (British Society for Antimicrobial Chemotherapy, 2018; Center for Disease Dynamics Economics & Policy, 2015; Van Boeckel et al., 2014). The use of antimicrobials is associated with the seasonal spread of infectious diseases like influenza (Polgreen, Yang, Laxminarayan, & Cavanaugh, 2011). From 2000 to 2010, the usage of antimicrobials peaked in Western Europe and North America between December and February, in June and July in South America, and within the tropics in August and September (Sun et al., 2012). This is due to winter flu seasons, heavy rains and monsoons as well as risks of infectious diseases (Van Boeckel et al., 2014).

According to the Center For Disease Dynamics and Policy (CDDEP), two main factors have been attributed to the rise in antimicrobial consumption all over the world. The first one is the increase in household income, which has enabled people to access and afford antibiotics easily. Although this has positive effects such as saving lives, it has a negative impact in case of inappropriate usage that leads to AMR. The second factor is the increase in demand for animal protein and the application of antimicrobials to boost the growth and development of animals and agriculture (Center for Disease Dynamics Economics & Policy, 2015).

Having discussed the global patterns and trends of AMR, it essential to comprehend its rate of surveillance. The next sub-headings will explore that in detail in two advanced economies namely United Kingdom (UK) and U.S., and in the Gulf Cooperation Council (GCC) countries.

1.2.1 AMR Rates and Surveillance in UK

Public Health England (PHE) established the English Surveillance Programme for Antimicrobial Utilisation and Resistance (ESPAUR) in July 2013 in order to support the UK 5-year AMR strategy. In collaboration with PHE, the National Health Service (NHS) and other healthcare providers aim to adopt the surveillance of AMR, antimicrobial consumption data, and support recommendations to enhance antimicrobial use in general and hospital practice. Using Second Generation Surveillance System (SGSS), a national database maintained by PHE, around 98% of hospital microbiology laboratories in England are submitting data regarding antimicrobial susceptibility testing results (Public Health England, 2015a, 2017). PHE also developed an Electronic Reporting System (ERS) in May 2015 for hospital laboratories in England to report cases of carbapenemase-producing Gram-negative bacteria. As a result, 95% of laboratories are registered to the system and monthly surveillance reports are produced to update rates of carbapenemase-producing Gram-negative bacteria (Public Health England, 2017).

According to the ESPAUR report, *E. coli* is considered one of the most common causes of bloodstream infection in UK and showed 15.6% increase between 2010 to 2014 (45 cases to 52 cases per 100,000 population). The incidence of *K. pneumoniae* infections increased by 20.8% between 2009 and 2014 (7.7 to 9.3 incidence per

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100,000 population). On the other hand, the incidence of *Klebsiella oxytoca (K. oxytoca), Pseudomonas spp., Enterococcus spp., S. aureus and Acinetobacter spp.* stayed relatively constant. However, the incidence of *S. pneumoniae* decreased by 23.4% between 2010 and 2014 (7.7 to 5.9 per 100,000 population), most likely due to the effect of the conjugate pneumococcal vaccine (Public Health England, 2015a).

In terms of resistance rates to antimicrobials, the 2014 data revealed that the rate of *E. coli* resistance to co-amoxiclav was 42%, *E. coli* resistance to ciprofloxacin was 18.7%, *K. pneumoniae* resistance to piperacillin/tazobactam was 16.9% and and *S. aureus* resistance to methicillin was 10% (Public Health England, 2015a, 2017). In 2016, *E. coli* resistance to ciprofloxacin was 18.1-18.7%, resistance to piperacillin/tazobactam was 11.8%, and co-amoxiclav was 40.8% (Public Health England, 2017).

The increased rates of AMR in UK can be attributed to the increase in antimicrobial consumption. All antimicrobial use (hospital/retail) increased from 21,784 in 2000 to 22,767 standards unit per 1000 population in 2014 (Figure 1.2). Broad-spectrum penicillins were the most used class of antibiotics and it increased from 6,874 in 2000 to 7,334 standards unit per 1000 population in 2014 and was accounted for 45% of total antimicrobial prescribing in England in 2016, followed by Cephalosporins that decreased from 1,747 to 777 standers unit per 1000 population in 2014 (Public Health England, 2017; The Center for Disease Dynamics Economics & Policy, 2015b). In a recent report by PHE, all antimicrobial prescribing reduced by 5% between 2012 and 2016 and broad-spectrum antibiotics (piperacillin/tazobactam and carbapenems) in hospitals also reduced by 4% from 2015 to 2016 (Public Health England, 2017).
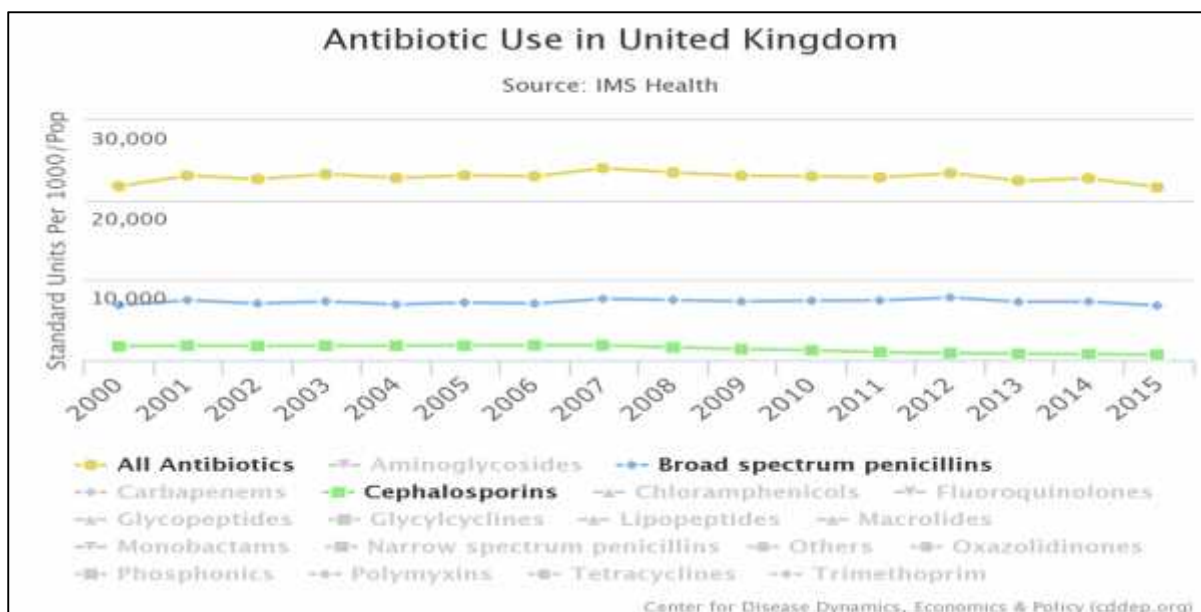
Figure 1.2: Antibiotic use (hospital/retail) in UK 2000-2014 (The Center for Disease Dynamics Economics & Policy, 2015b)

Information on antimicrobial consumption in UK is monitored through three different systems including; 1) NHS Digital database for Antimicrobial (NHSDDA) consumption in primary care, 2) Quintiles IMS for antimicrobial consumption in secondary care and 3) NHS Business Services Authority (NHSBSA) database for antimicrobial consumption in dental care. In 2014, the most commonly prescribed antimicrobials in England included: penicillins (45%), tetracyclines and macrolides (15%). The use of tetracyclines increased significantly by 13% between 2010 and 2014 while sulphonamides/trimethoprim increased by 5%. However, the use of beta-lactam antibiotics decreased by 17%, anti-*Clostridium difficile* antibiotics decreased by 3% and quinolones use decreased by 2%. These reductions were mainly in community (Public Health England, 2015a). Whereas, within hospital settings, the consumption of carbapenems increased by 36% and piperacillin/tazobactam increased by 55% between 2010 and 2014 (Public Health England, 2015a). The total antimicrobial consumption in primary and secondary care in 2016 was 21.4 defined daily dose per 1000 inhabitants per day that is 0.9% reduction from 2015. General Practice (GP) setting prescribed 74% of antimicrobials, 11% were prescribed for hospital inpatients, 6% for hospital outpatients, 5% for patients in dental care and 3% in other community settings (Public Health England, 2017).

1.2.2 AMR Rates and Surveillance in USA

In 1996, the National Antimicrobial Resistance Monitoring System (NARMS) was established as a collaborative project of national and local public health departments, the Food and Drug Administration (FDA), the U.S. Department of Agriculture (USDA), and CDC. This national surveillance system monitors changes in AMR in ill people (though the CDC), retail meats (through the FDA), and food animals (through the USDA). The NARMS project provides information about emerging AMR and outcomes of interventions developed to control the spread of AMR, in order to promote and save public health. The data of this project are used by the FDA to develop regulatory decisions to maintain the effectiveness of antimicrobials for both humans and animals (Centers for Disease Control and Prevention, 2016b; Department of Health and Human Services, 2012; Food and Drug Administration, 2016).

In 2013, CDC published a report summarising the top drug-resistant threats in the U.S (Centers for Disease Control and Prevention, 2013a, 2016a). Threats were grouped according to degree of concern: urgent, serious and concerning. The urgent threats include: *Clostridium difficile* (*C. difficile*) (caused half a million infections and 15,000 deaths in 2015), Carbapenem-Resistant Enterobacteriaceae (CRE) (causes 9,000 drug-resistance infections and 600 deaths per year) and Drug –resistance Neisseria gonorrhoeae annually (causes 188,600 resistance to tetracycline, 11,480 reduced susceptibility to Cefixime, 3,280 reduced susceptibility to Ceftriaxone, and 2,460 reduced susceptibility to Azithromycin).

Compared to the UK, the U.S. antimicrobial use (hospital/retail) decreased from 25,716 in 2000 to 18,522 standards unit per 1000 population in 2015 (Figure 1.3). Broad-spectrum penicillins were the most used class of antimicrobial and it decreased from 8,771 in 2000 to 6,846 standers unit per 1000 population in 2015, followed by cephalosporins that decreased from 4,659 in 2000 to 3,137 standers unit per 1000 population in 2015 (The Center for Disease Dynamics Economics & Policy, 2015b).
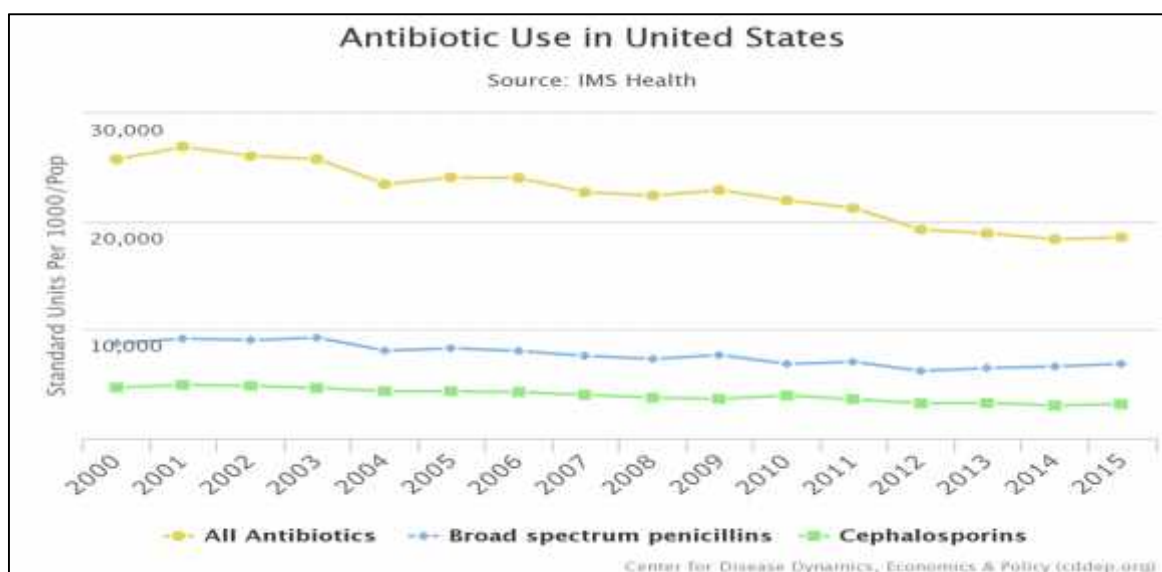
Figure 1.3: Antibiotic use (hospital/retail) in USA 2000-2015 (The Center for Disease Dynamics Economics & Policy, 2015b)

1.2.3 AMR Rates and Surveillance in GCC Countries

The GCC was established in 1981, including the following countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates (UAE). The main language in the GCC countries is Arabic. Citizens of the these countries can travel between the GCC countries freely and without any restrictions (Secretariat General of the Gulf Cooperation Council, 2016). The WHO groups its member states into 4 income groups based on the list of income of the World Bank (low, lower-middle, upper-middle, and high). All GCC countries are classified as high income countries (The World Bank, 2016; World Health Organisation, 2016c).

Some general information about GCC countries are summarised in Table 1.1 (Bahrain Central Informatics Organisation, 2015; Federal Competitiveness and Statistics Authority, 2016; Kuwait Public Authority for Civil Information, 2016; Oman National Centre for Statistics and Information, 2016; Qatar Ministry of Development Planning and Statistics, 2016; Saudi Central Department of Statistics & Information, 2015; Saudi Ministry of Health, 2015; Secretariat General of the Gulf Cooperation Council, 2016).

Table 1.1: General information about GCC countries

Country	Total area	Total population	Total hospitals
Bahrain	769 Km^2	1.3 million people (46% nationals, 54% foreign nationals)	25 hospitals (17 private and 8 government)
Kuwait	17,818 Km^2	4.4 million people (30% nationals, 70% foreign nationals)	34 hospitals (21 government and 13 private)
Oman	309,500 Km^2	4.5 million people (54% nationals, 46% foreign nationals)	70 hospitals (55 government and 15 private)
Qatar	11,500 Km^2	2.5 million people (10% nationals, 90% foreign nationals)	14 hospitals (10 government and 4 private)
Saudi Arabia	2.15 million Km^2	31 million people (68% nationals, 32% foreign nationals)	444 hospitals (308 government and 136 private)
UAE	83,600 Km^2	8.1 million people (12% nationals, 88% foreign nationals)	115 hospitals (79 private and 36 government)

In contrast with UK and USA, there are no national surveillance systems for AMR and antimicrobial use in GCC countries. Data on resistance pathogens in GCC countries were obtained from published studies. Between 01/1990 and 04/2011, it was reported that *E. coli* was presented in 44% (10,073/37,295) of total bacterial isolates, followed by *K. pneumoniae* in 20% (4,709/37,295), and *Pseudomonas aeruginosa* (*P. aeruginosa*) in 18.7% (4,287/37,295) of bacterial isolates (M. Aly & Balkhy, 2012). GCC countries also have high rates of carbapenemase-producing gram negative bacilli and Extended-spectrum B-lactamase (ESBL) mostly associates with nosocomial infections (H. M. Zowawi, Balkhy, Walsh, & Paterson, 2013).

The use of antimicrobials in GCC countries was shown to be high and is increasing over time, the consumption of all antimicrobials (Retail) in Saudi Arabia increased from 11,852 in 2000 to 17,173 standard units per 1000 population in 2015, while in UAE it increased from 11,548 in 2000 to 16,886 standard units per 1000 population in 2015. In Kuwait, it increased from 4,444 in 2000 to 4,729 standard units per 1000 population in 2015 (The Center for Disease Dynamics Economics & Policy, 2015a). The antimicrobial use (retail) is higher in Saudi Arabia in comparison with Kuwait and UAE (Figure 1.4).
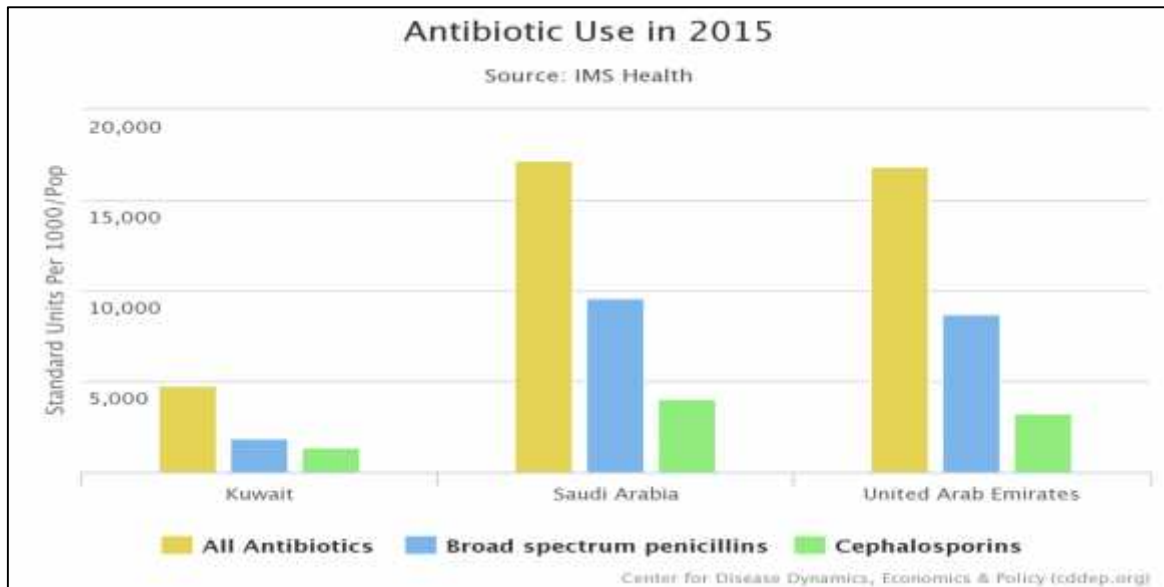
Figure 1.4: Antibiotic use (retail) in Kuwait, Saudi Arabia and UAE in 2015 (The Center for Disease Dynamics Economics & Policy, 2015b)

The emergence of AMR in GCC countries maybe due to lack of surveillance, stewardship programmes, and poor infection control. There is no national reporting system of antimicrobial consumptions in hospital settings in any GCC country. Also, there is no national reporting system of antimicrobial consumption (retail or hospitals) in Bahrain, Oman and Qatar.

1.3 Causes of AMR

One of the major causes of AMR is the uncontrolled use of antimicrobials. Regions where antimicrobials can be obtained without official prescriptions or restriction and without treatment guidelines have higher prevalence of AMR compared to regions where legislations require people to acquire antimicrobials only if they have prescriptions (World Health Organisation, 2016a).

One of the causes of AMR is the overuse or misuse of antimicrobials, as this will increase the development of resistant organisms (Figure 1.5).
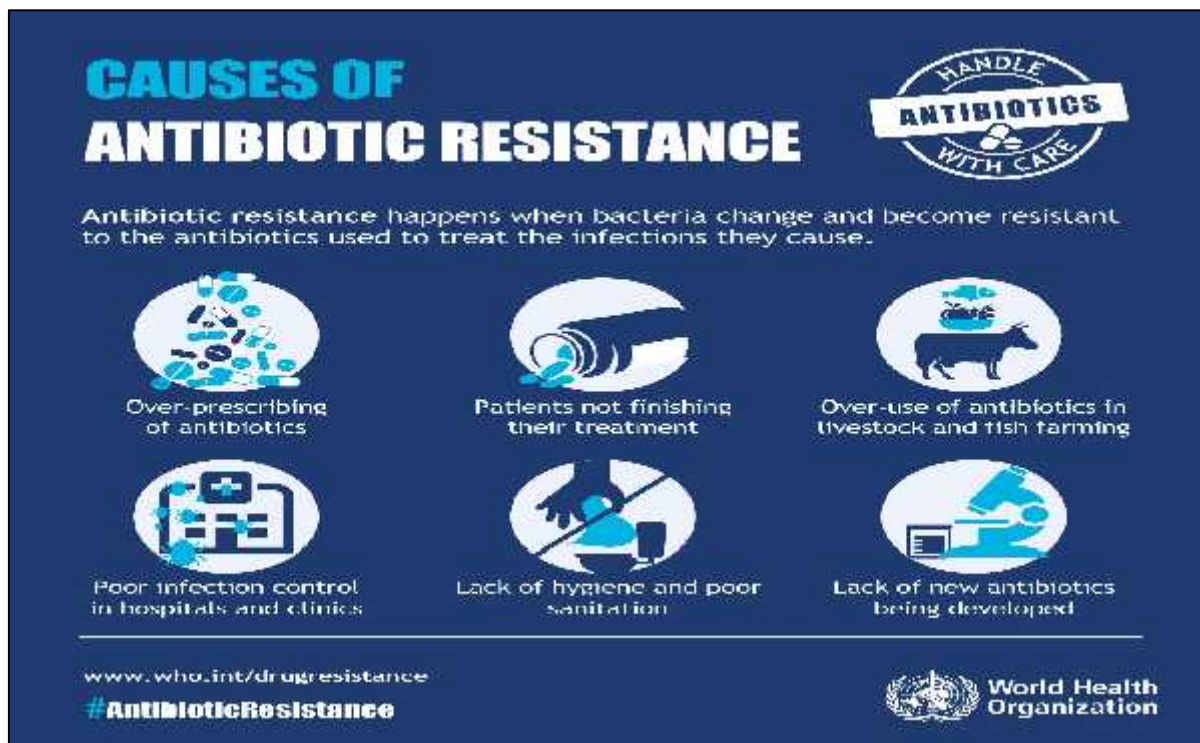
Figure 1.5: Causes of AMR (World Health Organisation, 2016d)

According to WHO (World Health Organisation, 2015d, 2016b), AMR can be due to:

丿 Poor antimicrobial prescribing practice, such prescribing antimicrobials when not needed.

丿 Inappropriate antimicrobial regimen, dose, duration or route of administration.

丿 Self-medication where antimicrobials can be obtained without prescriptions.

丿 Lack of policies and regulations for healthcare professionals regarding antimicrobials use and infection control.

丿 Overuse and misuse of antimicrobials in agriculture and animal husbandry.

AMR microbes are presented in humans, animals, environment (water, air and soil) and food, where they can easily spread between them (Figure 1.6). Lack of infection control, poor sanitary conditions and improper food-handling increase the spread of AMR (World Health Organisation, 2016b).
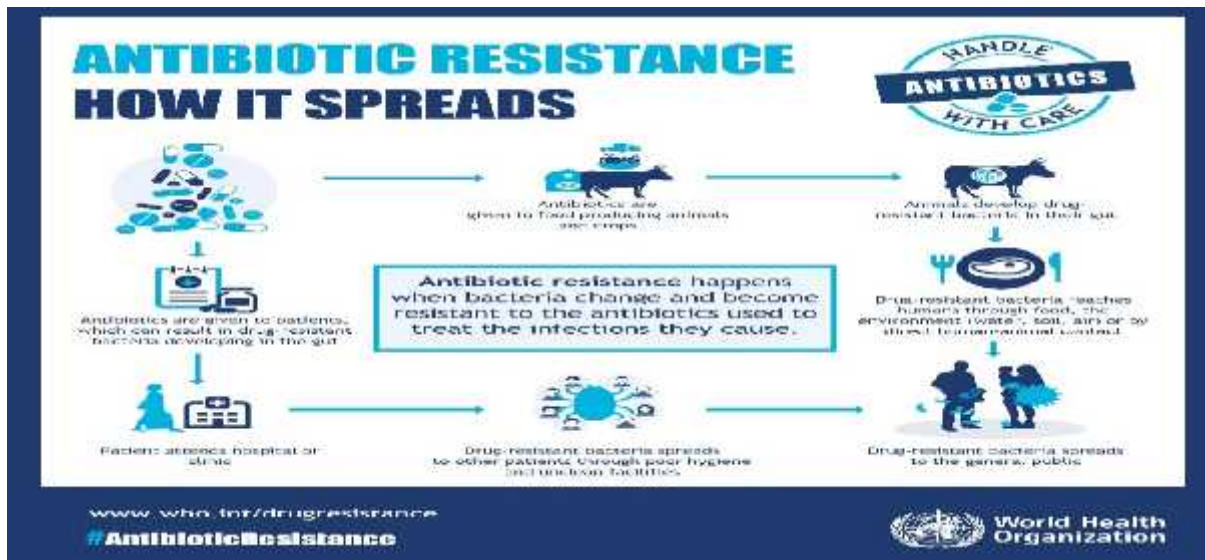
Figure 1.6: Methods of AMR spread (World Health Organisation, 2016d)

1.4 Actions to slow and prevent the development and spread of AMR

As mentioned earlier AMR is increasing due to the overuse and misuse of antimicrobials, as well as weak infection prevention and control. Number of actions (Figure 1.7) can be taken by different levels of society to slow and prevent the spread of AMR and preserve the effectiveness of available antimicrobials (Center for Disease Dynamics Economics & Policy, 2015; World Health Organisation, 2016a).

Figure 1.7: Strategies needed in national antimicrobial policies (Center for Disease Dynamics Economics & Policy, 2015)

Several action plans to tackle AMR have been undertaken including WHO global action plan, UK five-year strategy, and U.S. national strategy for combating AMR, and GCC strategic plan.

1.4.1 WHO Global action plan on AMR

Because of the AMR crisis, the May 2015 WHO assembly adopted a global action plan on AMR. This action plan highlights the importance of a "one health" approach that involves collaboration among international authorities and organisations, including: human medicine, veterinary medicine, agriculture, environment, finance, and consumers (World Health Organisation, 2015a). The goal and objectives of this action plan are summarised in Table 1.2.

Table 1.2: WHO Global action plan on AMR

WHO Global action plan on AMR 2015	
Goal	The goal of the WHO action plan on AMR is to ensure continuity of successful prevention and treatment of infectious diseases with safe and effective quality assured medicines that are used in a responsible way, and accessible to all people. It is expected that a national action plan on AMR will be developed by each country in line with the WHO global plan.
Objectives	⟩ To improve understanding and awareness of AMR through effective education, communication and training. ⟩ To strengthen the evidence base and knowledge through research and surveillance. ⟩ To decrease the risk of infection through effective infection prevention measures, sanitation and hygiene. ⟩ To optimize the consumption of antimicrobials in human and animal health. ⟩ To develop investments that consider the needs of all countries and to increase and support investment in new medicines, vaccines, diagnostic tools and other interventions.

1.4.2 UK Five-Year AMR Strategy

A cross-government 5-year AMR strategy was launched in 2013 and it was led by the Department of Health (DoH), PHE, Department for Environment, NHS England and Food and Rural Affairs (Defra). The 5 year national strategy, 2013 to 2018, takes 'One health' approach covering people, agriculture, animals and environment with an overall goal of slowing the development and spread of AMR (United Kingdom Department of Health, 2013). Each nation in UK (England, Scotland, Wales and

Northern Ireland) has a committee to oversee stewardship and ensure progress toward the national strategy (Table 1.3). The aim of the UK government is to reduce the rates of healthcare associated Gram-negative bloodstream infections and inappropriate antimicrobial prescribing by 50% by March 2021 (against 2015/2016 data) (O'Neill, 2016; Public Health England, 2017).

Table 1.3: Committees overseeing stewardship and the national AMR strategy in UK

Nation	Group	Date formed	Remit
England	Antimicrobial stewardship subgroup (ASG) of the Advisory Committee on Antimicrobial Resistance and Healthcare-Associated Infection (ARHAI) ESPAUR	2003 2013	Established as part of the Specialist Advisory Committee on Antimicrobial Resistance (SACAR), to focus on the prudent prescribing of antimicrobial across the NHS. Developed by PHE to bring together antimicrobial utilization and resistance data, examine national implementation of stewardship initiatives and develop quality measures, methods to monitor unintended outcomes of antimicrobial stewardship and both public and professional behaviour interventions.
Scotland	Scottish Antimicrobial Prespring Group (SAPG)	2008	To lead and coordinate delivery of the Scottish Management of Antimicrobial Resistance Action Plan (ScotMARAP).
Wales	Wales Antimicrobial Resistance Program Surveillance Unit (WARP-SU)	2008	Currently focuses on reporting antimicrobial usage and resistance data and coordinating nationwide antimicrobial audits.
Northern Ireland	Antimicrobial Resistance Action Committee (ARAC)	2002	ARAC provides expert advice to the Department of Health, Social Services and Public Safety (DHSSPS) on all issues to do with antimicrobial resistance and provides leadership on strategies for tackling this issue.

Public engagement is an important element of the UK AMR strategy. The Antibiotic Guardian (campaign) was developed by PHE, as one of the UK activities for the European Antibiotic Awareness Day (EAAD) (18th of November each year) and World Antibiotic Awareness Week (14-20 November) and to support the UK 5-year AMR strategy. This campaign aims to engage and stimulate behaviour change, increase knowledge about antibiotic use and resistance among healthcare workers and the public (Public Health England, 2015a, 2017). Antibiotic Guardian professional and public behaviour change and engagement campaign was developed by ESPAUR to provide webinars and training for healthcare personnel and run a national campaign

for the public to highlight the importance of appropriate antimicrobial use through different activities including; junior and family Antibiotic Guardian digital badges, posters with community pharmacies and badges for university students (Public Health England, 2017). Engagement with different stakeholder including; The British Dental Association, British Society for Antimicrobial Chemotherapy (BSAC), Care Quality Commission, Faculty of General Dental Practice (UK), Health Education England, National Institute and Care Excellence (NICE), the Royal Pharmaceutical Society and UK Clinical Pharmacy Association, was one of the key activities in improving practice, awareness and reducing inappropriate use of antibiotics (Public Health England, 2017). Moreover, the UK is cooperating with international surveillance organisations such as; European Antimicrobial Resistance Surveillance Network (EARS-Net) and GLASS to share AMR data, improve antimicrobial practice and reduce AMR rates (Public Health England, 2017).

1.4.3 The USA national strategy for combating AMR

This action plan indicates priorities and organises investments to curb, detect and monitor outbreaks of resistant microorganisms identified by CDC as urgent or serious threats. The national strategy has 5 interrelated goals for the government to act in collaboration with health care partners, public health, agriculture, food and safety, veterinary medicine, and federal, academic, and industrial research (The White House, 2014, 2015). The 5 goals of this strategy include:

1. Slowing the emergence of resistant bacteria and prevent the spread of resistant infections.
2. Strengthening the national One-Health surveillance efforts to combat resistance.
3. Advancing the development and use of rapid and innovative diagnostic tests for identification and characterization of resistant bacteria.
4. Accelerate the research to develop new antibiotics, other therapeutics, vaccines, and diagnostics.
5. Improving the international collaboration and capacities for prevention, surveillance and antimicrobial research and development.

The U.S. government has embarked on initiatives to educate the public on antimicrobial stewardship and increase awareness of the threat of AMR and

appropriate antimicrobial use. CDC's campaign 'Get Smart About Antibiotics Week' (14th to 20th of November each year), had an increase in public awareness and a 50% rise in participating partners. In animal medicine there are some educational activities such as 'Get Smart on the Farm' (Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria, 2016). The Task Force monitors progress towards achieving the national plan outcomes. They provide annual updates on federal government actions to control AMR, including success made in implementing the national action plan, strategies for addressing challenges and obstacles, and recommendations for new actions (The White House, 2014).

1.4.4 The strategic plan for combating AMR in GCC Countries

This plan was developed and approved by the GCC Center for Infection Control (GCC-IC). In April 2015, the center released the GCC AMR strategic plan that represents the views of experts and aligns with the 2015 WHO global action plan on AMR. This strategic plan helps in developing a tailored national plan for each GCC country (Balkhy et al., 2016). The goal, strategic aims and evaluation of the plan are summarised in Table 1.4.

In response to this plan and the WHO calls, some of the GCC countries developed or are developing their own national plans to combat AMR. The Saudi government developed the national AMR action plan in 01/2017, and is in the process of developing a national surveillance system for AMR after enrolling in GLASS since May 2017 in order to share AMR data, improve antimicrobial practice and reduce AMR rates. In the UAE, the national AMR action plan is still under development, and the country was enrolled in GLASS in April 2017. The national AMR action plan, in Bahrain was approved in 2016 after enrolling in GLASS in October 2016. Oman approved its national AMR action plan in May 2016 and enrolled in GLASS (World Health Organisation, 2018). No data is available for Kuwait and Qatar.

Table 1.4: The strategic plan for combating AMR in GCC countries

The strategic plan for combating AMR in GCC countries	
Goal	To provide a roadmap for GCC states and authorities to have and provide effective and timely actions to control AMR.

Strategic aims	1. To develop and understand the magnitude of AMR in the GCC countries among humans, animals, agriculture and the environment. 2. Preserve the limited and available effective antimicrobials for human use. 3. Improve early identification of emerging Multidrug-Resistant Organisms MDROs. 4. Reduce the spread of resistant pathogens through patients, animals, and agriculture. 5. Encourage and support collaborative research initiatives regarding AMR in humans, animals and environment.
Evaluation and monitoring	) The GCC-IC will monitor the progress and challenges and share experiences of implementation in annual workshops.) A platform will be given to the GGC states to share and raise awareness on the topic through the journal of Infection and Public Health.

A limited number of initiatives have been undertaken from GCC countries to educate public and increase awareness of the threat of AMR and appropriate antibiotic use. Only Kuwait and Saudi Arabia reported campaigns regarding AMR and antimicrobial use. A national campaign for the use of antimicrobial was run in Kuwait, following WHO recommendations. The campaign was launched in three phases starting in 2009 and then in 2011 and 2012 targeting all healthcare workers and general public in all government hospitals in Kuwait (Kuwaiti Infection Control Directorate, 2014). In Saudi Arabia, the Ministry of Health (MOH) launched antimicrobials awareness campaigns in its hospitals and shopping malls in accordance with the World Antibiotic Awareness Week (14-20 November 2016), in order to increase awareness and improve antimicrobial practice targeting both health care professional and the public (Saudi Ministry of Health, 2016).

Table 1.5 brings together the national policies to combat AMR in the UK, US and GCC countries.

Table 1.5: Comparison of national AMR policies implementation in UK, USA and GCC countries

Activity	UK	USA	GCC
National strategy implementation in: hospitals, community, veterinary, and agriculture.	✓	✓	Saudi 01/2017 Bahrain 2016 Oman 05/2016
Approval and support from high authorities	✓	✓	Saudi Bahrain Oman
Public health activities	✓	✓	Only in Kuwait and Saudi
Support research on AMR, IPC and development of new drugs	✓	✓	No available data
National surveillance system to monitor antimicrobial use and resistance rates	✓	✓	No available data
International collaboration to share data and experience	✓	✓	The following countries were enrolled in GLASS but no data is available yet: Saudi 05/2017 UAE 04/2017 Bahrain 10/2016 Oman 05/2016
An identified body to monitor and report progress and outcomes	✓	✓	No available data
Specific targeted outcomes to be measured	✓	✓	No available data

From Table 1.5, it is clear that more actions are needed in the GCC countries to fully implement the GCC plan on AMR in all sectors: hospitals, community, veterinary and agriculture. One way to combat AMR is for each GCC country to develop its own national plan to prevent and control inappropriate antimicrobial use in human, animals and agriculture. Moreover, a national surveillance system is necessary to monitor antimicrobial use and resistance in all sectors and to share data with different sectors, update policies and monitor progress at the national level. For these initiatives to succeed, higher authorities must be involved to facilitate and strengthen their implementation, maintain high level of health services and increase awareness of AMR.

A timeline of global key events on antimicrobials and AMR policies are summarised in Figure 1.8.
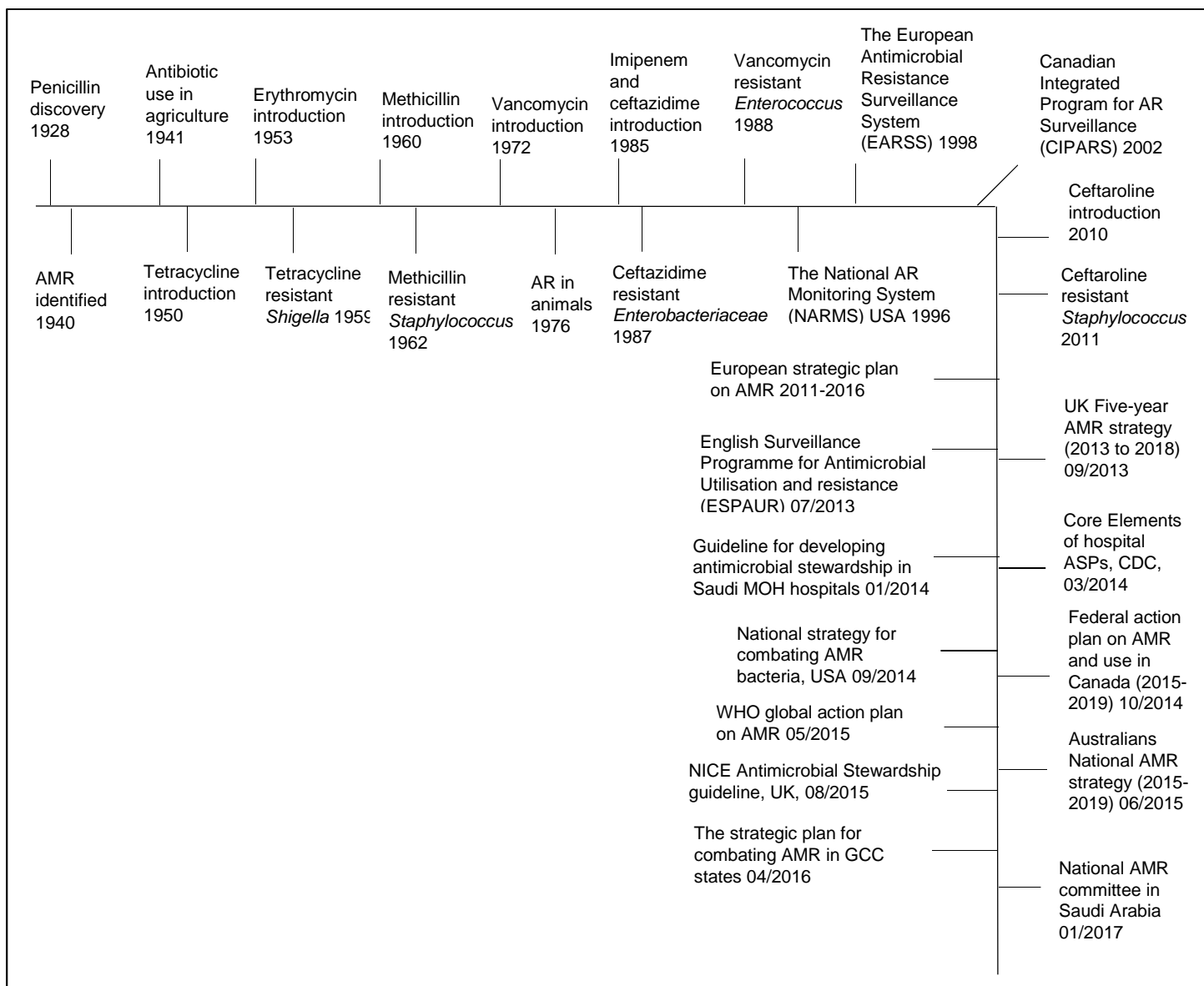
Figure 1.8: A timeline of global key events of antimicrobials and AMR policies

Several solutions have been proposed internationally to combat the growth of AMR including rationing antimicrobial use on farms, practising antimicrobial stewardship, reducing the inappropriate use of antimicrobials among outpatients (community), the adoption of more rapid diagnostic tests, developing new drugs, and coordinating schemes through the creation of national plans to address AMR. The previous sections of this chapter addressed AMR, its impact and causes. It also reported the patterns and trends in AMR globally and in UK, USA and GCC countries and gave examples of some international plans to combat AMR.

The next section will focus on one specific strategy to help combat AMR: ASPs, including; definition, team members, strategies and potential outcomes.

1.5 Antimicrobial stewardship programmes (ASPs)

According to the Infectious Diseases Society of America (IDSA), ASPs seek to improve the use of antimicrobial agents and achieve a corresponding reduction in resistance that can arise through improper or excessive use of these agents (The Infectious Diseases Society of America, 2016). Therefore, ASPs involve the application of collective strategies to enhance the proper use of antimicrobial agents, as well as minimise any adverse effects that may arise from their use. Also, ASPs generally aim to reduce the toxicity and the costs associated with the use of antimicrobials; these goals can be promoted through the selection of the right antibiotic regimen, correct dose, duration of use, and how a given agent is administered (Centers for Disease Control and Prevention, 2017; The Infectious Diseases Society of America, 2016). The Society for Healthcare Epidemiology of America (SHEA) and IDSA were the first to publish guidelines and clearly outline the concepts of ASPs (Dellit et al., 2007), which have been crucial in developing coordinated institutional programmes that enhanced antimicrobial stewardship.

1.5.1 ASPs team members

A successful ASP requires the collaboration of its team members (Table 1.6) with the hospital infection control and pharmacy, as well as with the related therapeutic committees. ASPs also require negotiation with the hospital administration regarding authority, compensation and expected outcomes for the programme, and especially the requisite infrastructure to track the institutional use of antimicrobials (Dellit et al., 2007; MacDougall & Polk, 2005):

Table 1.6: ASPs team members and responsibilities

Team member	Responsibility
ID physicians	Design, implement and ensure the successful functioning of the programme. This is achieved through supervising the therapeutic guidelines, antimicrobial restriction policies and other measures that are deemed necessary, as proven by evidence and practice.

Clinical/hospital pharmacists	Play an important role in the ASP implementation as they are the ones that process the medications and determine the formulary of the particular hospital concerned. The clinical pharmacists also give recommendations for the review of the medication by infectious disease specialists, hence calling for a specialised trained pharmacist for the administration of this programme.
Clinical microbiologists	Provide the requisite data on ASP, and therefore their timely reporting of the microbiology susceptibility test data is important in the selection of the most appropriate and focused antibiotic therapy.
Infection control staff and hospital epidemiologist	Gather data on nosocomial infections and conduct surveillance of the antimicrobial resistance.
Hospital managers	Provide the funding, frame policies for the ASP, and give physicians the autonomous power to implement the most appropriate ASP for the hospital. Therefore, the hospital managers are critical, but passive supporters of a successful ASP in any health care institution.

Earlier guidelines for implementing ASPs failed to include nurses or provide information on the role of nurses in ASPs. For example, the landmark IDSA/SHEA guideline for institutional ASPs recommends a multidisciplinary team comprising an ID physician and a clinical pharmacist with training in infectious diseases as core members, as well as clinical microbiologist, information system specialist, infection control specialist, and hospital administrator (Dellit et al., 2007), with no involvement of nurses. There is now increasing emphasis on the potential contribution nurses can make to the management of antimicrobials in hospital settings which could impact on the development of AMR (Edwards, Drumright, Kiernan, & Holmes, 2011). Consequently, current guidelines such as, the PHE "Start Smart, then Focus" recommends inclusion of a senior nurse in stewardship committee (Public Health England, 2015b). Similarly, the 2017 CDC core elements of hospital ASPs states that nurses can assure that cultures are performed before starting antibiotics in addition to their routine duties of medication review which places them in a position to initiate discussions of antibiotic treatment (Centers for Disease Control and Prevention, 2017). The aspects of antimicrobial management and potential contributions nurses can make is summarised in Table 1.7 (Edwards et al., 2011; Sumner et al., 2018).

Table 1.7: Roles of nurses in antimicrobial management

Aspect of antimicrobial management	Potential contribution
Treatment specificity	Could ensure treatment is in line with microbiology results, and use of broad-spectrum antimicrobials is limited where possible with support and training
Duration of treatment	Could ensure appropriate duration of antimicrobial therapy in collaboration with doctors and pharmacists
Route of administration	Could identify opportunities for switching from intravenous to oral antibiotics
Surgical prophylaxis	Can ensure appropriate duration prophylactic antimicrobials through discussion with doctors and pharmacists
Timing of antimicrobial administration	Can contribute to improvement antimicrobial administration practices through ASP training
Therapeutic drug monitoring	Can monitor blood results along with physicians to ensure doses are in-line with recommended guidance
Outpatient Antibiotic Therapy (OPAT)	Can promote use of OPAT services through engagement in decision making regarding patient's suitability

Although nurses have critical roles in ASPs, available literature shows little or no data on participation of nurses or the effect of the nurses' role in ASPs (Sumner et al., 2018). Given that nurses constitute the largest segment of the health care workforce (Manning, Pfeiffer, & Larson, 2016), their potentials should be fully exploited in ensuring appropriate use of antibiotics in healthcare settings.

1.5.2 ASP strategies

ASPs have become one of the most important infection control measures in the attempt to ensure the judicious use of antimicrobials, through restriction on their use, by means of educating prescribers, health personnel and patients, and by ensuring the proper use of feedback (Mckenzie, Rawlins, & Mar, 2013). Details are provided below for the core strategies (Table 1.8) and supplemental strategies (Table 1.9) for ASPs (Dellit et al., 2007; Nathwani & Sneddon, 2015).

Table 1.8: ASPs core strategies

ASPs core strategies	
Prospective audit with intervention and feedback (Back-end strategy)	**Formulary restrictions and preauthorisation (Front-end strategy)**
This involves the review of patients taking antimicrobial therapy and offering voluntary recommendations. This strategy is widely practiced, easily accepted and offers more educational opportunities, although it is more labour intensive.	This involves the restriction of certain class of antibiotics and approval from ID physician before such antibiotic is prescribed. This strategy provides direct reduction in use and inherently lowers the cost of restricted antibiotics.

Table 1.9: ASPs supplemental strategies

ASPs supplemental strategies	
Streamlining / timely de-escalation of therapy	Empirical antimicrobial therapy streaming or de-escalation based on culture results to target the causative pathogens can result in reduced antimicrobial use and cost saving.
Dose optimisation	Ensures provision of optimal therapy based on each case/drug characteristics and causative organism is essential in ASP.
Parenteral to oral conversion	The conversion of antimicrobials from parenteral to oral form reduces patients' hospitalisation time and cost.
Guidelines and clinical pathways	The enhancement of antimicrobial utilisation, encourages prescription based on evidence, and is facilitated by training and feedback.
Antimicrobial order forms	Facilitates adherence to guidelines and is effective in implementing ASP strategies.
Education	Increases acceptance of ASP strategies and influence change in antimicrobial use behaviour. Education is facilitated by incorporation with active intervention.

1.5.3 ASPs outcomes

ASPs promote the proper selection, duration, and dose of a given therapy using microbial agents throughout the entire course of treatment (Hamilton et al., 2015). This implies that the most significant benefit of this programme is the optimal use of therapy geared towards the general improvement of the clinical outcomes (British Society for Antimicrobial Chemotherapy, 2018; Hamilton et al., 2015). ASPs outcomes include: reduction in inappropriate or excessive use of antimicrobials, reduction in AMR rates, reduction in antimicrobial consumption cost, reduction in length of hospital stay and

reduction in readmission rates. Key ASPs outcomes are summarised below with some evidence-based studies (Table 1.10).

Table 1.10: ASPs outcomes

ASPs outcomes		
Outcome	**Example**	**Reference**
Reduction in inappropriate use of antimicrobials	ASP resulted in an immediate 17% reduction in broad-spectrum antimicrobial use in an intensive care unit (ICU), as well as a 10% reduction in broad-spectrum antimicrobial use outside the ICU.	(K. a. Cairns et al., 2013), Australia
	After the introduction of an ASP, 79.1% of the antibiotic uses were found to be inappropriate and reduced to 0%.	(Amer, Akhras, Mahmood, & Al-Jazairi, 2013), Saudi Arabia
Reduction in rates of resistant bacteria such as: MRSA and *Clostridium difficile* infections (CDI)	ASP reduced CDI rate by 0.0047/100 bed-days per month ($P = 0.0081$)	(Aldeyab et al., 2012), Ireland
	The results of an ASP showed that the rate of MRSA decreased by an average of 3% each year from 1999 to 2002.	(Martin et al., 2005), USA
	Implementation of the ASP in a rural hospital resulted in the reduction in the rate of CDI from an average of 5.5 cases per 10,000 patient days to an average of 1.6 cases per 10,000 patient days.	(Yam, Fales, Jemison, Gillum, & Bernstein, 2012), USA
Reduction in healthcare and antimicrobials expenditures	Implementation of the ASP at a community hospital led to a reduction in the expenditures on the use of antimicrobials by 26% from the previous year spending, with a total cost saving of $145,353.	(Bartlett & Siola, 2014), USA
	Expenses on all antimicrobials decreased by 24.7%, with a total cost saving of $1,401,126	(Martin et al., 2005), USA
Reduction in length of stay (LOS)	ASP reduced mean LOS from 6.2 days in the historical group	(Pasquale et al., 2014), USA

	to 4.4 days in the intervention group.	
Reduction in readmission rate	ASP reduced 30-day readmission rate from 16.71% in the historical group to 6.5% in the intervention group.	(Pasquale et al., 2014), USA

1.5.4 Barriers and facilitators to successful adoption and implementation of ASPs

The successful adoption and implementation of ASPs can be affected by number of factors. A study in the US that interviewed 15 ASP pharmacists and 6 physicians from 21 medical centres identified factors that can affect the successful implementation of ASPs (Pakyz et al., 2014). These factors were classified into culture and resources. Cultural factors included: communication process between staff and departments in the organisation, relationships between ASP members and non-ASP members, and conflict management. Resources factors included; information technology at the organisation, the analysis and reporting of antimicrobials consumptions and resistance, and the availability of personnel and expertise. A national survey was sent to all general acute care hospitals in California which received 223 responses (53% response rate). The study identified the following as barriers to ASPs: staffing constraints, lack of funding, lack of formal proposal to establish the programme, lack of administrative support, and lack of medical staff support (Trivedi & Rosenberg, 2013).

Another study in Australia that interviewed 17 healthcare professionals working in hospitals identified the following as barriers to the adoption of ASPs: lack of enforcement of ASPs policies, lack of adherence to prescribing guidelines, lack of up to date knowledge about appropriate antimicrobial use among senior specialists, and lack of resources including: ID physicians and pharmacists. The study also identified the following as potential solutions to ASPs: good communication between consultants, physicians and other healthcare professionals as a mean of education to improve the practice, hospitals management support and empowerment of the programmes, provision of clinical ASP service and electronic decision support system to practitioners, and involvement of pharmacists and nurses in antimicrobial therapy process (Cotta et al., 2015).

Having reviewed ASPs adoption barriers and facilitators, it will be interesting to outline the current status of ASPs in the UK, US, and GCC countries.

1.5.5 ASPs in UK

In England, there are 3 national ASP toolkits: Start Smart then Focus for hospitals (secondary care) (Public Health England, 2015b), the Treat Antibiotics Responsibly, Guidance, Education, Tools (TARGET) toolkit for community (primary care) (Royal College of General Practitioners, 2015) and Dental sector ASP toolkit (Public Health England, 2017). These toolkits provide educational materials and programmes to improve antibiotic practice. Moreover, in order to reduce unnecessary and inappropriate antibiotic use, two antimicrobial stewardship initiatives were developed by NHS: 1) Quality Premium (QP) in primary care from 2014/2015, and 2) Commissioning for Quality and Innovation (CQUIN) in secondary care from 2016/2017. As a result, 88% of Clinical Commissioning Groups (CCGs) reduced all antibiotics use to meet their objective and 83% reduced the consumption of broad-spectrum antibiotics to the target level. In 2016/2017, of the CQUIN, 33%, 37% and 52% of NHS acute trusts reduced piperacillin/tazobactam, total antibiotic and carbapenem consumption respectively to 2013/2014 levels (Public Health England, 2017).

The implementation of ASPs in primary and secondary care in UK was assessed by PHE: 68% (100) of Acute NHS trusts and 41% (68) of CCGs participated in the PHE survey. The national ASP policy for primary or secondary care was reviewed by 87% of acute NHS trusts in 2014/2015 and 85% in 2016/2017 and 60% of CCGs. However, implementation of an action plan to run ASP activities was done by only 46% of acute NHS trusts in 2014/2015 and increased to 55.3% in 2016/2017, and 13% of CCGs. The main results of the PHE assessment are outlined in Table 1.11 (Public Health England, 2015a, 2017).

Table 1.11: Comparison of ASPs activities in secondary and primary care, England, 2014, 2017

	Secondary care: Acute NHS trust n = 100 (2014/2015)	Secondary care: Acute NHS trust n = 116 (2016/2017)	Primary care: Clinical commissioning groups n = 82 (2014/2015)
Existence of ASP committee	94%	95.6%	18%
Written dedicated antimicrobial policy	93%	Not assessed	99%
Action plan/implemented toolkit	46%	55.3%	13%
Written education and training strategy	24%	Not assessed	1%
Implemented audits within ASP toolkit	74%	Not assessed	15%
NICE ASP guidance reviewed	Not assessed	93%	Not assessed
NICE ASP baseline audit completed	Not assessed	83%	Not assessed
ASP local indicators accessed on Fingertips	Not assessed	91%	Not assessed

1.5.6 ASPs in USA

The Centres for Medicare and Medicaid Services (CMS) introduced two important actions regarding ASPs in USA hospitals including the CMS (Centers for Medicare and Medicaid Services, 2016; Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria, 2016), and the Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria (Centers for Medicare and Medicaid Services, 2016; Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria, 2016):

〕 A condition of participation (CoP) that will request ASPs in inpatient settings to be aligned with the CDC core elements of hospital ASPs.

〕 New infection control and prevention standards that will require ASPs in Long-Term Care Facilities (LTCFs).

The implementation of ASPs in US hospitals was assessed by analysing the 2014 National Healthcare Safety network (NHSN) Annual Hospital Survey. Thirty-nine percent (1,642/4184) of US hospitals reported having ASPs that met all the CDC 7 core elements of ASPs (Pollack et al., 2016); 45% (741) of the hospitals were large hospitals with more than 200 beds, 37% (611) of hospitals were medium with 51 to 200 beds and 17% (290) of hospitals were small with 50 beds or less.

1.5.7 ASPs in GCC countries

The implementation of ASPs in GCC countries hospitals was assessed in a regional survey and response were only received from 47 hospitals in 4 GCC countries (2 from Bahrain, 2 from Oman, 2 from UAE and 38 from Saudi Arabia). Sixty-two percent (29/47) of the hospitals reported having ASPs in place (Enani, 2016). However, the situation is unknown in other hospitals and other GCC countries.

Compared to UK and US, current status of ASPs in GCC counties is not clear. Thus, a review of existing evidence on ASPs activities in the GCC countries is needed to understand the situation of ASPs in the region and develop recommendations for research and policy.

Chapter 2: ASPs in GCC countries Hospitals: A Review of Existing Evidence

2.1 Introduction

AMR is a global public health concern undermining efforts to treat infectious diseases, resulting in increased morbidity and mortality, and adding avoidable costs to already strained healthcare systems (World Health Organisation, 2016b). It is estimated that rates of mortality will be at 10 million people a year due to AMR, followed by cancer, road traffic accidents and other causes of deaths (O'Neill, 2014, 2016).

GCC countries are facing risks of inappropriate antimicrobial use and AMR with few national guidelines and policies to monitor and control antimicrobial use and resistance rates (M. Aly & Balkhy, 2012). Available reports indicate that rates of AMR are increasing in the GCC countries with rare and novel resistance strains (Areeshi, Bisht, Mandal, & Haque, 2014; El-Saed et al., 2013; Saber Yezli, Shibl, & Memish, 2015; H. Zowawi et al., 2015; H. M. Zowawi et al., 2014). The risk of AMR is even more serious in the GCC countries due to population mobility (MacPherson et al., 2009) - the high number of expatriates in the region, as well as around 10 million people that travel every year to Saudi Arabia for Hajj and Umrah, and the high number of tourists to the UAE and other GCC countries (Azeem et al., 2014; Kapiszewski, 2006; Östholm-Balkhed et al., 2013; H. M. Zowawi et al., 2013).

As mentioned earlier, ASPs are one of the main interventions to control the use of antimicrobials and reduce AMR rates; however, the level of adoption of ASPs in GCC countries is unclear. Thus, this review will aim to:

- 〕 explore the availability and the extent of ASPs adoption within GCC countries,
- 〕 identify factors that influence ASPs adoption, and the reported outcomes
- 〕 review the national policies of adopting or implementing ASPs within GCC countries.

Understanding the current status of ASPs adoption in GCC countries will have several implications not only for the public, but also for health care professionals and health policy makers.

2.2 Methods

2.2.1 Data Resources

Electronic databases of PubMed (MEDLINE), Embase, Scopus, CINAHL Plus, Ovid, Google scholar, grey literature (government documents, conference papers, doctoral thesis, evaluations and working papers), and official health authorities' websites for each GCC country were searched. Literature search ranged from year 01/1981 to 07/2017. References lists of retrieved articles and relevant review articles were checked manually for further relevant studies. Table 2.1 shows the search terms that were used. The search terms in the same group were combined using the Boolean term OR, while the three groups of search terms were combined using the Boolean term AND.

Table 2.1: Literature review search terms

ASP terms	Strategies terms	GCC terms
Antimicrobial stewardship program(s), Antimicrobial stewardship programme(s), Antimicrobial stewardship, Antimicrobial control program(s), Antimicrobial control programme(s), Antimicrobial management, Antimicrobial stewardship model, Antibiotic stewardship program(s), Antibiotic stewardship programme(s), Antibiotic stewardship, Antibiotic control, Antibiotic management	Strategy (s), measure (s), intervention(s), policy (s), practice (s), protocol (s), surveillance, procedure (s), implementation, adoption, recommendation	Gulf Cooperation Council, Gulf countries, GCC, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates.

2.2.2 Inclusion and Exclusion criteria

Studies were included if they meet the following criteria:
- Conducted in any GCC country (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates).
- Reported ASP in a hospital setting.
- Reported a national ASP/AMR policy.
- Published between 01/1981 and 07/2017.
- Published in English or Arabic language.

Studies were excluded if:

- ASPs were studied in primary healthcare centres, dental centres, cancer centres, and community pharmacies.
- Reported a single antibiotic policy intervention not part of ASP.
- Only reported consumption and resistance rates.
- Conducted on animals.

Two researchers screened all titles and abstracts independently to determine whether the article met the inclusion criteria and should be retrieved. A third researcher screened a random 10% sample to check the reliability of the screening. Any discrepancies were resolved through discussion between the three researchers. The first researcher then read and extracted data from the articles included in this review.

2.2.3 Quality assessment and data extraction process

The Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) standards (Moher, Liberati, Tetzlaff, & Altman, 2009) were used to extract data and assess the quality of studies. Search results were exported to Mendeley, a free reference manager and academic social network (Elsevier Inc.360 Park Avenue South New York, New York 10010). Titles and abstracts were screened in order to retrieve the full text of the article. As this is the first ever review of ASPs in GCC hospitals, all papers/research found from the search were included.

2.3 Results

A total of 2,801 titles and abstracts were reviewed from the literature search. Nine hundred and sixty-two duplicates were removed. After titles review, 1740 were excluded, 48 after abstract review and 27 after full text review, leaving twenty-four articles eligible for inclusion. Grey literature searching identified 7 further papers, and 2 National ASP/AMR policies, totaling 33 included papers as highlighted in Figure 2.1.

Of the 33 papers reviewed, 13 were from Saudi Arabia, five from Qatar, four from Bahrain, four from Oman, three from Kuwait, two from UAE and 2 national AMR/ASP strategies/guidelines one from the GCC and one from Saudi Arabia). All the included papers are published in English language only.

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┌──────────────────────────┐
│ Studies identified through │
│ database searching = 2801  │
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              │──────────────────→  ┌────────────────────────────────────────────┐
              │                      │ Studies removed after applying limits and    │
              ↓                      │ removing duplicates = 962                     │
┌──────────────────────────┐        └────────────────────────────────────────────┘
│ Studies screened for title = │
│ 1839                         │──────→  ┌──────────────────────────────────────────────┐
└──────────────────────────┘            │ Studies excluded after title screening = 1740│
              │                          │ and included:                                │
              │                          │ Studies not relevant to ASP and antibiotics  │
              ↓                          │ (e.g.: management of hepatitis, asthma,      │
                                         │ diabetes, arthritis, acne, hypertension,     │
                                         │ meningitis, malaria, pneumonia and           │
                                         │ tuberculosis) = 1253                         │
                                         │ Studies reporting patterns of AMR rates = 253│
                                         │ Studies reporting patterns of antibiotic     │
                                         │ use/misuse = 115                             │
                                         │ Studies about antibiotic use/misuse not in   │
                                         │ GCC countries = 65                           │
                                         │ Studies reporting antibiotic use/misuse in   │
                                         │ primary/community or dentistry settings = 54 │
                                         └──────────────────────────────────────────────┘
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Studies identified through database searching = 2801

Studies removed after applying limits and removing duplicates = 962

Studies screened for title = 1839

Studies excluded after title screening = 1740 and included:
Studies not relevant to ASP and antibiotics (e.g.: management of hepatitis, asthma, diabetes, arthritis, acne, hypertension, meningitis, malaria, pneumonia and tuberculosis) = 1253
Studies reporting patterns of AMR rates = 253
Studies reporting patterns of antibiotic use/misuse = 115
Studies about antibiotic use/misuse not in GCC countries = 65
Studies reporting antibiotic use/misuse in primary/community or dentistry settings = 54

Studies abstract evaluated = 99

48 articles were removed after abstract screening as they were:
Studies reporting patterns of AMR rates = 23
Single Antibiotic intervention not part of ASP = 9
Studies about antibiotic use/misuse not in GCC countries = 7
Studies about antibiotic use/misuse in community/primary care = 6
No access to full article = 3

Full articles evaluated = 51

27 articles were removed after evaluating full text as they were:
Studies evaluating/reporting antibiotic use/misuse= 14
Studies not in GCC countries = 8
Single Antibiotic intervention not part of ASP = 5

Included articles = 24

Grey literature: 7 papers
National ASP/AR policies: 2

Included papers = 33

Figure 2.1: Literature review flow chart of data extraction and study selection process.

2.3.1 Existing hospital ASPs in GCC countries

Evidence of the existence of hospital ASPs was identified in all GCC countries. Majority (13/33) of the reports were from Saudi tertiary hospitals and medical cities. This was followed by Qatar (5/33) reports from tertiary and community hospitals; Bahrain, 4 reports from military hospitals, Oman, 4 reports from tertiary hospitals, Kuwait, 3 reports, one from government hospital and 2 reported Ministry of Health (MOH) efforts to increase awareness about AMR among professionals, patients and the public through national campaigns. Two reports were identified from the UAE and they were from tertiary hospitals. A national strategic plan for combating AMR was identified in GCC countries (Balkhy et al., 2016).

The main ASP strategies that were reported in GCC countries hospitals included: guidelines and clinical pathways, prospective audit with intervention and feedback, and formulary restriction and pre-authorisation. Other reported strategies include: parenteral to oral conversion, streamlining/timely de-escalation of antimicrobial therapy, and education of professionals and patients.

No evidence was found in relation to national surveillance systems in antimicrobial consumption and AMR rates in any GCC country as part of ASPs initiatives.

In hospitals that reported ASP activities, ASP team was composed of only ID specialists and consultants, and sometimes infection control nurses and specialists. In few reports, pharmacists were monitoring antimicrobial consumption and giving feedback on appropriate antimicrobial therapy. In Saudi hospitals, microbiologists provided AMR rates data to hospital committees to update ASPs interventions based on their resistance data.

Table 2.2 summarises the findings in relation to the evidence of existing ASPs, strategies employed and composition of ASP team.

Table 2.2: Evidence of ASPs in GCC countries hospitals

Country	Authors	Setting	Study Type	Existing ASPs	Components of ASPs	ASP Team
Bahrain	(AlAnsari, AlAlawi, AlQahtani, & Darwish, 2013)	Outpatient setting attached to Bahrain Military hospital	Audit of antimicrobials used, patients treated, patient satisfaction and total costs comparison	Strategy to reduce the risk of healthcare associated infections and patients' LOS	Outpatient parenteral antimicrobial therapy: Treatment policy and protocol	ID physician, Chief resident family physician, specialist nurse, pharmacist
	(S. Al Alawi, Abdulkarim, Elhennawy, Al-Mansoor, & Al Ansari, 2015)	Outpatient setting attached to Bahrain Military hospital	retrospective review of case notes of patients admitted to OAPT clinic	Strategy to reduce the risk of healthcare associated infections and patients' LOS	Establishing guideline and protocol of ceftriaxone use in OPAT treatment policy and protocol. No involvement of antibiograms	ID consultant, family physician and specialist nurse
	(Alqahtani, 2015) (Conference presentation)	400-bed defence force hospital	Before/after study	Strategy to reduce Multi-drug resistance bacteria and antibiotic consumption	Formulary restrictions and preauthorization, local antibiotic susceptibility antibiogram, parenteral to oral conversion, guideline and clinical pathways, antibiotic audit with intervention and feedback, education	AMS teams and committees
	(World Health Organisation, 2016e) (WHO report)	Country's preparedness and capacities	International mission report	Hospitals have various elements of ASPs since 2012. No national plan for detection and reporting of AMR pathogens or infections. No national plan for ASPs at central or facility level. No centres implementing ASPs. No ASPs exist in private hospitals or primary care centres	AMS teams and committees, antimicrobial use guidelines, and staff training. Strong NHRA control (National Health Regulatory Agency).	AMS teams and committees

Country	Authors	Setting	Study Type	Existing ASPs	Components of ASPs	ASP Team
Kuwait	(Al-Mousa & Aly, 2012)	The Directorate of Infection Control in Kuwait organised a national campaign to encourage judicious use of antibiotics in healthcare settings during the period 19–26 March, 2009	Letter to editor and campaign report on ministry of health website	Campaign to raise awareness of doctors, pharmacists, patients and the public regarding appropriate antibiotics use called: 'Wise use or lose'.	Education activities to healthcare professionals, patient and public. Reminder SMS communication to Drs to use antibiotics wisely. Posters displayed on hospital corridors	Organised by National directorate of infection control, Scientific and Awareness committee. No involvement of teams within hospitals in design
	(N. Y. Aly, Omar, Badawy, Al-Mousa, & Sadek, 2012)	9 government hospitals	Audit of medical records in 9 government hospitals assessing adherence to hospital antibiotic policy	National antibiotic policy printed and distributed in booklets to hospitals since 2007. Hospitals use the national policy as basis for their local antibiotic policy. Existing antibiotic policy and guidelines at national and local levels.	Antibiotic policy contains broad evidence-based guidelines for the prescription of antibiotics to ensure appropriate prescribing	Organised by National directorate of infection control, Scientific and Awareness committee. No involvement of teams within hospitals in design
	(Kuwaiti Infection Control Directorate, 2014) (Government online report)	Nationwide Campaign including: Audits of adherence to national/ hospital antibiotic policy (first one reported by Aly, 2012. National awareness campaigns (1st	Campaign on antimicrobial resistance and judicious use targeting doctors in the private sector	Antibiotic policy, audits of adherence to policy. National awareness campaigns Education workshop 14/11/12 to private sector and campaign activities in government hospitals and primary care centres	Antibiotic policy Audits of prescribing and adherence to policy	Organised by National directorate of infection control, Scientific and Awareness committee. No involvement of teams within hospitals in design

Country	Authors	Setting	Study Type	Existing ASPs	Components of ASPs	ASP Team
		one reported by Al-Moussa & Aly, 2012).				
Oman	(Gunn, Ali, Abdo-Rabbo, & Suleiman, 2009)	Four major hospitals	Retrospective examination of medical records of patients admitted for Lower Segment Caesarean Sections (LSCS)	The Ministry of Health Antibiotic Chemotherapy Policy & Guidelines were published in 1998 and cover the use of antibacterials in prophylaxis and treatment	most major hospitals in Oman have established their own "in house" guidelines for almost all antibiotic use	Not identified
	(Al-Abri, Al-Maashani, Memish, & Beeching, 2012)	Tertiary hospital (Royal Hospital) Muscat	Retrospective case study involving a review of case notes of 342 patients	CAP guidelines	Guidelines and antimicrobial use policy	Not identified
	(Al Za'abi, Shafiq, Al Riyami, & Ali, 2013)	Tertiary hospital (Sultan Qaboos university hospital)	A review of patients' medical records of 365 patients	Antibiotic handbook (antibiotic policy) produced by the hospital in 2006 is the primary antibiotic protocol Restricted Antibiotic-Vancomycin	Antibiotic policy/ guidelines and restricted antibiotics	Not identified
	(Al-Maliky, Al-Ward, Taqi, Balkhair, & Al-Zakwani, 2017)	Tertiary hospital (Sultan Qaboos University hospital)	Observational study involving 366 patients	Local infections guidelines and Restricted antibiotic policy	Antimicrobial guidelines restricted antibiotic policy	Not identified
Qatar	(F. Y. Khan, Matar, & Khudair, 2010)	Tertiary hospital (Hamad General Hospital)	Retrospective audit of medical records of 69 patients	Local infection guideline: Guidelines for management of CAP	local infection guideline	Not identified
	(Abdel-Aziz et al., 2013)	Tertiary hospital (Hamad General Hospital)	Retrospective analysis of patient data from different surgical units in hospital	Surgical antimicrobial prophylaxis guidelines	Antimicrobial guidelines	Not identified

Country	Authors	Setting	Study Type	Existing ASPs	Components of ASPs	ASP Team
	(Pawluk, Black, & El-Awaisi, 2015)	Primary/ community and secondary care	Cross-sectional survey targeting all pharmacists practicing in Qatar	Various ASP strategies reported by pharmacist in secondary care in Qatar	Formulary restriction of antibiotics, clinical practice guidelines for infectious diseases, audit and feedback, IV to oral step-down guidelines, patient education, prescriber education, protocols that transfer authority from prescribers to pharmacists, antimicrobial cycling	Pharmacists review medication and feedback to prescribers
	(Garcell, Arias, Fernandez, Guerrero, & Serrano, 2016)	Community hospital (75-bed facility)	Observational study monitoring antibiotic consumption and compliance with policies (2012-2015)	Hospital has an established ASP programme Current strategies for ASP in hospital	Antimicrobial prescribing policy for therapeutic use and surgical prophylaxis including antibiotic stop orders, switching from IV to oral antibiotics and antibiotic restriction. Prescribing audits, antimicrobial consumption monitoring, feedback to medical staff and management, data dissemination, staff training and development.	Pharmacists monitor consumption and disseminate rates to medical and management staff. Infection prevention and control committee working closely with Quality and Patient Safety committees.
	(Guanche Garcell et al., 2016)	Community hospital (2013-15)	Interventional study to determine the impact of ASP on antimicrobial related activities in hospital	Existing, fully functional ASP focusing on appendectomies with quality indicators (compliance with timing, selection and dose, discontinuation of antibiotic prophylaxis as per protocol).	Staff education, monitoring antimicrobial consumption and providing feedback to prescribers	Compliance with antibiotic prophylaxis was monitored by an infection control practitioner. Monitoring of antimicrobial consumption was monitored by pharmacists.

Country	Authors	Setting	Study Type	Existing ASPs	Components of ASPs	ASP Team
Saudi Arabia	(Jacobs et al., 2003)	Riyadh Armed forces hospital	Interventional study involving 228 patients admitted to ICU for Percutaneous Dilatational Tracheostomy	Antibiotic protocol and procedure guidelines	Microbiology/ antibiotic protocol	Not identified
	(Dib, Al-Tawfiq, Al Abdulmohsin, Mohammed, & Jenden, 2009)	Tertiary hospital Dhahran Health Centre	Interventional study with reviews of medical records pre-and post-intervention	Hospital infection control practices advisory committee producing antimicrobial use guidelines, education and feedback	Antimicrobial use guidelines, education and feedback	Clinical pharmacist review and feedback to prescriber regarding adherence to guidelines. Infectious disease consultants used in persistent use cases
	(Amer et al., 2013)	Tertiary hospital (KFSHRC)	Comparative historically-controlled study. 24 patients enrolled on the active ASP arm and 49 patients on the historical control arm	ASP implementation in 2011 including ASP team, prospective audit and feedback, and education interventions. Appropriateness of prescribing assessed against formulary restrictions, adapted international infection guidelines. Verbal and written reports to ICU prescribers.	Proactive core strategies: formulary restriction and pre-approval strategies, prospective audit and feedback. Supplementary strategies: education interventions, guidelines, antimicrobial order forms, pharmacodynamics dose optimisation, antimicrobial cycling.	ASP team (ID/ Intensivist physician and ASP pharmacists)
	(Malhani, Al-ghamedi, & Enani, 2014) (conference poster)	Medical City (King Fahad)	Retrospective audit of medical records 172 patients before ASP implementation and	Report on one ASP strategy implementation in hospital	Audit and feedback to prescriber regarding IV to oral switch and duration of therapy	ASP team not identified possibly including pharmacists

Country	Authors	Setting	Study Type	Existing ASPs	Components of ASPs	ASP Team
			205 patients' post-implementation			
	(Al-Somai, Al-Muhur, Quteimat, & Hamzah, 2014)	Tertiary hospital (King Abdullah Medical City) Makkah.	Pre- and post-study to explore the impact of implementation of antimicrobial policy	Antimicrobial policy	Antimicrobial policy adapted from international infectious disease guidelines	Clinical pharmacist, ID consultant
	(Al-Tawfiq, Momattin, Al-Habboubi, & Dancer, 2015)	Dhahran Health Centre 380-bed general hospital	Interventional study	Selective reporting of Gram-negative bacillus susceptibility by clinical laboratory services and pharmacy, considering local resistance rates and international guidelines. Education activities	Cascade and restrictive reporting. Formulary restriction, guidelines and education activities	Microbiologists-microbiology lab
	(Al-Harthi et al., 2015)	University hospitals, private hospitals and public hospitals	A cross-sectional self-administered questionnaire		To investigate the perceptions, attitude, and prescribing practice among clinicians about AR	Not identified
	(AlAwdah et al., 2015) (Conference poster)	Tertiary hospital (Riyadh)	Pilot prospective quality-improvement interventional study in paediatric ICU a	Reported existence of ASP. Formulary restriction	Formulary restriction	ASP team mentioned but not identified. Most likely including clinical pharmacist reviewing medication and recommending antimicrobial optimisation according to restricted formulary recommendations.

Country	Authors	Setting	Study Type	Existing ASPs	Components of ASPs	ASP Team
	(Haseeb et al., 2015) (conference paper)	Survey of ASPs in Makkah hospitals	Survey targeting hospitals in Makkah region	Existing elements of ASP	Audit of antimicrobial use, education and training, and infection control and surveillance. Most common types of strategies were formulary restrictions for broad-spectrum antimicrobials and use of automatic stop orders to limit empirical therapy of antimicrobials in Makkah hospitals	Not identified
	(M. M. Alawi & Darwesh, 2016)	1002-bed tertiary care university hospital	Prospective before/after	Audit, review and restriction	Audit and review Number of prescriptions and dispensations, incidence of Multi drug resistance (MDR) and cost	Not identified
	(Salahuddin et al., 2016)	Specialist hospital in Riyadh (King Faisal specialist hospital)	Prospective cohort study	Antibiotic protocol and sepsis guidelines	De-escalation strategy and Sepsis guideline adapted from an international guideline (2012)	Not identified
	(Enani, 2016)	Mainly in tertiary hospitals	Regional survey targeting healthcare professionals in hospitals involving several GCC countries.	Evidence of existing ASPs in tertiary care settings in Saudi Arabia.	Although the definition of ASPs was not provided, restricted list of antimicrobial agents and antimicrobial audits were the main strategies reported	Not identified
	(Alshukairi et al., 2016)	Specialist hospital (King Faisal specialist hospital,) Jeddah	Pre-post intervention study	De-escalation protocol	De-escalation protocol, education and training of nurses and physicians re protocol, and auditing adherence to protocol	Not identified
		Tawam tertiary hospital,	Report	Existing functional ASP	Pre-approval antibiotics (restricted antimicrobials),	Microbiologists, ID physicians, ID

Country	Authors	Setting	Study Type	Existing ASPs	Components of ASPs	ASP Team
United Arab Emirates	(Hashmey et al., 2013) (oral presentation)	National Oncology referral centre			guidelines and pathways, IT setting of infection control antibiotic stewardship worklist, prospective audit with feedback	pharmacists, Infection Control Practitioners liaising with IT and Quality office.
	(El Hassan et al., 2014)	Mafraq hospital, Abu Dhabi	Retrospective review of data of 250 patients	Surgical antimicrobial prophylaxis guidelines	Hospital guidelines on surgical antimicrobial prophylaxis and use of bacterial antibiograms	Surgeons, clinical pharmacists and surgical nursing staff. Med review by pharmacists

2.3.2 Barriers and facilitators to ASPs adoption in GCC countries hospitals

Barriers and facilitators to successful adoption of ASPs were addressed in 9 of the 33 retrieved reports. At the individual level, barriers to ASP adoption includes lack of knowledge about appropriate antimicrobial therapy and AMR, lack of awareness of the availability of antimicrobial polices and guidelines, lack of awareness and knowledge of ASPs, lack of time and staff to make the required tests, lack of confidence to de-escalate antimicrobial therapy when required and lack of confidence to prescribe other antibiotics rather than what is usually prescribed. At the institutional level, barriers were reported to hinder the adoption of ASP in GCC countries hospitals; lack of expertise (ID specialists/consultants), lack of antibacterial agents, lack of educational and training programmes on appropriate antimicrobial therapy and risks of AMR, lack of microbiology equipment, and lack of management support. Also, lack of financial resources to fund ASPs was reported as a barrier to ASPs in hospitals.

Factors that were reported to enhance ASP adoption were prescribers' experience and knowledge of appropriate antimicrobial therapy according to the Kuwaiti Infection Control Directorate (Kuwaiti Infection Control Directorate, 2014), availability of written, clear and accessible antibiotic policy (Gunn et al., 2009), as well as feedback and discussions between prescribers and other healthcare professionals (Al-Tawfiq et al., 2015).

Table 2.3 summarises the barriers and facilitators of successful ASPs adoption by hospitals in GCC countries.

Table 2.3: Identified barriers and facilitators to ASPs adoption in GCC countries hospitals

Country	Authors	Facilitators	Barriers
Kuwait	(Kuwaiti Infection Control Directorate, 2014) (Government online report)	Experience (in relation to age) and antibiotics knowledge can lead to good antimicrobial stewardship	Excessive antibiotics prescribing as reported by Drs include: lack of time to perform the required investigation, fear of complication and antibiotic resistance concerns. Barriers to adherence to policy as reported by Drs include: non-availability or poor distribution of the policy, neglect of reading the policy, being incomplete or not updated and interrupted supply of some antibiotics. Knowledge of types of resistant organisms & isolation precautions
Oman	(Gunn et al., 2009)	Those hospitals that had a consistent policy and especially a written policy, made known to all staff, had better outcomes as far as post-operative infections	Many health workers considered the guidelines to be out-dated
Qatar	(Pawluk et al., 2015)	Not identified	Non-availability of an infectious diseases specialist is the most prominent perceived barrier to implementation and expansion of ASP. Training of pharmacists and pharmacy staff on elements of ASP are also perceived barriers.
Saudi Arabia	(Al-Tawfiq et al., 2015)	Alleviate prescribers concerns through discussing evidence of intervention and providing support. Held small group meetings with targeted (main) prescribers and key/ influential prescribers to encourage physicians to support ASP initiative	Many physicians were comfortable only with prescribing familiar antibiotics, difficulty persuading physicians to prescribe specific agents/ combinations, relevant microbiology not always available, no incentive for prescribers to choose more appropriate antibiotics
	(Al-Somai et al., 2014)	Not identified	Maintaining antimicrobial control during time of Hajj in Makkah is a challenge because of increased number of admitted patients and increased antimicrobial use.
	(Haseeb et al., 2015) (conference paper)	Not identified	Majority of the hospitals lacked local antimicrobial guidelines based on hospital-wide antibiograms
	(Salahuddin et al., 2016)	Not identified	reluctance of physicians to de-escalate antimicrobial therapy in complicated, sicker patients with drug resistance or fungal sepsis
	(Enani, 2016)	Not identified	Lack of programme funding and personnel as main barriers. Other barriers include obstruction from prescribers, and administration, lack of awareness of ASPs
	(Alshukairi et al., 2016)	Not identified	High resistance rates in other centres and transfer of resistance to specialist centres upon admission for last resort intervention

2.3.3 Outcomes of hospital adoption of ASPs in GCC countries

A number of outcomes were used to evaluate ASPs in GCC countries. They include; reduction of healthcare associated infections, reduction of inappropriate antimicrobial prescribing, reduction in length of hospital stay and mortality rates, reduction of expenditures of antimicrobials and reduction of AMR rates.

Most of the reported studies from Saudi Arabia used more than one outcome to assess the ASPs interventions, while other studies in the rest of GCC countries used reduction in inappropriate antimicrobial prescribing to assess ASPs interventions. The reduction in AMR rates as an outcome of ASPs was only assessed in 2 studies from Saudi Arabia.

The reduction in post-operative infections was reported in 6 studies (4 from Saudi, 1 from Oman and 1 from UAE), and in one of the studies the peri-operative infection complications were reduced from 32% to 11% (Jacobs et al., 2003). Reduction in *C.difficile* infection rates was reported in 2 studies (Al-Tawfiq et al., 2015; Hashmey et al., 2013).

Only 5 studies reported reduction in antimicrobial expenditures. Four of the studies were carried out in Saudi hospitals, and reported a reduction of up to half the cost of antimicrobials budget (Al-Somai et al., 2014; Amer et al., 2013; Enani, 2016; Malhani et al., 2014). The fifth study was carried out in UAE reporting a 40% reduction in antimicrobial budget (Hashmey et al., 2013).

The reduction on the readmission rates and mortality rates were reported in only 3 studies (Al Alawi et al., 2015; AlAnsari et al., 2013; and Amer et al., 2013). Two studies from a military hospitals in Bahrain reported that the outpatient service including ASPs interventions reduced hospital admissions (2 out of 101 in 2013 and 6 out of 97 in 2015) (Al Alawi et al., 2015; AlAnsari et al., 2013). A study in Saudi hospital reported a reduction in mortality rate from 33% to 17% due to the introduction of ASP (Amer et al., 2013).

Only few studies reported the reduction in AMR rates as an outcome of ASPs. This is can be due to the lack of involvement of microbiologists in ASPs. A reduction in AMR rates was reported in a Saudi study, but an increase in the resistance rates to some other heavily used alternative antibiotics were observed (Al-Tawfiq et al., 2015).

Another study in a Saudi hospital reported no impact on AMR rates (Alshukairi et al., 2016).

The reduction in broad-spectrum antibiotics was used to assess the impact of ASPs in all the retrieved studies, with only one study reporting a decrease in the consumption of cefuroxime (Guanche Garcell et al., 2016). The authors however reported that reduction in consumption of Cephalosporins resulted in an increase in consumption of Pencillins and Macrolides.

The reported outcomes of the adoption of ASPs by hospitals in GCC countries are summarised in Table 2.4.

Table 2.4: Outcomes of hospital adoption of ASPs in GCC countries

Country	Authors	Reduction of inappropriate prescribing	Reduction of healthcare associated infections	Reduction of direct antimicrobial cost	Reduction LOS/ mortality metrics	Reduction of antimicrobial resistance	Reduction of Broad-spectrum antibiotic use
Bahrain	(AlAnsari et al., 2013)	Not measured	Not measured	Not measured	Only 2 out of 101 patients were admitted to hospital	Not measured	High usage of Ceftriaxone
	(S. Al Alawi et al., 2015)	Not measured	Not measured	Not measured	Only 6 out of 97 patients admitted to hospital	Not measured	increased use of broad-spectrum antibiotics due to resistance to first and second line.
	(World Health Organisation, 2016e) (WHO report)	Not measured	Not measured	Not measured	Not measured	Detection and identification of AMR	Not measured
Oman	(Gunn et al., 2009)	Not measured	Hospitals that had a consistent policy and especially a written policy, made known to all staff, had better outcomes as far as post-operative infections	Not measured	Not measured	Not measured	Not measured
	(Al-Abri et al., 2012)	80% adherence to antimicrobial treatment guidelines of CAP but excessive IV	Not measured	Not measured	Not measured	Not measured	Not measured

Country	Authors	Reduction of inappropriate prescribing	Reduction of healthcare associated infections	Reduction of direct antimicrobial cost	Reduction LOS/ mortality metrics	Reduction of antimicrobial resistance	Reduction of Broad-spectrum antibiotic use
		use of macrolides					
	(Al-Maliky et al., 2017)	Not measured	Not measured	Not measured	Not measured	Not measured	High use of broad-spectrum antibiotics (90% of antibiotic prescriptions) due to lack of adherence/ compliance with guidelines and policy
Qatar	(F. Y. Khan et al., 2010)	Adherence to guideline in 75% of cases	Not measured	Not measured	Not measured	Not measured	Not measured
	(Abdel-Aziz et al., 2013)	Only 40% of surgical patients received the right antibiotic due to lack of adherence to hospital policy.	Not measured	Not measured	Not measured	Not measured	Not measured
	(Garcell et al., 2016)	Not measured	Not measured	Not measured	Not measured	Not measured	Reduction in use of cephalosporins but rise in use of other antibiotics such as oral penicillin's and IV macrolides.
	(Guanche Garcell et al., 2016)	Appropriate prescribing and administration of antibiotics improved	Not measured	Not measured	Not measured	Not measured	reduction in antimicrobial use especially cefuroxime
Saudi Arabia	(Jacobs et al., 2003)	eliminated inappropriate prescribing	Reduced perioperative infective complication	Not measured	Not measured	Not measured	Not measured

Country	Authors	Reduction of inappropriate prescribing	Reduction of healthcare associated infections	Reduction of direct antimicrobial cost	Reduction LOS/ mortality metrics	Reduction of antimicrobial resistance	Reduction of Broad-spectrum antibiotic use
			s from 32% to 11%				
	(Dib et al., 2009)	Education and feedback to prescriber enhanced adherence to guidelines from 35% to 68%.	Not measured	Not measured	Not measured	Not measured	Not measured
	(Amer et al., 2013)	appropriate empirical antibiotics improved from 31% to 100%	No impact on C diff rates	half the total cost of antibacterial agents	Reduction of hospital stay 376 DDD compared to 2404 DDD pre-ASP. Deaths decreased from 33% to 17%.	Not measured	Not measured
	(Malhani et al., 2014) (conference poster)	Not measured	Not measured	Cost savings reported as a result of ASP team interventions	Not measured	Not measured	Not measured
	(Al-Somai et al., 2014)	ASP interventions resulted in 37% reduction in antimicrobial consumptions	Not measured	Reduction of direct antimicrobial cost	Not measured	Not measured	Not measured
	(Al-Tawfiq et al., 2015)	Not measured	Reduced C.diff rates	Not measured	Not measured	Reduction of antimicrobial resistance for some organism-antibiotic combinations and increase in	Not measured

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Country	Authors	Reduction of inappropriate prescribing	Reduction of healthcare associated infections	Reduction of direct antimicrobial cost	Reduction LOS/ mortality metrics	Reduction of antimicrobial resistance	Reduction of Broad-spectrum antibiotic use
						resistance of the heavily used antibacterial (piperacillin-tazobactam)	
	(AlAwdah et al., 2015) (Conference poster)	Improved antimicrobial prescribing in relation to reduced DOT for major antibiotics used.	Not measured	Not measured	Not measured	Not measured	Not measured
	(Enani, 2016)	Two thirds report the outcome	Two thirds report the outcome	Two thirds report the outcome	60% report the outcome	55% report the outcome	Two thirds report the outcome
	(Alshukairi et al., 2016)	Not measured	Not measured	Not measured	Not measured	No significant effect on antimicrobial resistance	Not measured
United Arab Emirates	(Hashmey et al., 2013) (oral presentation)	Not measured	Reduction in c. diff	40% reduction in consumption and associated costs	Not measured	Reduction in MDR	Reduction in use of broad-spectrum antibiotics
	(El Hassan et al., 2014)	Low adherence to hospital guidelines (32%) resulted in inappropriate SAP prescribing	Not measured	Not measured	Not measured	Not measured	Not measured

2.4 Discussion

Findings of this review show varying level of adoption of ASPs and/or activities directed at control of AMR in the GCC countries. This is similar to the findings of a recent review on the impact of ASPs on antibiotic prescribing and prescribing behaviours in some Middle Eastern countries (Nasr, Paravattil, & Wilby, 2017). In 2015, a strategic plan for combating AMR was developed for the GCC states. The plan was developed in response to the WHO call for action against increasing rates of AMR. This plan provides a guide for all GCC countries to develop effective and timely local plans to monitor and control AMR (Balkhy et al., 2016). Prior to development of this strategic plan however, the General Administration of Pharmaceutical care in Saudi MOH had in 2013 developed pharmacy strategic plan. The strategic plan consisted of a number of programmes, one of which was to initiate national ASP with aim of establishing antimicrobial stewardship committee in MOH (Yousef Ahmed Alomi, 2017; Saudi Ministry of Health, 2014). This may explain why the majority of ASP reports included in this review was from Saudi Arabia.

Although there is evidence of existing antimicrobial stewardship activities in the GCC countries, most of the included studies did not define ASPs or provide their components. There was also no evidence of follow up report on the progress of the initiated programmes.

Antimicrobial stewardship guidelines such as, the IDSA/SHEA (Dellit et al., 2007) has outlined strategies that may be employed to control antibiotic use in hospitals, as well as composition of antimicrobial stewardship committee. In hospitals that reported adoption of ASP, strategies employed were consistent with published guidelines, although the ASP teams were mostly composed of ID specialists/consultants. Surprisingly, lack of ID specialists/consultants was reported as one of the main barriers to the adoption of ASPs by hospitals in GCC countries. For example, according to a Saudi MOH report, the number of ID specialists/consultants in Saudi MOH hospitals is only 57 (Saudi Ministry of Health, 2017a). This profession may not be attractive due to the work environment and low payments compared to private sector (Manyisa & van Aswegen, 2017). In the U.S. only 50-58% of US hospitals have access to ID services (Reese, Gilmartin, Rich, & Price, 2014; Septimus & Owens, 2011). The ID

specialists/consultants leading ASPs need the help of pharmacists and microbiologists to monitor and control the use of antimicrobials and provide recommendations to prescribers and other healthcare workers on the appropriate use of antimicrobials (Struelens, 2003). However, this review reveals that there is lack of involvement of pharmacists and microbiologists in ASPs and antimicrobial therapy. To be successful in ASPs adoption, a multidisciplinary team must be put in place to improve antimicrobial therapy (Cairns et al., 2016; Schmitt et al., 2014).

The high influx of international travellers in and out of the GCC countries, especially, Saudi Arabia, for Hajj and Umrah, was reported as one of the barriers. This is because the number of hospital admissions increase dramatically during these periods, which results in an increase in consumption of antimicrobials, and increased risk of AMR development (Al-Somai et al., 2014). Other factors identified as barriers to the adoption of ASPs included lack of knowledge, workload, prescribing behaviour and lack of blame-free environment, and lack of resources. These factors are similar to the findings of other studies (Hulscher, Grol, & Meer, 2010; Pakyz et al., 2014). It was also reported in a systematic review that hospitals in the region lack blame-free environment where reporting of errors is not practiced (Elmontsri, Almashrafi, Banarsee, & Majeed, 2017).

From this review, a number of facilitators enable the adoption of ASPs by hospitals in GCC countries including; knowledge and experience of prescribers, availability of polices and guidelines, good communication between staff and departments, and feedback to prescribers on antimicrobial therapy. These facilitators were identified in previous studies, highlighting the importance of staff knowledge and experience, availability of expertise and team work between staff to improve antimicrobial therapy (Pulcini et al., 2014; Skodvin et al., 2015).

A Cochrane review of interventions to improve antibiotic prescribing practices for hospital inpatients classified ASP outcomes into primary and secondary outcomes. Primary outcomes include compliance with antibiotic guidelines or policies and duration of treatment. Secondary outcomes include clinical outcomes such as, mortality, length of hospital stay; microbial outcomes, including *C. difficile* infection and colonisation or infection with antimicrobial-resistant bacteria (Davey et al., 2013,

2017). The authors also report ASP interventions were effective in increasing compliance with antibiotic policy and reducing duration of antibiotic treatment (Davey et al., 2017); as well as reducing AMR and healthcare-associated infections, and improve clinical outcomes (Davey et al., 2013). Outcomes used in assessing ASPs in the GCC countries were in line with Davey et al. (2013; 2017) classification, however, it was found that there were no changes in resistance rates, or a reduction was observed in some organisms, and an increase in resistance was observed in other organisms. This can be due to poor interventions, and/or lack of involvement of microbiologists who should provide resistance patterns that helps in the development and adoption of ASPs. Also, this can be due to inadequacy of testing methods for antimicrobial susceptibility in hospitals in the region (Al-Tawfiq et al., 2015).

2.4.1 Limitations and future research

Although ASPs activities were explored previously in the region (Nasr et al., 2017), this review is considered the first comprehensive review to explore the adoption of ASPs in GCC countries hospitals. All study types and grey literature were reviewed in order to increase the scope of evidence and provide a clear picture and understanding on the level of adoption, barriers and facilitators, and outcomes of the adoption of ASPs in the GCC countries. However, most of the reviewed studies did not define ASPs or provide their components. As mentioned earlier, only little evidence was identified with no follow up report or studies about the progress of programmes. Therefore, further studies are required to evaluate ASPs for longer period and understand how these programmes can be adopted and how barriers can be overcome. Also, studies are required to explore the situation of antimicrobial use and resistance in community pharmacies, private hospitals and primary healthcare centres.

2.4.2 Implications for practice

The adoption of ASPs in GCC countries hospitals remains low due to the identified barriers in this review. There is a need for each GCC country to develop a national ASPs strategy to improve antimicrobial therapy and reduce AMR (Balkhy et al., 2016; World Health Organisation, 2015a). Any national strategy should link to the GCC regional strategy to share experiences and ideas, and improve practice.

Communication and collaboration between organisations to share experiences and ideas about the adoption of ASPs and how to overcome barriers can help to improve organisational learning and practice. Also, collaboration between hospital management and healthcare professionals is important to improve the adoption of ASPs and enforce guidelines and recommendations. This is to be accompanied with educational and training programmes about ASPs, appropriate antimicrobial use and risks of AMR, in order to increase the knowledge and awareness of staff and facilitate the adoption process.

2.5 Conclusion

AMR is increasing in the GCC countries very rapidly, with rare and novel resistant strains, and one of the key measures to improve appropriate antimicrobial practice and reduce rates of AMR is ASP. Despite the reported benefits of ASPs, their adoption by hospitals in GCC countries remains low and underreported. A national surveillance system should be introduced to report consumption and resistance rates to help in the development of ASPs in the region. All of these should be done with the engagement of all different stakeholders including; healthcare professionals, institutional and regional levels, and national/governmental levels.

It is clear that studies are required at national levels to investigate the availability of ASPs and barriers and facilitators for their implementation in GCC countries. It is important to organise studies that will recommend changes to high authorities to increase their awareness regarding AMR and ASPs, provide required resources, enforce policies as well as periodic assessments to monitor the outcome of these interventions.

2.6 Why Saudi Arabia

The focus of this thesis therefore is to explore and investigate the level, process and factors influencing the adoption and implementation of ASPs in MOH hospitals in Saudi Arabia, to provide hospitals and policy makers with evidence-based recommendations on how to overcome the barriers to ASPs adoption in order to improve antimicrobial practice and reduce AMR. Besides being a Saudi citizen, sponsored by the Saudi government, worked as a hospital pharmacist in a Saudi

hospital with no monitoring of antimicrobial use, able to get access to the data in the country, and willing to contribute and improve the health practices in Saudi hospitals, the following reasons are the main drivers for this research to be carried out in Saudi MOH hospitals:

1. The only ASP guideline identified in all GCC countries is in Saudi Arabia targeting MOH hospitals, but the implementation progress is not known.
2. Risks of AMR is more in Saudi Arabia due to the high number of expatriate working in Saudi Arabia and their mobile in and out of the country, also due to the high number of visitors from all over the world for Hajj and Umrah (around 10 million international visitors per year).
3. There are more published studies/reports from Saudi Arabia showing high AMR rates.
4. The GCC-IC is located and monitored from Saudi Arabia, which is the guide for infection control for all GCC courtiers.
5. Most of the reported papers in this review were from Saudi Arabia.
6. The healthcare system in Saudi Arabia is the biggest in the area with a total of 444 hospitals.

Therefore, the remaining part of this chapter discussed the health care system in Saudi Arabia.

2.7 Research Context

2.7.1 Saudi Arabia

Saudi Arabia is a sovereign nation that is situated between the central portions of the Arab Peninsula of South-West Asia (Al-Yousuf, Akerele, & Al-Mazrou, 2002). It is bordered with Bahrain and the UAE to the east, Iraq to the north and northeast, Jordan to the northwest, the Red Sea to the west, Yemen to the south and Oman to the southeast (Figure 2.2). Saudi Arabia is composed of 13 regions, which are further divided into governorates, in addition to the regional capitals.

Figure 2.2: Saudi Arabia map

2.7.2 Saudi Arabia Healthcare System

The Saudi healthcare system is supervised by the MOH, which controls the operations of public providers and monitors the private providers. The structure of the MOH public health care system provides universal healthcare coverage in a two-tier framework:

1) 2,325 primary healthcare clinics and centres that mainly provide basic, preventive, emergency and antenatal care, supported by mobile clinics that serve rural or remote regions.

2) 274 hospitals and specialised facilities (63% of hospitals in Saudi) that are primarily situated in the urban areas (Saudi Ministry of Health, 2017a).

The MOH conduct the planning and development of health care, offering curative and preventive health care, and the management of public hospitals. The MOH hospitals are staffed by physicians (31,112), nurses (79,361), pharmacists (2,765), allied health professionals (43,704) (Saudi Ministry of Health, 2017a). Despite the pre-eminence of the MOH, there are several important health care providers in Saudi Arabia (Figure 2.3) (King Faisal Specialist Hospital & Research Centre, 2013; Saudi Ministry of

Defense, 2015; Saudi Ministry of Health, 2013; Saudi Ministry of National Guard, 2015). The Ministry of health operates 63% (274) of the hospitals in Saudi Arabia.
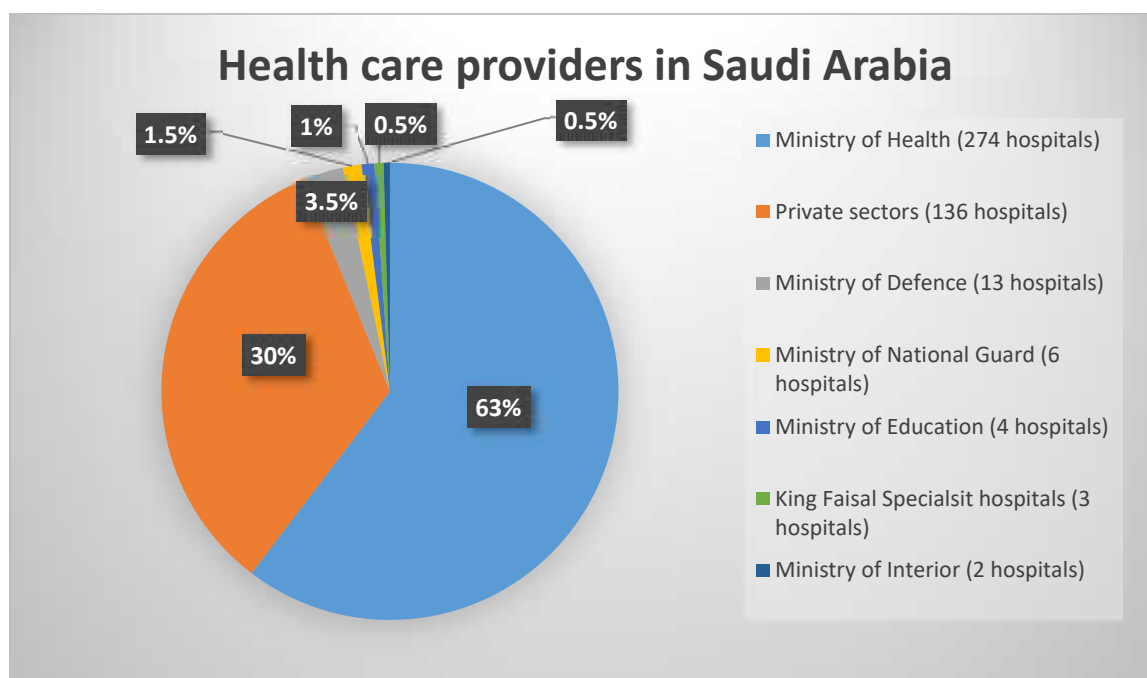
Figure 2.3: Health care providers in Saudi Arabia

In the year 2016, a total of 137 million visits were made to healthcare facilities in Saudi Arabia. Around 64 million visits (46%) were to MOH facilities, 50 million (36%) were to private sectors, and 23 million (16%) were to other governmental hospitals. The total number of hospitalised patients in 2016 were 3.4 million patients in all healthcare facilities in Saudi Arabia. Around 1.7 million (50%) were hospitalised in MOH hospitals, 1.2 million (35%) were in private sectors, and 0.5 million (15%) were in other governmental hospitals (Saudi Ministry of Health, 2017a).

The majority of MOH hospitals (79.5%) are general hospitals as shown in Table 2.5 (Saudi Ministry of Health, 2017a).

Table 2.5: Classification of Saudi MOH hospitals

Hospitals types	Number
General	218(79.5%)
Psychiatric	18 (6.5%)
Obstetrics/Gynaecology and paediatrics	16 (6%)
Convalescence	7 (2.5%)
Eye	4 (1.4%)

Obstetrics/Gynaecology	3 (1%)
Paediatrics	3 (1%)
Chest	3 (1%)
Rehabilitation	2 (0.7%)
Total	**274 (100%**

In terms of external accreditation, several hospitals in Saudi Arabia have achieved the Gold Seal of Approval® as entities that have attained the Joint Commission International (JCI) accreditation. These include: academic medical centres, hospitals and primary care providers. JCI identifies, measures and shares best quality and patient safety practices with the world (Joint Commission International, 2015). The partnership with JCI is mainly to ensure that these hospitals achieve excellence, which applies from the point of accreditation, maintenance of the accreditation, updating of standards and the offering of guidance that can help in improving performance that JCI accreditations intended for (Joint Commission International, 2015).

In Saudi Arabia, only 15 of the hospitals owned by the MOH have the JCI accreditation, as a result of concerted efforts by the hospitals to improve in their systems and the adoption of measures, standards and specifications that comply with the internationally acceptable requirements of the provision of healthcare (Saudi Ministry of Health, 2012).

2.7.3 Health seeking behaviour in Saudi Arabia

The term 'illness behaviour' has been used to describe the way an individual perceives symptoms, evaluate, and act when he recognises pain, discomfort or other signs of organic malfunction (Young, 2004). Illness behaviour is sometimes referred to as health behaviour, care-seeking behaviour or health seeking behaviour (HSB). HSB has been defined as any activity an individual undertakes to define his/her state of health and obtain suitable advice or treatment (Oberoi, Chaudhary, Patnaik, & Singh, 2016). HSB research looks at the ways people behave in relation to their health, as well as factors that facilitate the use of formal health services (Mackian, 2003). A number of studies have been carried out in different countries to investigate these factors. Two main approaches have been employed in investigation of what facilitates the use of health services, and what influences people to behave differently in relation

to their health. The first approach focuses on the 'end point' (utilisation of the formal system, or health care seeking behaviour); the second focuses on the 'process' (illness response, or health seeking behaviour) (Mackian, 2003). Studies on utilisation of formal health services have shown that the decision to engage with a particular medical channel is influenced by a number of factors which lie between patients and health services. These include geographical, social, economic, cultural and organisational factors. Table 2.6 summaries the determinants of HSB (Mackian, 2003).

Table 2.6: Determinants of HSB

Category	Determinant	Details
Cultural	Status of women	Element of patriarchy
Social	Age and sex	
Socio-economic	Household resources	Education level Maternal occupation Marital status Economic status
Economic	Costs of care	Treatment Travel Time
	Type and severity of illness	
Geographical	Distance and access	
Organisational	Perceived quality	Standard of drugs Standard of equipment Competence of staff Attitudes of staff Interpersonal process

In Saudi Arabia, healthcare is offered for free to Saudi citizens through more than 2300 PHCs and 270 hospitals (Almalki, Fitzgerald, & Clark, 2011; Saudi Ministry of Health, 2017a). In spite of the government investment in healthcare through the MOH, more than 1.9 million (15.2%) and 1.7 million (13.4%) Saudis aged 15 years or older are hypertensive and diabetic, respectively. A further, 57.8% and 43.6% of those affected have not been diagnosed with hypertension and diabetes, respectively, while among those diagnosed, 31.1% and 9% are not treated (El Bcheraoui, Basulaiman, et al., 2014; El Bcheraoui, Memish, et al., 2014). In a study to identify barriers to healthcare services in Saudi Arabia, it was concluded that individual characteristics (age, level of education, type of disease) are more important than system-based characteristics in healthcare-seeking practices (El Bcheraoui, Tuffaha, Daoud, Kravitz, et al., 2015).

With regards to antibiotics, socio-economic and geographical determinants have been found to drive antibiotics use behaviour. Poor knowledge and unhealthy perception about antibiotics have been identified among the general population and students in Saudi Arabia. A study that aimed to determine the prevalence of self-prescription of antibiotics in Saudi community found that 78.7% (536/681) of participant practice self-prescription of antibiotics without seeing a doctor (Al Rasheed et al., 2016). Another study in Riyadh, found out that 77.6% (253/327) of community pharmacies dispensed antibiotics without a medical prescription (Bin Abdulhak et al., 2011). In a study aimed to estimate the prevalence of self-medication with antibiotics among third year nursing students, 35.44% (28/79) of the students practiced self-medication with antibiotics (Khanam & Haj-ali, 2017). A related study also reported high prevalence (54.5% (214/394)) of self-medication with antibiotics among female students in a Saudi university (Al Barakh et al., 2016). These studies show that even among persons in higher education, misuse of antibiotics is still common in Saudi Arabia; a multi-pronged intervention, including educational campaign targeting different groups in the Saudi population will therefore be required to stir health seeking and antibiotics use behaviour in the right direction.

2.7.4 Country Cooperation Strategy for WHO and Saudi Arabia 2012-2016

The Country Cooperation Strategy for WHO and Saudi Arabia 2012-2016 was intended to bring the help of WHO to support Saudi Arabia in addressing its particular local health challenges and priorities (World Health Organisation, 2013). This involves the examination of the health needs of the nation within the context of its health sector, socioeconomic status, and national policies and health strategies. WHO has collaborated with the Saudi Arabian government to update its information on the health sector, together with other players such as the Ministries of Health, Education, Agriculture and Social Affairs. The United Nations Children's Fund (UNICEF) and GCC have also committed to pursuing measures to support health initiatives and programmes (World Health Organisation, 2013).

The Country Cooperation Strategy for WHO and Saudi Arabia 2012-2016 holds that there is a need for improvement, especially in the strengthening of the WHO office through a fund-in-trust arrangement. It also necessitates a timely response to requests

for support and guidance, as well as the identification of technical expertise elsewhere other than Saudi Arabia (World Health Organisation, 2013). This notwithstanding, the WHO in collaboration with the Government of Saudi Arabia have enlisted four strategic priorities for collaborative work (World Health Organisation, 2013):

- Strengthening the control of communicable diseases and health security.
- Strengthening the promotion of health and control of noncommunicable diseases.
- Strengthening the health care delivery systems.
- Improvement of partnership for health development.

The Saudi government established the Expanded Programme for Immunisation (EPI) to focus on the vaccination of preventable diseases (such as Measles, Mumps and Rubella), which has contributed in the reduction of infection rates in the country. This initiative has increased immunization coverage by approximately 90%, reducing incidences of diseases that are targeted by the immunization (Saudi Ministry of Health, 2013).

2.7.5 AMR Rates and surveillance in Saudi Arabia

No national surveillance system for AMR and antimicrobial consumption exists in Saudi Arabia. The following data regarding resistance pathogens were obtained from a global surveillance report on AMR that was developed by WHO in 2014. The WHO report produced the following data by reviewing all the available publications regarding AMR in Saudi Arabia (World Health Organisation, 2014).

A study that was conducted in an adult ICU at a tertiary care centre which tested 392 isolates found that there is a 61% resistance of *E. coli* to third generation chephalosprins (AlJohani et al., 2010). Another study found among 2530 isolates there is a 74.1% resistance of *E. coli* to fluoroquinolones (Al-Tawfiq & Anani, 2009). It was also found that *K. pneumoniae* resistance to Ceftriaxone is 59% among 96 isolates in a general ICU in a tertiary care hospital (Saeed, Kambal, & El-Khizzi, 2010). MRSA was presented in 92% of 112 isolates in a specialist hospital (Ahmad, 2010). In another study in a tertiary care hospital in Riyadh, 46% Nontyphoidal *Salmonella* (NTS) resistance to fluoroquinolones was found among 213 isolates (Somily et al., 2012).

The increased rates of AMR in Saudi Arabia can be attributed to the increase in antimicrobial consumption. All antimicrobial use (retail) increased from 11,852 in 2000 to 17,173 standards unit per 1000 population in 2015 (Figure 2.4). Broad-spectrum penicillins were the most used class of antibiotic and it increased from 6,398 in 2000 to 9,571 standards unit per 1000 population in 2015, followed by Cephalosporins that increased from 3,076 in 2000 to 4,041 standards unit per 1000 population in 2015 (The Center for Disease Dynamics Economics & Policy, 2015b). Saudi Arabia is among the top consumers of antimicrobials (retail) in GCC countries (Figure 1.4), and the increasing emergence of AMR is likely to put the country on a fast track to the post-antimicrobial era. The implementation of effective ASPs can potentially reduce the spread of resistance and promote the rational use of antimicrobials. Another reason for increased AMR rates is the sales of antimicrobial in community pharmacies without official prescriptions as discussed earlier.
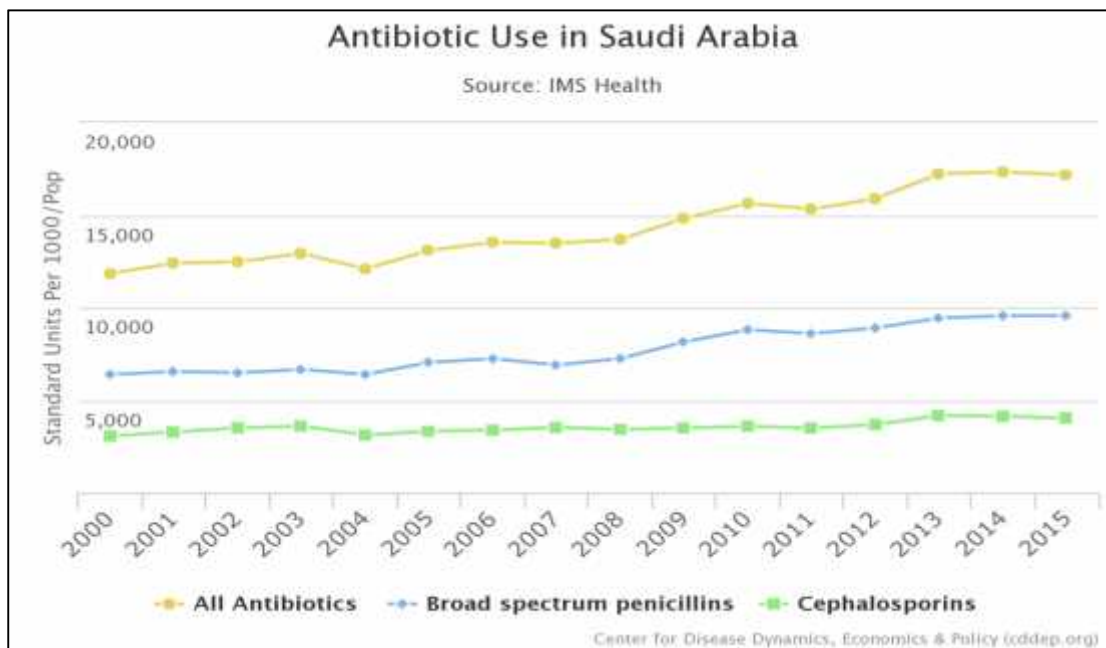
Figure 2.4: Antibiotic use (retails) in Saudi Arabia 2000-2015 (The Center for Disease Dynamics Economics & Policy, 2015b)

A number of factors are associated with the emergence and spread of AMR and infectious diseases in Saudi Arabia. The large number of international travellers, as big number of different workers in health sectors and other sectors are non-Saudis. In addition, the hosting of more than 10 million international visitors through the year for Hajj and Umrah to Makkah and Madinah (Azeem et al., 2014; Kapiszewski, 2006;

Memish et al., 2014; Saudi Ministry of Health, 2017a; H. M. Zowawi et al., 2013) is among the factors that increase the risk of AMR spread, as travel and gatherings of large number of people within a short period of time are considered risk factors for acquiring and spreading of AMR bacteria and infectious diseases (Memish et al., 2014; Östholm-Balkhed et al., 2013; Rogers, Aminzadeh, Hayashi, & Paterson, 2011). Consequently, the Saudi MOH requires that people coming from some countries, willing to make Hajj or Umrah and applying for an entry visa to get vaccines for the following conditions: Yellow fever, meningococcal meningitis and poliomyelitis and the seasonal influenza vaccine (Ministry of Health, 2016).

The Saudi MOH has released its 10 years strategic plan with the aim to improve health care services in primary centres and hospitals. The goals of this plan include: adopt an integrated and comprehensive approach to healthcare with focus on educational and research activities; increase the quality of services and monitor performance; recruit qualified healthcare personnel and develop human resources; develop electronic health services and information systems; and optimise the use of resources and develop ways for funding (Ministry of Health, 2009). Therefore, the Saudi MOH has released the ASP plan to combat AMR in hospitals through the general department of pharmaceutical care. The plan has 5 stages starting from year 2014 to 2018, each stage to involve more hospitals and strategies (Yousef A. Alomi, 2015). However, there are no reports regarding the implementation or progress of the MOH initiative.

The Saudi MOH guideline for ASPs implementation is the only ASP guideline in the gulf area. However, the implementation progress of ASPs within hospitals is unknown, therefor the aim of this thesis was to explore and investigate the level and process of adoption of ASPs and factors influencing their implementation in Saudi MOH hospitals, to provide hospitals and policy makers with evidence-based recommendations on how to overcome the barriers to ASPs adoption in order to improve antimicrobial practice and reduce AMR.

In the next section the research justification, questions, aim and objectives will be presented.

2.8 Research justification and rationale

AMR is a global public health concern undermining efforts to treat infectious diseases, resulting in increased morbidity and mortality, and adding avoidable costs to already strained healthcare systems. The irrational use of antimicrobials, and lack of ASPs are major contributing factors to AMR.

Saudi Arabia is among the top consumers of antimicrobials (retail) in the world, and the increasing emergence of AMR is likely to put the country on a fast track to the post-antimicrobial era. The implementation of effective ASPs, especially in hospitals, can potentially reduce the spread of resistance and promote the rational use of antimicrobials.

A Saudi national guideline for ASPs implementation within MOH hospitals has been developed. However, there is little data about the availability and implementation of ASPs within hospitals. Thus, studies at national level are necessary to investigate the level of implementation, and barriers to and facilitators of APSs adoption and implementation. Steps should also be taken to recommend changes to high authorities to support and facilitate ASPs adoption and implementation, as well as to implement periodic assessments that monitor the progress and outcomes of these interventions.

This study, therefore, explores the barriers and facilitators for the adoption and implementation of ASPs in Saudi MOH hospitals, from the perspectives of hospital physicians, pharmacists, microbiologists, infection control practitioners, hospital managers, nurses and policy makers; investigates the level of implementation and factors influencing the adoption and implementation of ASPs in MOH hospitals on a national level; and explores the adoption and implementation process of ASP in a MOH hospital that has ASP in place and outline how the adoption and implementation barriers could be removed.

Finally, due to lack of studies regarding public knowledge and perceptions regarding AMR and appropriate antimicrobial use, and findings of the qualitative study (chapter 4) suggested that there is lack of patients' knowledge and perceptions regarding antimicrobial use and AMR, patient's knowledge and perceptions regarding antimicrobial use and resistance were evaluated.

2.9 Research questions

1. What is the level of ASPs implementation in Saudi MOH hospitals?
2. What are the barriers and facilitators for the adoption and implementation of ASPs in Saudi MOH hospitals?
3. What is the process and steps of ASP adoption and implementation in a Saudi MOH hospital?
4. What is the level of patients' knowledge and perceptions regarding antimicrobial use and resistance in Saudi MOH hospitals?

2.10 Research aim

The aim of this research is to explore and investigate the level and process of adoption of ASPs and factors influencing their implementation in Saudi MOH hospitals, to provide hospitals and policy makers with evidence-based recommendations on how to overcome the barriers to ASPs adoption in order to improve antimicrobial practice and reduce AMR.

2.11 Research Objectives

To achieve the research aim, the following objectives must be accomplished:

1. Explore the perspectives of physicians, pharmacists, microbiologists, infection control practitioners, nurses, hospital managers and policy makers on the barriers and facilitators of ASPs in Saudi MOH hospitals.
2. Investigate the level of implementation and factors influencing ASPs adoption and implementation in Saudi MOH hospitals at national level.
3. Understand the process of ASP adoption and implementation (initiation, adoption decision, and implementation) in a Saudi MOH hospital.
4. Evaluate the knowledge and perceptions regarding antimicrobial use and resistance among adult hospital patients in Saudi MOH hospitals.
5. Produce evidence-based recommendations for successful adoption and implementation of ASPs in Saudi MOH hospitals.

Chapter 3: Research Methodology

This chapter explains the research methodology used in this thesis. It describes and justifies the theoretical framework and research methods adopted in this thesis. Further, it explains the research design and methods used to answer the research questions and achieve the research objectives and aim. Finally, techniques to increase the reliability and validity of this research were discussed as well as analysis of both qualitative and quantitative data and ethical considerations in this research.

3.1 Theoretical Framework

The theoretical framework is the structure that holds, supports and describes the research study theory that explains and justifies the research problem (Bryman, 2016; Creswell, 2009). It informs and justifies the study design, sampling, setting, analysis and interpretation in order to address the research objectives. The research methodology and methods should be identified and justified for each research. The research methodology involves the strategies, procedures and deign that are used to achieve the desired outcome through a specific method. While, the methods include the process of collecting and analysing data (Crotty, 1998).

The theoretical framework also justifies the researcher's philosophical assumptions, epistemology (knowledge and how to acquire it) and ontology (reality and how to view it), behind the research (Bowling, 2009; Bryman, 2016). Although it is sometimes referred as epistemology and ontology, it is usually referred to as a paradigm. The research paradigm involves; concepts and assumptions that drives thinking and research as well as methodology and methods of the research (I. B. Cohen, 1994; Crotty, 1998).

3.2 Theoretical Paradigms

Theoretical paradigms include: positivism, constructivism, transformative, pragmatism, critical and deconstructivism (Bowling, 2009; Creswell, 2009; Crotty, 1998; Mackenzie & Knipe, 2006). Positivism (Deductive approach) is associated with quantitative methods and based on experimental and observational studies to test hypothesis. On the contrary, constructivism/interpretivistivism (inductive approach) is associated with qualitative methods and based on the concept that reality is multiple

and constructed by the participants own experience and views to generate hypothesis. On the other hand, critical/ transformativism is driven by demands to improve society through political debates and actions. It discuses methodology and methods to assess transformative theory usually through the use of mixed methods approach in order to gain different points of view in relation to the research area. On the other side, pragmatism approach follows multiple approaches and concentrates on the problem, actions and situations by using both qualitative and quantitative methods in order to understand the problem and achieve the results (Bowling, 2009; Creswell, 2009; Crotty, 1998; Mackenzie & Knipe, 2006).

The framework of this thesis was developed bearing in mind the ability to answer the research questions in order to achieve the research aim and objectives. From reviewing the literature, there is increasing rates of antimicrobial resistance in Saudi hospitals. Even though there is a national ASP strategy for MOH hospitals, the adoption and implementation of ASP in this context is still unknown. Only few studies reported the implementation of ASPs in some large Saudi hospitals. However, the situation in other MOH hospitals that represent 60% of all hospitals in Saudi Arabia is still unknown. In addition, studies have overlooked the adoption and implementation of ASP in this context and none has yet to identify the barriers of adoption and how to overcome them. Finally, it was identified from the qualitative study (Chapter 4) that there is lack of knowledge and perceptions among patients in Saudi hospitals (without ASPs) regarding appropriate antimicrobial use. Therefore, a pragmatic paradigm that used both qualitative and quantitative methods (mixed-method approach) was adopted in order to answer the research questions and achieve the research aim and objectives.

A qualitative study was carried out in three Saudi MOH hospitals with the involvement of policy makers at regional and national levels in order to explore adoption, implementation, barriers and facilitators of ASPs in Saudi MOH hospitals. The qualitative study was exploratory in nature to identify and understand the situation in the three hospitals using semi-structured interviews in order to obtain more (in-depth) data from participants. Complementing this, a quantitative study was carried out to investigate the level of implementation, barriers and facilitators of ASPs adoption at national level. This was followed by a qualitative study in a Saudi MOH hospital that

has ASP in place in order to explore the process of adoption and implementation of ASP and identify how to successfully overcome adoption barriers. Finally, a quantitative study was conducted to evaluate the knowledge and perceptions of antimicrobial use and resistance among adult hospital patients in Saudi MOH hospitals.

3.3 Qualitative research

Qualitative research describes the phenomenon being studied in terms of words rather than numbers. It is concerned with the qualities of social phenomena that are obtained through direct and reactive observations (Creswell, 2009; Rice & Ezzy, 1999). Qualitative data may be obtained through interviews, tape recording, recordings in a diary, focus group techniques and life histories amongst other methods (Bowling & Ebrahim, 2005; Smith, 2002). The advantage of this method is that it may be used in instances when the researcher has little pre-existing knowledge about the subject under investigation. It also offers the opportunity to deal with complicated or sensitive issues in order to formulate an inductive or explorative hypothesis, instead of applying the findings to a bigger population (Bowling, 2009). It is important to note that this mode of research is used at the exploratory stage of a study and may be relevant to investigations of public health, especially when that is reliant upon the understanding of people (Rice & Ezzy, 1999). In essence, qualitative research helps in the understanding and answering of the questions on 'how' and 'why', which makes it ideally suited to determining the behaviour and thoughts of people (Smith, 2002).

Qualitative data can be collected through the use of interviewing technique. Research interviews can be structured, unstructured or semi-structured (Bowling & Ebrahim, 2005). Structured interviews seek to find answers to specific questions and are asked precisely the same way to each of the research participants, while unstructured interviews are led by the participants who are allowed to provide their own stories in their own words and without the involvement of the researcher. However, semi-structured interviews entail the use of open and closed questions which have been developed by the researcher before conducting the interviews and the questions are flexible in response to participant comments.

Interviews are carried out face-to-face or remotely, such as by telephone. The advantage of face-to-face interviewing is that the interviewer can probe for clarification, offers less chance of error, and can include complicated and detailed questions. However, this approach may be expensive, time-consuming, contain interviewer bias, and produce data that is difficult to analyse. In contrast, telephone interviews are efficient with regards to time, but are only restricted to use where there is a brief questionnaire and with non-sensitive topics. The rate of response to this method is typically low, especially when sensitive questions or topics are required (Bowling, 2009).

There are number of methods for qualitative research sampling including; 1) Convenience sampling involves sampling of subjects (participants) for reasons of convenience (easy to recruit, likely to respond, near at hand), 2) Purposive sampling (judgement sampling) samples a group of settings or people with particular characteristics (selection of particular respondents is made because they have valuable knowledge on the researched topic), 3) Snowballing technique includes asking an initial group of participants to recruit more participants relevant to the research area, and 4) Theoretical sampling where sampling categories are developed during the research process (Bowling, 2009).

3.4 Quantitative research

This term refers to the acquisition of data concerned with quantities and the relationships between attributes. It therefore entails the collection and the analysis of data that is highly structured in the positivist tradition. This approach is recommended in situations where there is pre-existing knowledge that allows the use of standardised methods of collecting data (Bowling, 2009; Creswell, 2009).

One of the most popular tools for collecting quantitative research data is the use of questionnaires. The survey tools can be structured or semi-structured in nature (Bowling, 2009; Smith, 2002). Structured questionnaires involve the use of standardised questions that are presented to the respondents in the same way, while semi-structured questionnaires involve the use of fixed questions but offers the participant some flexibility to enable them raise other issues or offer other responses.

The advantage of structured questionnaires is the ability to collect unambiguous data that is easier to analyse due to the pre-coded questions. They can cover significantly large populations than interviews, increasing generalisability, and are often more popular in dealing with sensitive topics due to the anonymity they afford to respondents. However, the pre-coded responses obtained through this method may not be comprehensive and respondents may be forced to choose answers that may not properly represent their views. Another disadvantage of this method is the inability to ensure that the targeted participant will be the one to complete the questionnaire (Bowling, 2009; Smith, 2002).

There are number of methods for quantitative research sampling including; 1) unrestricted random sampling where members of the targeted population are numbered and a number of them is selected randomly, numbers are replaced before the next draw, so each unit can be selected more than once, 2) simple random sampling which follows the unrestricted random sampling method, but without replacing numbers of population before each draw, so each unit can be selected once, 3) systematic random sampling that involves selection of samples from a list, with this method there is a risk of bias if the list of population is ordered as a trend can occur, 4) stratified random sampling where the targeted population is divided into strata (layers) (for example, nurses, pharmacists, microbiologists) and sampling from the layers is carried out using systematic or simple random sampling, 5) sampling with probability proportional to size where units are stratified by size and a sample is selected based on each size group, and 6) non-random sampling (quota sampling) that is a stratified sampling method where the selection within geographical layer is non-random (Bowling, 2009).

3.5 Mixed Method Research

The mixed method research uses both the qualitative and quantitative research approaches. Table 3.1 highlights the different typologies suggesting how to use a mixed method approach in actual research (Bowling & Ebrahim, 2005; Creswell, 2009).

Table 3.1: Mixed method research strategies

Sequential explanatory strategy	Sequential exploratory strategy	Sequential transformative strategy	Concurrent triangulation strategy	Concurrent nested strategy	Concurrent transformative strategy
This strategy gives priority to quantitative data. The two methods are put together in the interpretation stage of the study.	This strategy entails an initial phase of qualitative data collection that is followed by collection and analysis of quantitative data. This is used to develop a new quantitative tool.	This strategy has two different phases of data collection but either methods can be used initially. The findings will be integrated at a later stage.	This strategy entails the researcher attempting to cross-validate or confirm the findings from the quantitative and qualitative methods within the same study.	This strategy involves both the quantitative and qualitative data being collected at the same time. However, there is a dominant method used in the project.	This strategy is informed by the theoretical perspective and may be achieved through triangulation or nested strategies. In this approach, the integration occurs at the interpretation stage.

3.6 Methodological design

The aim of this thesis is to develop evidence-based recommendations to improve successful adoption and implementation of ASPs in Saudi MOH hospitals in order to improve antimicrobial practice and reduce AMR (Figure 3.1). These evidence-based recommendations were developed through a number of studies; 1) A systematic literature review to explore the existing evidence on ASPs and activities in the GCC region including Saudi Arabia (Chapter two), 2) Semi-structured interviews with different healthcare professionals and policy makers to explore barrier and facilitators for successful ASPs adoption and implementation in Saudi MOH hospitals (Chapter four), 3) A national survey to investigate level of implementation and factors influencing the adoption and implementation of ASPs in Saudi MOH hospitals (Chapter five), 4) A case study (in-depth interviews) with core members of the ASP in a Saudi hospital that has ASP in place to understand the process of ASP adoption and implementation and how to overcome barriers (Chapter six), and 5) A survey to evaluate patients' knowledge and perceptions of antimicrobial use and resistance (Chapter seven).
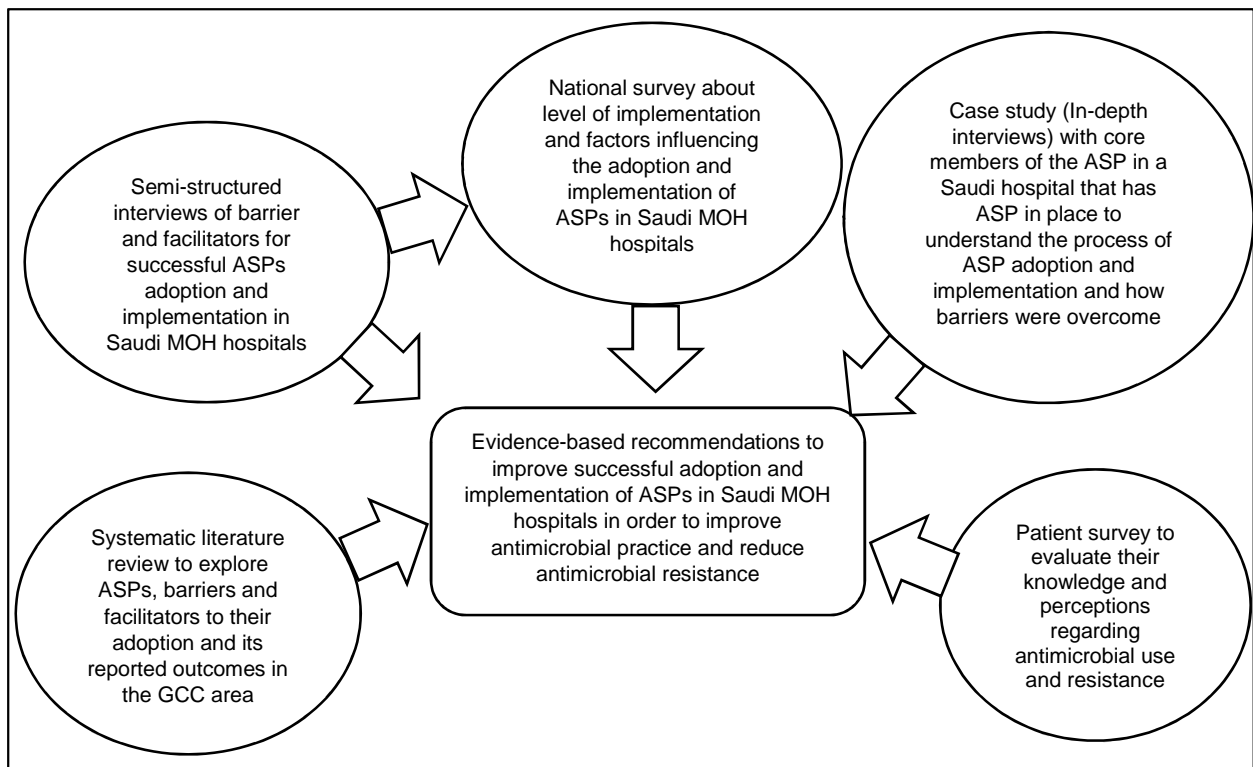
Figure 3.1: Methodological design

3.7 Thesis Framework and Structure

A pragmatic approach was used in this research to explore and understand ASPs adoption and implementation in Saudi MOH hospitals and produce evidence-based recommendations for their successful adoption and implementation.

This research adopted a mixed-methods approach that uses semi-structured interviews, supplemented by the distribution and completion of questionnaires. The interviews enabled to capture of both verbal and non-verbal expressions, and behaviours and emotions. The themes that emerged from the interviews were used to design the national survey. These were used to elicit responses from a large number of participants while ensuring that the different perspectives of participants are obtained. The questionnaires are also preferred as a follow-up on the responses offered by the semi-structured interviews, as well as enabling triangulation of the data that has been collected by the semi-structured interviews (Bowling & Ebrahim, 2005). In-depth interviews were also conducted in a Saudi MOH hospital that has ASP in place in order to capture both verbal and non-verbal expressions, behaviours and emotions of participants and gain in-depth data from participants regarding the

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adoption and implementation process of ASP and how adoption and implementation barriers were overcome. A patient survey was also conducted in order to obtain responses from a large number of participants and evaluate their knowledge and perceptions regarding antimicrobial use and resistance.

This thesis has a total of eight chapters. Chapter one provides an overview of the issue of AMR, actions to slow and prevent its development and spread and ASPs as one of the solutions to prevent antimicrobial resistance. Chapter two encompasses a systematic literature review regarding ASPs in the GCC countries hospitals. Chapter three includes the theoretical framework of this thesis and different research theories and approaches. It also describes the methods used in this research and the theory behind it.

This research was carried out in two phases (as illustrated in Figure 3.2). Phase one commenced with semi-structured interviews (Chapter four) with healthcare professionals in three Saudi MOH hospitals and four MOH leaders, followed by a national survey (Chapter five), developed from the qualitative study, that was sent to all Saudi MOH hospitals. Phase two started with semi-structured interviews (Chapter six) with participants involved in the process of ASP adoption and implementation in the medical city, followed by self-administered questionnaires (Chapter seven) to patients in two Saudi MOH hospitals. Chapter eight includes the overall discussion interpreting the results of phase one and phase two studies, summary of the results, recommendations and future research to improve ASPs implementation in order to reduce rates of AMR and improve patients care and safety in Saudi MOH hospitals.
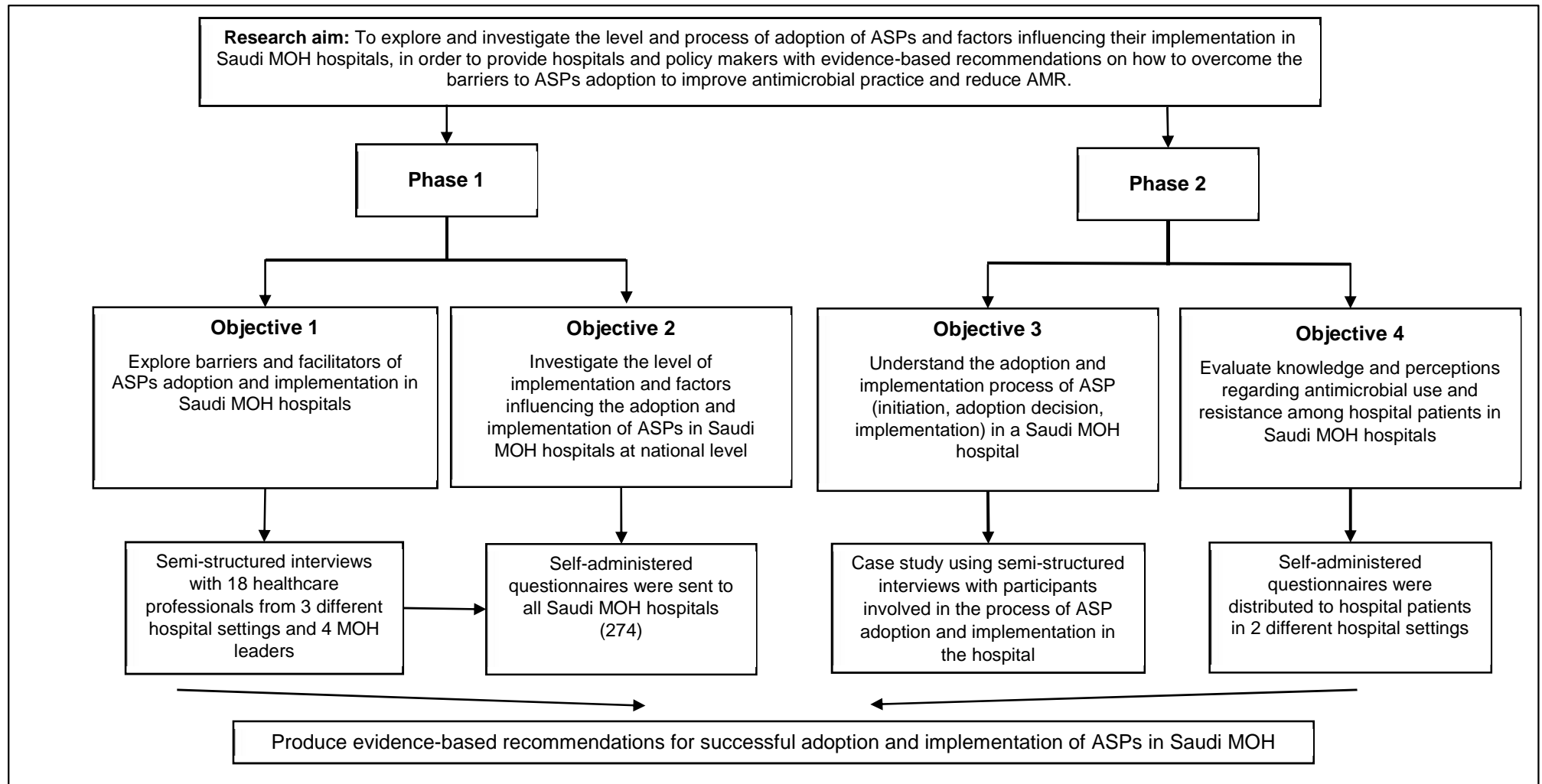
Figure 3.2: Overview of research phases and methods

3.8 Summary

Table 3.2 provides a summary of the research questions, methodology, rationale, methods and the respective chapters.

Table 3.2: A summary of the research questions, methodology, rationale and methods

Research questions	Methodology	Rationale	Methods	Chapter
What are the barriers and facilitators for the adoption and implementation of ASPs in Saudi MOH hospitals?	Qualitative	Explore barriers and facilitators for ASPs successful adoption and implementation in Saudi MOH hospitals and develop a national survey (quantitative tool) regarding ASPs.	Semi-structured interviews	4
What is the level of ASPs implementation in Saudi MOH hospitals? What are the barriers and facilitators for the adoption and implementation of ASPs in Saudi MOH hospitals?	Quantitative	Investigate the level of implementation and factors influencing the adoption and implementation of ASPs in Saudi MOH hospitals at national level.	Online self-administered questionnaire	5
What is the process and steps of ASP adoption and implementation in the medical city?	Qualitative	Qualitative study to understand the process of ASP adoption and implementation in the medical city	In-depth interviews	6
What is the level of patients' knowledge and perceptions regarding antimicrobial use and resistance in Saudi MOH hospitals?	Quantitative	Evaluate the institutional role of patient education on antimicrobial use and resistance in Saudi MOH hospitals.	Self-administered questionnaire	7

3.9 Reliability

Refers to the consistency and reproducibility of the instrument and its degree of being free from random error (internal consistency) (Bowling, 2009). Item equivalence and convergence can be assessed by; 1) split half where the instrument is divided into two parts and the correlations between the 2 are compared, and 2) Cronbach's alpha that estimates reliability based on all correlations between all items within the scale (an estimate of internal consistency, value range from 0 to 1). It is accepted that the minim acceptable level for Cronbach's alpha (internal consistency reliability) is 0.7, while others accept 0.5 (Bowling, 2009; Bryman, 2016).

Repeatability is assessed by; 1) inter-rater where the results obtained by 2 raters are compared to measure to which extent they agree, and 2) test-retest that measures the stability of the instrument over a period of time by repeating the administration of the instrument at different time where nothing else has changed (Bowling, 2009; Bryman, 2016).

To increase the reliability of this research the following steps were followed (Bowling, 2009);

- The interviewer was trained in order to avoid cases of biased interviewing whereby the respondents are made to answer questions in a certain manner.
- The researcher was trained on the use of values and collection, analysis and interpretation of data in order that they are logical to increase reliability.
- The researcher was careful to conceptualise proper methods, sampling procedures and analysis techniques in order to ensure that the observed values and the true values are consistent in order to increase reliability.
- The researcher was endeavoured to avoid, ambiguous wording of the questions, interpretation of the questions by the respondents in an inconsistent manner, or the inability of the respondents to offer accurate information that may reduce the reliability of the data.
- The respondents were adequately informed that the interviews are not to assess them to enable them freely participate in the research.
- Transcribed data were verified with the participants to ensure further reliability.
- The field data that included the audio recordings and the filed notes were carefully reviewed by the investigator and supervisory team in order to

categorise them. The investigator carried out the categorisation and further approved by the supervisory team with regard to their reliability.

⌡ Only the true results were reported without any need for overemphasis, in order to have the true body of knowledge that increases reliability.

3.10 Validity

Validity assesses whether an instrument measures what it is meant to measure (Bowling, 2009). There are two types of validity namely internal validity and external validity. Internal validity refers to how well an experiment has been carried out to avoid confounding or more than one possible variable acting at the same time (Bowling, 2009). On the other hand, external validity is the validity of the causal inferences present in a specific research that is based on experiments. This relates to the extent to which the results of a study can be generalised in other instances or to other people (Bowling, 2009). There are different forms of validity including; 1) face validity that refers to investigators assessments of the instrument to make sure it is clear, reasonable, relevant and unambiguous, and 2) content validity that refers to the assessment of the instrument (usually by a panel) to check the content of the instrument and ensure it will measure what it is supposed to measure (Bowling, 2009; Bryman, 2016).

To increase the validity of the study, the following steps were followed (Bowling, 2009);

⌡ The researcher ensured that there are no faulty designs, methods, sampling procedures and irrelevant techniques in the analysis of the data in order to eliminate any differences between the observed values and the true values which effectively increase validity.

⌡ The data collection tools (interview schedules and surveys) were checked by the investigator and supervisory team (face validity) as well as external experts (content validity) to verify their relevance, reasonability and ambiguity in order to increase their validity. This guaranteed that the content of the instrument is logical, balanced and covers the scope and domain that is intended to be measured.

⌡ The researcher carried out a comparison with the most established methods of collecting similar information.

) The researcher incorporated questions that can easily be answered.

) The researcher ensured that the instruments cover all the issues that are relevant to the topic through the incorporation of appropriate questions and giving the respondents the opportunity to report on the issues assumed to be most important.

) Transcribed data was verified with the participants to ensure further validity.

3.11 Determinants of ASPs adoption

A number of conceptual frameworks exist in the area of healthcare innovations adoption and diffusion. One of the most prominent frameworks is the Generic Implementation Framework (GIF) (Moullin, Sabater-Hernandez, Fernandez-Llimos, & Benrimoj, 2015). It advocates that implementation of interventions (investigation, protocol or programme) is influenced by number of factors, strategies and evaluations which need to be considered during the process of implementation (Figure 3.3). However, this framework did not determine/detailed those factors, strategies and evaluations that may affect the process of implementation. Thus, this framework can be used as a basis or a memory aid during the design/implementation of the intervention and should be tailored based on the innovation, setting, user and objective.
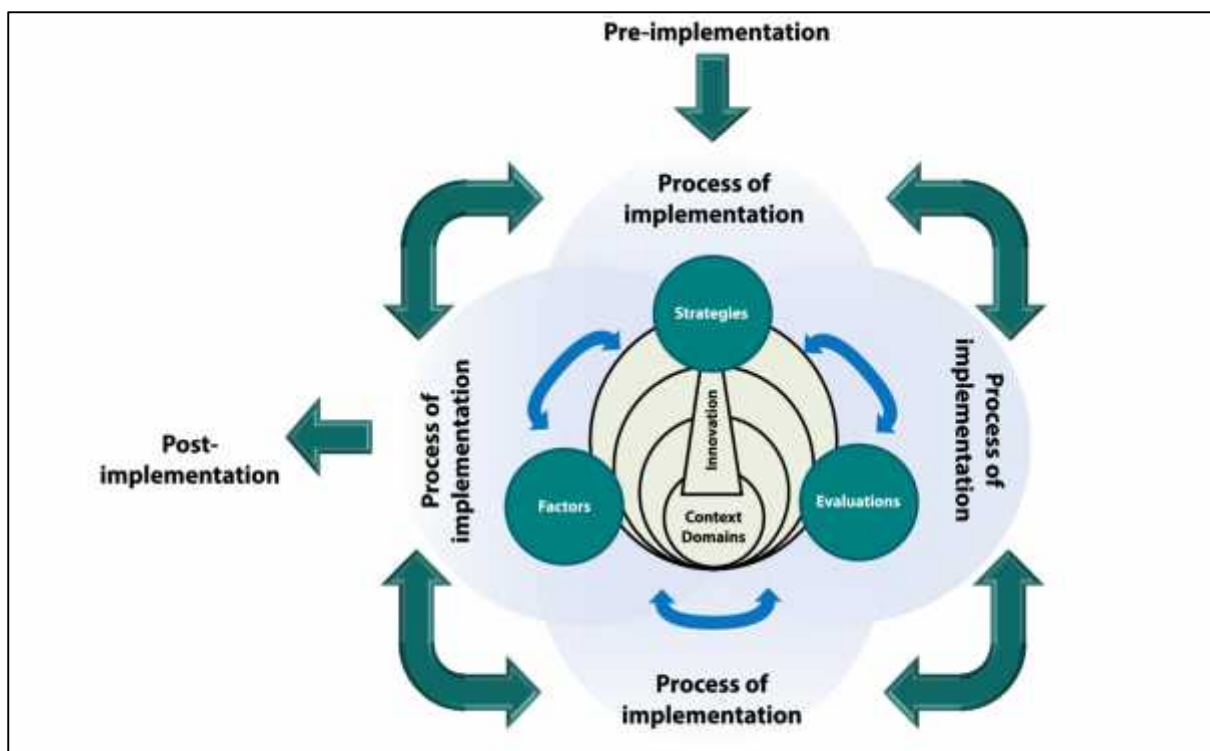
Figure 3.3: Generic Implementation Framework (GIF) (Moullin et al., 2015)

Figure 3.4 highlights a conceptual framework on the determinants of diffusing, disseminating, and implementing innovations in health organisations (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004). This framework advocates that a number of factors affect implementation of healthcare innovations including: innovation characteristics (e.g. compatibility, complexity, trialability, risk), assimilation by the system, diffusion and dissemination of the process (e.g. networks, marketing, expert opinion), system antecedents for innovation (structure, absorptive capacity for new knowledge, receptive context for change), system readiness for innovation (tension for change, support and advocacy, monitoring and feedback), outer context (interorganisational networks and collaboration): (socio-political climate, incentives, environmental stability, political directives), implementation and routinisation (organisational structure, leadership and management, human resources issues, funding, feedback), and linkage among the intervention stages (design stage and implementation stage).

SYSTEM ANTECEDENTS FOR INNOVATION

THE INNOVATION
Relative advantage
Compatibility
Low complexity
Trialability
Observability
Potential for reinvention
Fuzzy boundaries
Risk
Task issues
Nature of knowledge
required (tacit/explicit)
Technical support

Structure
Size/maturity
Formalization
Differentiation
Decentralization
Slack resources

Absorptive capacity for new knowledge
Preexisting knowledge/skills base
Ability to find, interpret, recodify,
and integrate new knowledge
Enablement of knowledge sharing
via internal and external networks

Receptive context for change
Leadership and vision
Good managerial relations
Risk-taking climate
Clear goals and priorities
High-quality data capture

SYSTEM READINESS
FOR INNOVATION
Tension for change
Innovation-system fit
Power balances
(supporters v. opponents)
Assessment of implications
Dedicated time/resources
Monitoring and feedback

COMMUNICATION
AND INFLUENCE

DIFFUSION
(informal, unplanned)
Social networks
Homophily
Peer opinion
Marketing
Expert opinion
Champions
Boundary spanners
Change agents

DISSEMINATION
(formal, planned)

OUTER CONTEXT
Sociopolitical climate
Incentives and mandates
Interorganizational
norm-setting and
networks
Environmental stability

Resource system

LINKAGE

User system
System antecedents

The innovation

Knowledge
purveyors

Diffusion

System readiness

Dissemination

Adoption/assimilation

Change agency

LINKAGE

Implementation

Outer context

Consequences

LINKAGE
Design stage
Shared meanings and mission
Effective knowledge transfer
User involvement in specification
Capture of user-led innovation

Implementation stage
Communication and information
User orientation
Product augmentation, e.g. technical help
Project management support

ADOPTER
Needs
Motivation
Values and goals
Skills
Learning style
Social networks

ASSIMILATION
Complex, nonlinear
process
"Soft periphery" elements

IMPLEMENTATION
PROCESS
Decision making devolved
to frontline teams
Hands-on approach by
leaders and managers
Human resource issues,
especially training
Dedicated resources
Internal communication
External collaboration
Reinvention/development
Feedback on progress

Figure 3.4: Conceptual model for considering the determinants of diffusion, dissemination and implementation of innovations in health services delivery and organisation (Greenhalgh et al., 2004)

Another framework for the determinants of innovation within the healthcare organisations was developed by (Fleuren, Paulussen, Dommelen, & Buuren, 2014; Fleuren, Wiefferink, & Paulussen, 2004) (Figure 3.5). This framework grouped the factors that can affect the implementation of healthcare innovations into four groups including: the socio-political context characteristics (patient cooperation, patient awareness, legislation and regulations), organisation characteristics (reinforcement management, relationship with other organisations, collaboration between departments, staff capacity, available expertise, financial resources, material recourses, administrat support), user characteristics (support colleagues, skills,

knowledge, ownership, task orientation,) and the innovation characteristics (clear procedures, compatibility, trialability, relevance for patient, risks for patient, complexity).
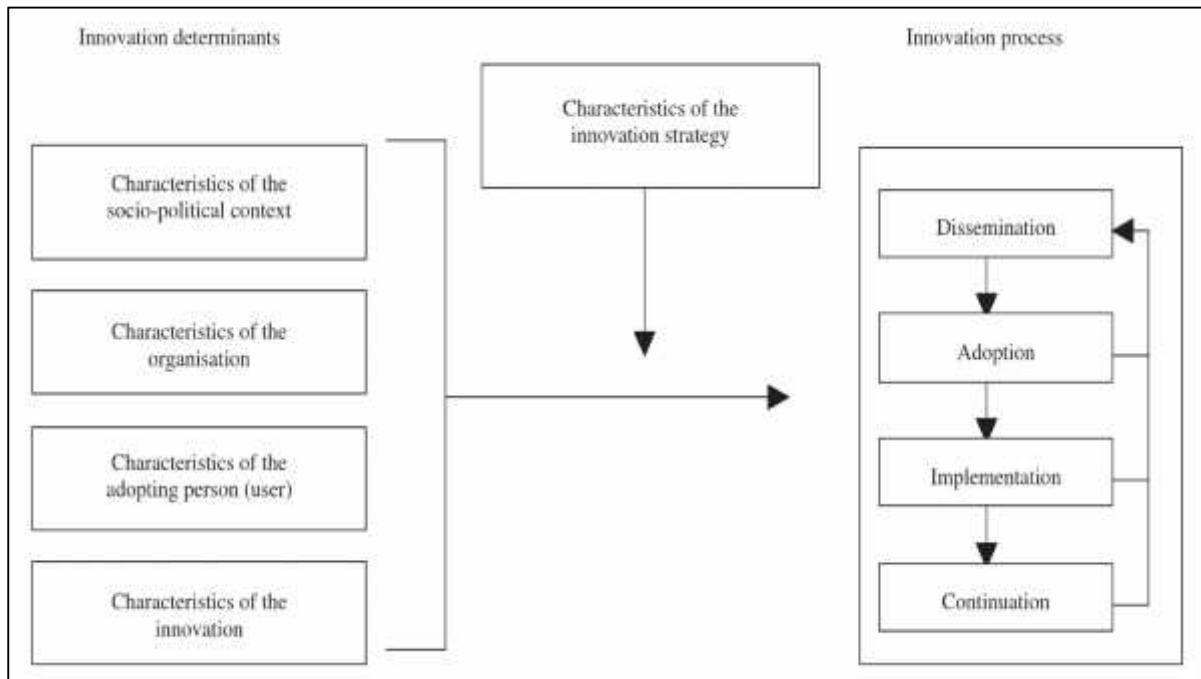
Figure 3.5: Framework representing the innovation process and related categories of determinants (Fleuren et al., 2014, 2004)

The last two models are approximately consistent and represent same factors that can affect the implementation process, however, the determinants of innovation within the healthcare organisations model (Fleuren et al., 2004) is well-presented, more organised, easy to understand and interpret, has been updated recently (Fleuren et al., 2014) and grouped the factors into four groups making it easy to analyse and categorise themes and understand and interpret data.

Therefore, a framework representing the major phases in ASP processes and related categories of determinants (Figure 3.6), has been developed based on the determinants of innovation within the healthcare organisations model (Fleuren et al., 2014, 2004) informing the analysis. The conceptual framework was also used to develop the interviews schedules and survey questionnaires. Themes and subthemes raised during the interviews and did not fit into this framework were incorporated and added to the framework, so no emerging themes and subthemes to be missed. Researchers looked for evidence of themes related to:

1) Characteristics of the socio-political context, such as legislation, rules, and patient characteristics.

2) Characteristics of the hospital such as leadership commitment and availability of resources.

3) Characteristics of the healthcare professionals/hospital staff, such as skills, support from colleagues and knowledge.

4) Characteristics of the ASP, such as advantages and disadvantages.
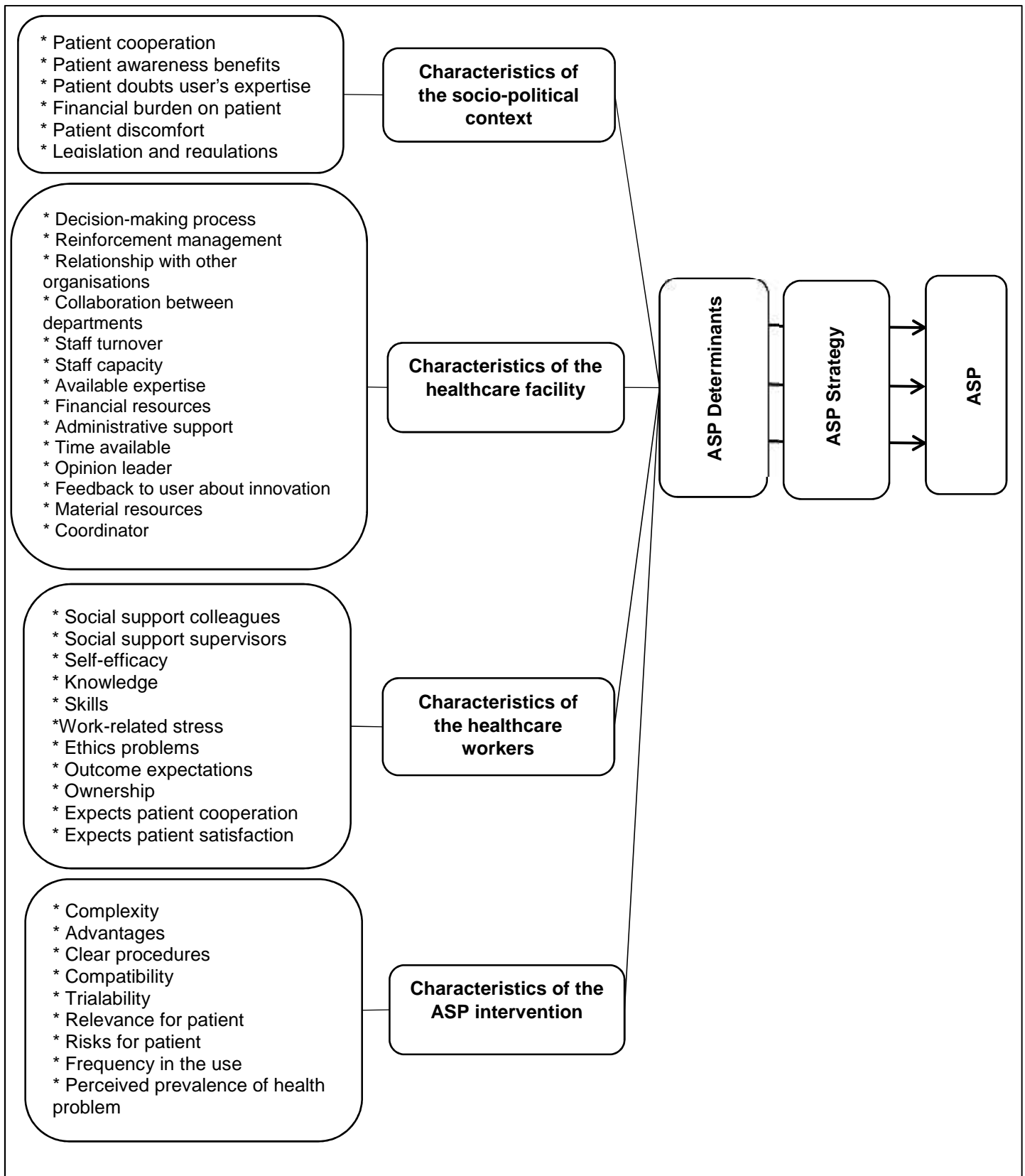
Figure 3.6: ASP process and related categories of determinant

3.12 Ethical considerations

This research adhered to Ethical Guidelines for Educational Research outlined by the British Education Research Association (BERA 2011). The research obtained the approval of the University of Hertfordshire Ethics Committee (Protocol number: LMS/PGR/UH/02344) (Appendix one). Besides, official permissions were obtained from the health authorities and participating hospitals in Saudi Arabia as described in each study.

Participants were informed of their right to withdraw from the study at any time, without requiring an explanation for doing so. In addition, they were informed that the data they provide will be confidential and only used for research purposes. Data reporting ensured that the participants remain anonymous and that their right of confidentiality is consistently respected. To achieve this, their names, addresses and other details were excluded from the research. Storage and usage of personal information were undertaken in accordance with the UK Data Protection Act 1998.

Chapter 4: ASPs in Saudi MOH hospitals: implementation, barriers and facilitators: a qualitative study

4.1 Introduction

Available literature shows high rates of AMR in Saudi Arabia (M. Aly & Balkhy, 2012; Shibl et al., 2014; S Yezli, Shibl, Livermore, & Memish, 2014; H. M. Zowawi, 2016; H. M. Zowawi et al., 2013). From reviewing the literature (chapter two), it was noted that while there is an ASP guideline for Saudi MOH hospitals (Yousef Ahmed Alomi, 2017; Saudi Ministry of Health, 2014), the extent of implementing this guideline remains unknown. In light of the high rate of resistance in the country, and risk of further spread of resistance due to influx of visitors from all over the world for Hajj and Umrah, it is essential to explore ASPs implementation to minimise the increase in AMR.

The objective of this qualitative study is to explore the perspectives of physicians, pharmacists, microbiologists, infection control practitioners, hospital managers, nurses and MOH leaders regarding:

- ﺍ The adoption/implementation of ASPs in Saudi MOH hospitals.
- ﺍ The barriers and facilitators of ASPs adoption and implementation in Saudi MOH hospitals.

The findings of this qualitative study informed the development of a national survey (Chapter five) to establish the status of ASPs in Saudi MOH hospitals and identify barriers and facilitators to their successful implementation on a national level.

4.2 Methods

4.2.1 Design

To achieve the objectives of this study, semi-structured interviews were carried out.

4.2.2 Development and source of interview schedule

The interview schedule (Appendix two) was developed following a review of the literature and discussion among the researcher and supervisory team, as well as consultation with three ASP pharmacists (two from Saudi Arabia and one from the UK)

and two ID consultants (from Saudi Arabia). Questions in the schedule were all open-ended to obtain in depth views or perspectives of study participants. The interview schedule has two main sections, which primarily consist of open questions. Firstly, is a section on background information (six questions), such as location of hospital, number of beds, hospital type, position of healthcare professional, gender and years of experience. Secondly, open-ended questions (14 questions) were used to explore the available strategies to control antimicrobials in Saudi hospitals, and the associated factors (barriers and facilitators) influencing the adoption and implementation of ASPs in Saudi hospitals.

Background information questions were developed after discussion between the researcher and supervisory team to explore participants demographic data (hospital type, city, number of beds, position, gender and years of experience). Questions 1-7 were developed after discussion between the researcher and supervisory team to explore characteristics and availability of ASPs in hospitals (available strategies, team members, roles of members, frequency and nature of meetings, and effectiveness of available strategies). Questions 8-14 were adapted from published tools (Cotta et al., 2015; Pakyz et al., 2014) to explore factors (barriers and facilitators) influencing the adoption and implementation of ASPs in hospitals.

The interview schedule was developed bearing in mind the four main domains of the conceptual framework (Fleuren et al., 2014, 2004) to cover all different factors that can affect the adoption and implementation of ASPs in hospitals. Questions 1, 4, 5, 6 and 7 was developed based on the domain: characteristics of the ASP to explore characteristics and availability of ASPs in hospitals. Question 2 was developed based on the domain: characteristics of healthcare organisation to explore the availability of expertise in hospitals. Question 3 was developed based on the domain: characteristics of healthcare workers to explore knowledge and skills of healthcare workers in regards to ASPs. Questions 8-14 was developed to explore factors (barriers and facilitators) influencing the adoption and implementation of ASPs in hospitals that can be under any of the four different domains: characteristics of the socio-political context, characteristics of the healthcare organisation, characteristics of the healthcare workers and characteristics of the ASP. Probing questions were also asked based on the responses of the participants to get more details.

4.2.3 Validation of interview schedule

The following steps were taken to ensure validity of the interview schedule (Bowling, 2009; Smith, 2002): Face validity: the interview schedule was checked by the researcher and the supervisory team to ensure their relevance, reasonability and that no ambiguity exists. Content validity: three ASP pharmacists (two from Saudi Arabia and one from the UK) and two ID consultants (from Saudi Arabia) checked the content of the interview schedule to ensure that the content of the instrument is logical and easy to understand.

4.2.4 Pilot study

The interview schedule was piloted with 16 different healthcare professionals from three MOH hospitals including: an ID consultant, five hospital pharmacists, four clinical microbiologists, four infection control practitioners and two hospital managers (Table 4.1), to ensure validity and practicality. After processing their feedback, appropriate adjustments were made to the interview schedule. The outcomes of this pilot study informed the following:

I) Conduct the interviews in the main language of the participant (Arabic or English) in order to allow participants to express their thoughts easily and to get in-depth data.

II) Explain the purpose of this study and ensure the privacy and confidentiality of participants in order to obtain their trust and record the interviews.

III) Target other healthcare professionals that are involved in antibiotic therapy (general physicians and nurses)

IV) Target policy makers on regional and national levels in order to capture different viewpoints and understand the full picture of ASPs in Saudi hospitals.

Table 4.1: Demographic data of the pilot study participants

		Number of participants					
		Male	Female	ID Physician	Hospital pharmacist	Microbiologist	CEO/Medical director	ICP
Hospital type	Local	2	2	0	1	0	1	2
	Regional	4	1	0	2	2	1	0
	Central	3	4	1	2	2	0	2
	Total	9	7	1	5	4	2	4

ID: Infectious Diseases specialist/consultant, CEO: Chief Executive Officer, ICP: Infection Control Practitioner (specialist/consultant)

4.2.5 Setting

In Saudi Arabia, MOH provides approximately 60% of in-patient care. The three participating hospitals were selected to represent three different types of general MOH hospitals, in an effort to capture a representative sample of different healthcare settings environments. These facilities can be broadly classified as: a local hospital (50 beds), a regional hospital (180 beds) and a central hospital (380 beds). Leaders from the general directorate of health affairs in a Saudi region (Infection control department and pharmaceutical care department) and Saudi MOH (general department of infection control and general department of pharmaceutical care) were targeted.

4.2.6 Sampling and recruitment of participants

Purposive sampling was the method of sampling for this study, which involved recruiting participants who have knowledge that is valuable to the research process (Involved in ASPs and antimicrobial therapy). Participants were ID physicians, hospital pharmacists, clinical microbiologists, infection control practitioners (Specialists/consultants and nurses) and hospital managers (Chief Executive Officers (CEOs) and Medical directors). These were chosen because they represent the team members of the ASP, play a significant role in the adoption and implementation of these programmes, and their combined efforts can improve infection control and reduce antimicrobial resistance (Waters, 2015). Also, healthcare professionals dealing with antibiotics (physicians and nurses) and policy makers at both regional and national levels (infection control departments and pharmaceutical care departments) were targeted in order to capture different viewpoints on antibiotics use and the current policy initiatives in Saudi Arabia. Invitation letters (Appendix three) were sent to the targeted participants, through the head of each department, to introduce the study, obtain approval, and to schedule the interview.

4.2.7 Data collection

Interviews were conducted face-to-face in participants main language (Arabic or English) and audio recorded (using Sony ICD-PX333 recorder) for later transcription. Notes were taken during the interviews for non-verbal responses such as looking sad, smiling, feeling angry, etc. Interviews were conducted in a quiet area (pharmacy

meeting room) to avoid any interruptions. Consent forms (Appendix four) were obtained from each participant. The interviews were conducted between January 2017 and February 2017. The recruitment of participants continued until no more new themes emerged in the final three interviews. Reflexivity was considered during the interviews and analysis, so the researcher's views and opinion do not influence the participants responses.

4.2.8 Data analysis

The interviewer used a recorder to audio record all of the interviews for later verbatim transcription and analysis. Transcripts were generated into Microsoft Word 2016 for each of the recorded interviews and labelled with a unique code for each participant. Themes and issues raised during the interviews were utilised to produce the codes, which were then organised into a framework that formed the basis of the primary coding structure. Interviews that were conducted in Arabic (15 out of 22) were analysed and coded first, then, themes, subthemes and quotes from participants were translated to English. Two independent researchers mapped and interpreted interviews data to capture the emerging themes and avoid any bias that could influence the analysis process. A third researcher screened a random sample (20% of the interviews) to check the reliability of the coding. Any discrepancies were resolved through discussion between the three researchers. A framework analysis using five sequential components was undertaken for each interview (Braun & Clarke, 2006). The five components of the analytical methodology are:

I) Familiarisation with the collected data.
II) Developing a thematic framework from the interviews and the themes emerging from the data (through the identification of main topics and subtopics).
III) Indexing (coding the data) into themes.
IV) Charting by rearranging indexed data according to the thematic framework.
V) Mapping and interpreting data.

A framework representing the major phases in ASP processes and related categories of determinants (Figure 3.6), was developed based on the determinants of innovation within the healthcare organisations model (Fleuren et al., 2014, 2004) informing the analysis. The conceptual framework was also used to develop the interview schedule.

Themes and subthemes raised during the interviews and did not fit into this framework were incorporated and added to the framework, so no emerging themes and subthemes to be missed. Researchers looked for evidence of themes related to:

1) Characteristics of the socio-political context, such as; legislation, regulations, patient cooperation, patient awareness benefits, financial burden on patient and patient discomfort.

2) Characteristics of the healthcare facility, such as; decision-making process, reinforcement management, relationship with other organisations, collaboration between departments, staff turnover, staff capacity, available expertise, financial resources, administrative support, time available, opinion leader, feedback to user about innovation, material resources, and coordinator.

3) Characteristics of the healthcare workers, such as; social support colleagues, social support supervisors, self-efficacy, knowledge, skills, work-related stress, ethics problems, outcome expectations, ownership, expects patient cooperation, expects patient satisfaction.

4) Characteristics of the ASP, such as; complexity, advantages, clear procedures, compatibility, trialability, relevance for patient, risks for patient, frequency in the use, perceived prevalence of health problem.

4.2.9 Trustworthiness of interview transcript

The following tests were used to ensure reliability (Bowling, 2009; Smith, 2002):
Inter-rater: two raters coded the transcribed interviews and the results were compared to measure the extent to which they agree. A third researcher screened a random 20% sample to check the reliability of the coding. Any discrepancies were resolved through discussion between the three researchers. Further reliability was ensured through verification of the transcribed data with the participants.

4.2.10 Ethical considerations

Official approvals were obtained from the General Directorate of Health Affairs in AlBaha (Appendix five). The researcher obtained written consents (Appendix four) from the participants and provided a participant information sheet explaining the nature of the study and its objectives (Appendix six). All audio recordings were stored in locked drawers and electronic files (password protected) stored on computer to which

only the researcher/supervisors have access. Audio files and electronic/paper files of the interviews' transcripts will be destroyed three years after completion of the writing of thesis.

4.3 Results

All healthcare professionals (22/22) who were approached for recruitment had agreed to participate in this study. Twenty two interviews were conducted with healthcare professionals comprising physicians (n=5; 23%), nurses (n=4; 18%), hospital pharmacists (n=3; 14%), hospital managers (n=2; 9%), infection control practitioners (ICP) (n=2; 9%), ID consultant (n=1; 5%), microbiologists (n=1; 5%), the head of the infection control department in the health directorate office in a Saudi region (n=1; 5%), the head of the pharmaceutical care department in the health directorate office in a Saudi region (n=1; 5%), a consultant clinical microbiologist at the general department of infection control at MOH (n=1; 5%), a clinical pharmacist at the general department of pharmaceutical care at MOH (the editor of the ASP guideline at the Saudi MOH) (n=1; 5%). Approximate length of each interview was around 25 minutes. Table 4.2 and Table 4.3 summarise demographic characteristics of participants and their experience respectively.

Table 4.2: Demographic data of participants

		Number of participants								
		Male	**Female**	**ID Physician**	**Hospital pharmacist**	**Microbiologist**	**CEO/Medical director**	**ICP**	**Physicians**	**Nurses**
Hospital type	**Local**	3	1	NA	0	NA	1	1	1	1
	Regional	2	2	NA	1	0	0	NA	2	1
	Central	5	5	1	2	1	1	1	2	2
	AlBaha health office	2	0	0	1	0	0	1	0	0
	MOH	0	2	0	1	1	0	0	0	0
	Total	12	10	1	5	2	2	3	5	4

Table 4.3: Years of experience of participants

		Number of participants
Years of experience	**2 years and < 5 years**	1
	5 years and < 10 years	8
	10 years	13

Four main themes emerged from the collected data regarding ASPs in Saudi MOH hospitals. They include: 1) adoption/implementation of ASPs in Saudi MOH hospitals, 2) National AMR strategy in Saudi, 3) Barriers to ASPs implementation in Saudi MOH hospitals, and 4) The potential facilitators of ASPs implementation in Saudi MOH hospitals. Each will be discussed as follows.

4.3.1 Adoption/implementation of ASPs in Saudi MOH hospitals

Participants from the three hospitals indicated there were no formal ASPs. However, there was at least an antibiotic policy at the hospitals aimed at controlling use of antimicrobials. This included restriction policy on antibiotics, where antibiotics were grouped into three categories A, B, and C.

- Group A antibiotics (unrestricted antibiotics) were generally available and free for use by all physicians in the hospital.

- Group B antibiotics (restricted antibiotics) were potentially toxic and expensive antimicrobials. They were prescribed by the consultants or their designees (specialist or resident) after informing the consultant and under their responsibility. The consultant should countersign the order of group B antibiotics if the resident or the specialist ordered it. There is no need to complete a justification form in these cases.

- Group C antibiotics (reserved antibiotics) are potentially toxic and expensive antimicrobials. They are reserved for severe sepsis or serious infections caused by multi-drug resistant microorganisms. They are prescribed by the consultant who is required to complete a justification form.

There were guidelines for treatment for certain infections, including central nervous system infection, gastrointestinal infections and respiratory system infections, such as pneumonia. The prescribing guidelines were developed by the Saudi MOH, but were not updated regularly by hospitals. However, some personnel were not aware of hospital antibiotic policy and antibiotics were dispensed without review or restrictions. The following quotes highlight available strategies or policies to control antibiotics use in Saudi MOH hospitals:

"According to our policy we make restriction for the antibiotic A, B, C OK, A anybody can dispense any physician, B specialist, C consultant" (Hospital pharmacist 2)

"We have an antibiotic policy, which contains guidelines of empirical treatment for any disease to its antibiotic" (Hospital pharmacist 1)

4.3.2 National AMR strategy in Saudi Arabia

In response to the WHO call on members to develop and implement comprehensive action plans on AMR, on 19/01/2017 the Saudi MOH launched the national committee to combat AMR. The committee's main responsibility is to make guidelines, policies and programmes to control AMR, and to monitor implementation of these policies or programmes at national level:

"….. has established a national committee represented by all government agencies and non-governmental and civil society." (Consultant clinical microbiologist 2)

The national committee consists of the following:

- The head of the health facilities Infection control department at MOH (the chairman of the committee)
- A member from the health facilities Infection control department at MOH (the rapporteur of the committee)
- A member from the ministry of Environment, Water and Agriculture
- A member from the GCC infection control centre
- A member from the National Centre for diseases prevention and control
- A member from the ministry of National Guard
- A member from the ministry of Culture and information
- A member from King Faisal specialist hospital and research centre
- A member from the ministry of defence, health services department
- A member from Saudi Commission for Health Specialties
- A member from the Saudi Central board for accreditation of healthcare institutions
- A member from the Saudi Society for medical microbiology and infectious diseases
- A member from the Saudi food and drug authority

) A member from the medical cities in Saudi
) A member from the Saudi society for infectious diseases in children
) A member from a medical school in a Saudi university
) A member from the ministry of Interior, health services department
) A member from the Saudi society for sterilization and infection control
) A member from the general department of Laboratories and Blood bank at MOH
) A member from the National Health Laboratory at MOH
) A pharmacist from the general Pharmaceutical care department at MOH
) A member from the Field Epidemiology program at MOH
) A member from the Communication and Relations department at MOH
) A member from the Ministry of Education
) A member from King Abdulaziz City for Science and Technology
) A member from the Health Licenses department at MOH

The committee has 5 subcommittees as highlighted in the following quote:

"….and from this large committee, there are 5 technical subcommittees: awareness committee, the laboratory surveillance, infection control, antibiotic stewardship, and the drug economy and research" (Consultant clinical microbiologist 2)

The national antibiotic stewardship subcommittee monitors the progress of ASPs implementation through regional ASPs committees and hospital ASPs committees.

"…and then there are committees in regions in health affairs directorates" (Clinical pharmacist 5)

The regional antibiotic stewardship committee consists of the following:
) Consultant physician to be the head of the committee
) Pharmacist (the rapporteur of the committee)
) A member of the Infection control department at the region
) A member of the infectious disease department at the region
) A member of the drug information centre at the region
) A member of the IT department at the region
) A member of the Quality department at the region

To review guidelines and strategies and monitor the work at regional level and report to the national committee

Hospitals antibiotic stewardship committees consist of the following:

⟩ A consultant physician to be the head of the committee
⟩ A pharmacist to be the rapporteur of the committee
⟩ A microbiologist
⟩ A member of the Infection control department at the hospital
⟩ A member of the infectious disease department at the hospital
⟩ A member of the IT department at the hospital
⟩ A member of the Quality department at the hospital

To implement guidelines and strategies and monitor the work in the hospital and report to the regional committee

4.3.3 Barriers to ASPs implementation in Saudi MOH hospitals

Data regarding barriers to successful adoption and implementation of ASPs in Saudi MOH hospitals were categorised into three main themes using the innovation within the healthcare organisations model (Fleuren et al., 2014, 2004) described on page 80. Subthemes were developed from the codes.

They included I) characteristics of the socio-political context (Legislation and regulation), II) characteristics of the healthcare organisation (Accountability, administrative support, available expertise, collaboration between staff/departments, financial resources, functional structure, recourses, staff capacity/staff turnover and education and training) and III) characteristics of the healthcare professionals (awareness, knowledge/skills and support from health professionals/responsibility) (Table 4.4). The subtheme "availability of expertise" was the most common subtheme identified by participants (19/22), followed by education and training (17/22) and administrative support (15/22) as seen in Figure 4.1.

Table 4.4: Themes and subthemes regarding barriers to successful adoption and implementation of ASPs in Saudi MOH hospitals

Main themes	Subthemes/ (Number of participants identified each subtheme)
Characteristics of the socio-political context	Legislation and regulation/ (15/22)
Characteristics of the healthcare organisation	Accountability/ (13/22)
	Administrative support/ (15/22)
	Available expertise/ (19/22)
	Collaboration between staff/departments/ (10/22)
	Financial resources/ (5/22)
	Functional structure/ (7/22)

	Recourses (IT)/ (15/22)
	Staff capacity/staff turnover/ (14/22)
	Education and training/ (17/22)
Characteristics of the healthcare professionals	Awareness/ (13/22)
	Knowledge/skills/ (15/22)
	Support from health professionals/responsibility/ (9/22)
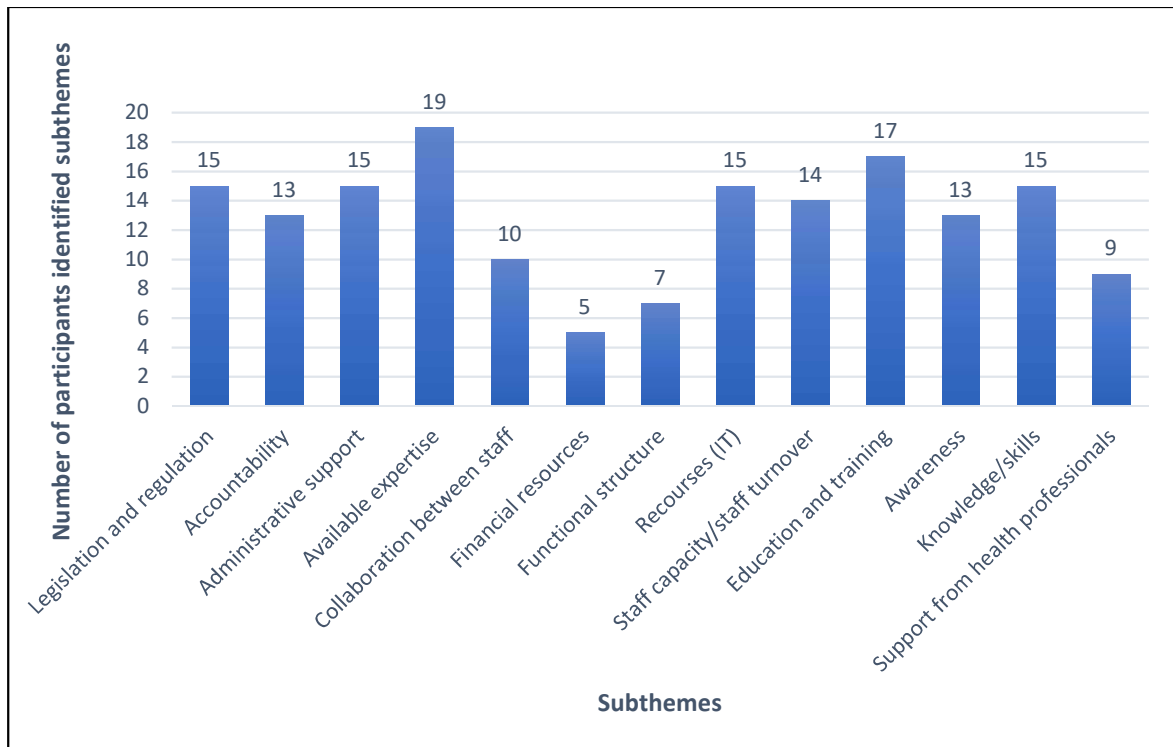
Figure 4.1: Subthemes identified from the interviews regarding barriers to ASPs in Saudi MOH hospitals and the number of participants identified each subtheme

I) Characteristics of the socio-political context

Legislation and regulation

The majority of participants (15/22) highlighted the lack of rule to question staff about their inappropriate practices and there is fear of accusation of negligence as barriers that prevent adoption of ASPs.

"There is no procedure, no procedure, there is no action that we can make… we don't have anything in our hands" (Clinical pharmacist 4)

"We discussed a few times with the administration, but in the end doctors here fear to be accused of negligence" (Infection control consultant 1)

II) Characteristics of the healthcare organisation

Subthemes identified under this theme included; accountability, administrative support, available expertise, collaboration between staff/department, education and training, financial recourses, functional structure, recourses (IT), and staff capacity/staff turnover.

Accountability

Lack of questioning of inappropriate prescribing (13/22), non-compliance with policy (11/22) and lack of feedback or follow up (8/22) were reported as some of the barriers to the adoption of ASPs.

".... there is no accountability, I mean, if you prescribed the patient five antibiotics, no one will ask you why you have prescribed this" (Physician 2)

"No one asks a physician why you have used such kind of combinations relating to antibiotics" (Microbiologist 1)

"There is no follow up or notification if someone broke the policy" (Physician 5)

Administrative support

Most of the participants (15/22) believe that the lack of administrative support and commitment is a major barrier to ASPs, and around half of the participants (12/22) believe this is due to the lack of administrative awareness about the benefits of ASPs and risks of AMR.

"There is lack of motivation, lack of support, ...support of leadership" (Physician 3)

"The administration isn't convinced itself to discuss the programme" (Hospital pharmacist 2)

Available expertise

Lack of professionals required to form antibiotic stewardship team were reported by most of the participants (19/22) as one of the major barriers to the adoption of ASPs. Healthcare professional were required to perform duties they do not have sufficient expertise (5/22) as explained in the following quotes:

"Unfortunately, there is no clinical pharmacist here" (Infectious Diseases Consultant 1)

"…… the infection control in all hospitals, he is not a consultant or specialist in Infection control, he is a surgeon or radiologist and he is told; he is the Infection control doctor, …...and the hospital assigned him to cover this place because the lack of expertise" (Physician 4)

"I think if there is a clinical pharmacist, there is no ID consultant and vice versa" (Clinical pharmacist 3)

Collaboration between staff/departments

Nearly half of the participants (10/22) reported lack of inter-professional and interdepartmental collaboration as barriers to the adoption of ASPs. Some participants (8/22) believed that staff resistance or non-compliance with guidelines are barriers to the adoption of ASPs.

"There is a gap in between the medical administration, the hospital administration and the technical administrations" (Hospital pharmacist 2)

"One patient is getting more than one antibiotic regimen, because doctors are not discussing each other" (Nurse 2)

"They have sometimes resistance to our guideline by asking why we chose a certain kind of medicine not that one they use" (Clinical pharmacist 3)

Education and training

Lack of staff education and training was reported by majority of participants (17/22) as a major barrier to ASPs adoption and implementation. Healthcare professionals reported their unawareness of ASPs due to lack of training in ASPs.

''…. training, even the definition itself, orientation and education on the Stewardship, and people even don't know what is Stewardship" (Consultant clinical microbiologist 2)

"No, nobody from pharmacy, they are not educating" (Nurse 1)

"We don't have educational programmes to explain for us the guidelines of antibiotics, no we do not have the system, it doesn't not exist" (Physician 2)

Financial recourses

Some participants (5/22) reported lack of financial recourses as a barrier for ASPs adoption.

"…. but I think the hospital, the hospital budget or the budget of the ministry of health, are affecting all of us" (Infection control specialist 3)

"…. the big problem that we faced is that there is no budget to print this" (Clinical pharmacist 3)

Functional structure

Absence of the role of pharmacists to perform their duties and review and discuss antibiotic therapy emerged as a barrier to the adoption of ASPs (7/22).

"the role of the pharmacist is not activated, frankly they have no roles"
(Hospitals pharmacist 2)

Resources (Information Technology (IT))

The majority of participants reported the lack of IT (15/22) and miscommunication in hospitals with IT support (5/22) as barriers to successful adoption of ASPs.

"…. but most of hospitals don't have electronics so they can't tell us about their consumption" (Clinical pharmacist 3)

"There is another problem with IT now, if whenever doctors are entering from here, sometimes pharmacy they cannot receive it in their computer" (Nurse 4)

Staff capacity/staff turnover

Inadequate number of staff (14/22) as well as staff turnover (9/22) were found to limit the adoption of ASPs.

"All people are busy and our number is not big, no one in us sees the other unless in the monthly meetings, there is cooperation but we have overload, and the number of staff is little" (Physician 5)

"Persons who are, for example, responsible for the program, they leave suddenly to continue their studies without making endorsement for the new staff, so I start with someone new from the beginning" (Clinical pharmacist 3)

III) Characteristics of the healthcare professional

Subthemes identified under this theme included awareness (of antibiotic resistance and the need to control antibiotic use), knowledge/skills of professionals required for successful adoption of ASPs, and refusal to accept recommendations to change prescribing behaviour.

<u>Awareness</u>

It was reported by several participants (13/22) that the lack of awareness of the problem of antibiotic resistance across different staff is a barrier that will affect the adoption of ASPs.

"… they don't know the danger of antibiotic resistance" (Hospital pharmacist 2)

"There is no awareness related to stewardship program till now" (Microbiologist 1)

"The first thing is that doctors feel that this entire thing is a paper work" (Infection control consultant 2)

<u>Knowledge/skills</u>

Inadequate knowledge of some staff about spectrum of antibiotics, doses and combination were reported by number of participants (15/22) as some of the problems associated with the adoption of ASPs.

"Now I face a problem, I have lack of knowledge, because I have freshly graduated physicians, they have lack of knowledge" (Hospital pharmacist 5)

"…. these doses have problems, and they are following an old regimen" (Hospital pharmacist 2)

<u>Support from health professionals/responsibility</u>

Refusal to accept recommendations and non-compliance with antibiotic policy were also reported (9/22) as some of the barriers to the adoption of ASPs. Healthcare professionals explained their views as follows:

"Some doctors, we cannot tell all, really some are really stubborn." (Nurse 3)

"I have seen that sometime there is very stubborn behaviour of the physicians" (Microbiologist 1)

4.3.4 Facilitators to ASPs implementation in Saudi MOH hospitals

Facilitators of ASPs in Saudi MOH hospitals were also categorised into two main themes using the innovation within healthcare organisations model (Fleuren et al., 2014, 2004). They included I) characteristics of the socio-political context (Legislation and regulation) and II) characteristics of the healthcare organisation (Accountability, administrative support, available expertise, collaboration between staff/departments/organisations, education and training, formal reinforcement by management, recourses, staff capacity and staff turnover) (Table 4.5). The subtheme "availability of expertise" was the most common subtheme identified by participants (19/22), followed by education and training (18/22) and administrative support (15/22) as seen in Figure 4.2.

Table 4.5: Themes and subthemes regarding facilitators to successful adoption and implementation of ASPs in Saudi MOH hospitals

Main themes	Subthemes/ (Number of participants identified the subtheme)
Characteristics of the socio-political context	Legislation and regulation/ (10/22)
Characteristics of the healthcare organisation	Accountability/ (13/22)
	Administrative support/ (15/22)
	Available expertise/ (19/22)
	Collaboration between staff/departments/organisations/ (14/22)
	Education and training/ (18/22)
	Formal reinforcement by management/ (9/22)
	Recourses (IT)/ (15/22)
	Staff capacity/ (11/22)
	Staff turnover/ (9/22)
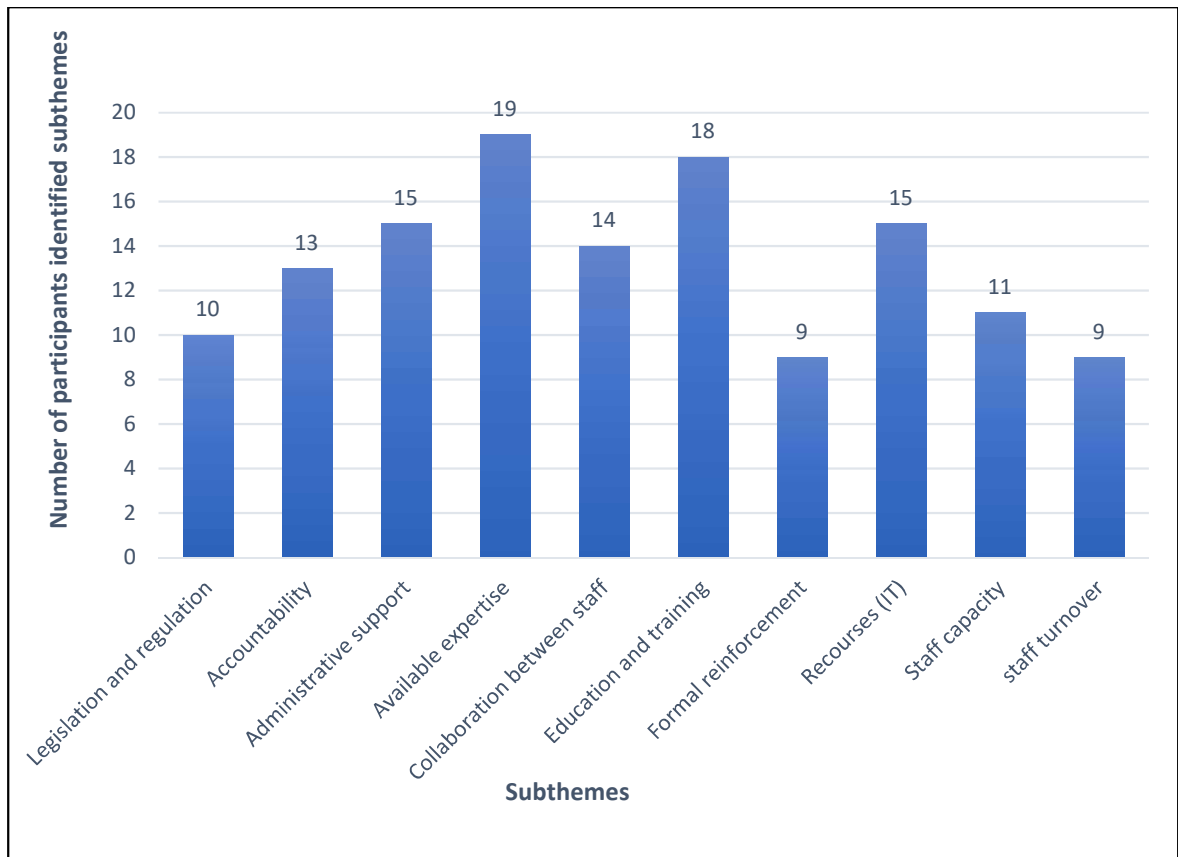
Figure 4.2: Subthemes identified from the interviews regarding facilitators to ASPs in Saudi MOH hospitals and the number of participants identified each subtheme

I.   Characteristics of the socio-political context

Legislation and regulation

To successfully adopt ASPs in Saudi MOH hospitals, around half of the participants (10/22) sited making ASPs a prerequisite for accreditation as a facilitator as shown in the quote below:

"According to the third Edition of CBAHI standards, they are obligating them to use the stewardship" (Medical director 2)

"They (ASPs) are to be within the standers of accreditations. …..., and to be obligatory" (Hospital pharmacist 2)

II.   Characteristics of the healthcare organisation

Subthemes identified under this theme included; accountability, administrative support, available expertise, collaboration between staff/department/organisations, education and training, formal reinforcement by management, opinion leader, recourses (IT), staff capacity and staff turnover.

Accountability

Participants in the interview (13/22) reported that a policy of interrogating and holding people accountable for their prescribing behaviour will facilitate the adoption of ASPs.

"You need to follow up people not applying policies, and ask them why not to apply it?" (Physician 1)

"There should be a procedure which is called warning" (Hospital pharmacist 4)

Administrative support

The commitment and support of hospital administration was highlighted by number of participants (15/22) as a facilitator for ASPs adoption as emphasised in the quotes below:

"They are to be involved in the program and its implementation…. I mean we need support from the administration" (Hospital pharmacist 5)

"The administration can play a very good role. Like to have a regular follow-up, …... administration should be playing a regular role in infection control committee meetings" (Microbiologist 2)

"I mean the administration should take the matter formally, the administration is essential in this topic" (Physician 1)

Available expertise

To successfully adopt ASPs, a major facilitator that was reported by almost all study participants (19/22) was the availability of the key experts required for the implementation of the programme including ID specialists, clinical pharmacists, infection control specialists and microbiologists.

"I think if they will assign clinical pharmacists, they will recruit more infectious disease staff and to have qualified infection control practitioners. I think it will be fully implemented" (Medical Director 1)

"We want a specialist in infection control or studied infection control or ID consultant" (Physician 4)

Collaboration between staff/departments/organisations

Teamwork and multilayer collaboration, involving different professional groups (pharmacists, physicians, infection control staff, microbiologists, nurses) within hospitals; between hospitals that have ASPs and those that do not have; and different stakeholders (MOH, Ministry of Agriculture) were highlighted as facilitators for ASPs adoption and implementation by majority of participants (14/22).

"Sending consultants who have been here for a long time to peripheral hospitals, they stay there for a month, or two or three weeks at least and he will work with them to teach them" (Infection control practitioner 3)

"First of all, there should be some combined meetings, some combined platform for all the physicians, nurses, technicians, pharmacists and like, these should all be held at a single platform" (Microbiologist 2)

Education and training

The majority of participants (18/22) reported staff education and training regarding ASPs and hospital policies as a facilitator to successful ASPs adoption.

"there will be a workshop before we start, targeting all medical and nursing staff, workshops to be held for a whole week or two containing the same content, till we get the whole targeted staff" (Hospital pharmacist 2)

"To increase education because the education is considered the main thing" (Clinical pharmacist 3)

"there should be regular workshops, there should be some compulsion for such workshops that should be arranged and everyone should be attending those workshops" (Microbiologist 2)

Formal reinforcement by management

Participants (9/22) reported that making ASPs a formal directive of the MOH, empowering individual's hospital infection control committees (6/22) will facilitate the adoption of ASPs. This is emphasized in the quote below:

".... but if its implemented through the ministry, sure everybody will follow" (Nurse 2)

"The infection control committee should be empowered" (Microbiologist 1)

Opinion leader

The need for opinion leader or champion who preferably should be a native was identified as a facilitator for ASPs by some participants (4/22).
"You need a clever leader so he tries to unify different staff backgrounds, I mean, he should be Saudi and encourage them to follow what he feels and he believes that it will be for the benefit to the whole institution" (Physician 3)

Resources (IT)

To implement ASPs, IT support and efficient communication system was identified as a facilitator by several participants (15/22).

"We need a good IT system and good internal communication system between the concerned departments, the ID, the pharmacy and ward"
(Infection control consultant 2)

"ASP will not happen if you don't have a good IT system" (Physician 2)

Staff capacity

Adequate number of staff (clinical/ hospital pharmacists, infectious diseases physicians, microbiologists, nurses, infection control practitioners) required for ASPs was highlighted as a facilitator of ASPs by number of participants (11/22).

"We need additional number for the follow up" (Physician 5)

"We need to increase the number of Infectious disease, the staff of Infectious disease, because we have only one doctor" (Physician 4)

Staff turnover

It was reported by number of participants (9/22) that a period of stability for staff appointed to stewardship role is a factor that would ensure implementation and continuation of ASPs.

"We want a specialist in infection control or studied infection control or ID consultant, and it is preferred that he remains in his position for a long period"
(Physician 3)

"We need a kind of stability, because this changing every month or two, there is a new one, we need stability" (Physician 1)

4.4 Discussion

The objectives of this qualitative study were to explore the adoption and implementation of ASPs in Saudi MOH hospitals as well as identify the barriers and facilitators to ASPs adoption and implementation in Saudi MOH hospitals.

To my knowledge this is the first qualitative study regarding adoption, implementation, barriers and facilitators of ASPs in Saudi MOH hospitals.

In recent years, there have been calls from international and national organisations (Public Health England, 2015b; The White House, 2014, 2015; United Kingdom Department of Health, 2013; World Health Organisation, 2015a) to implement ASPs in order to slow the development of AMR. Findings of this study showed that there were no formal ASPs committees or programmes in the participating hospitals. There were however prescribing guidelines and policies (reserved and restricted antibiotic lists) aimed at promoting judicious use of antibiotics in the participating hospitals. Interestingly, the guidelines reported were developed by Saudi MOH with some of the healthcare staff being unaware of their existence.

High prevalence of resistant bacteria has been reported in Saudi Arabia (AlJohani et al., 2010; Areeshi et al., 2014; Balkhy et al., 2012; El-Saed et al., 2013; Saber Yezli et al., 2015). AMR therefore poses serious health threat in Saudi Arabia. The threat is particularly compounded by over 10 million pilgrims' visits to the cities of Makkah and Madinah with increased risk of transmission of AMR bacteria (Azeem et al., 2014; Balkhy et al., 2016; Kapiszewski, 2006; H. M. Zowawi et al., 2013). As a consequence of this threat, and in line with WHO call for national action plans against AMR, the Saudi MOH has recently launched a national committee to combat antibiotic resistance. The committee's responsibility includes among others monitoring implementation of programmes to control antibiotic resistance. The committee recommends establishment of hospital antibiotic stewardship committees. Composition of hospital stewardship committees, as described in previous guidelines (Barlam et al., 2016; Centers for Disease Control and Prevention, 2014; Dellit et al., 2007; Public Health England, 2015b) include consultant physician, pharmacist, microbiologist, infection control expert, IT expert, and a member of the quality department.

While the launching of a national antibiotic resistance strategy by the Saudi MOH is a laudable step towards combating AMR, a number of barriers were

identified in this study which would potentially prevent adoption and successful implementation of ASPs in Saudi MOH hospitals. Also, a number of factors were identified that would facilitate successful ASPs implementation. A framework of the determinants of innovations within healthcare organisations (Fleuren et al., 2014, 2004) was used to classify these barriers and facilitators. The facilitators were a reverse of the barriers, and are therefore discussed as corrective measures. The barriers to adoption and implementation included characteristics of the socio-political context, characteristics of the healthcare organisation, and characteristics of the healthcare professionals.

A key socio-political characteristic that would prevent adoption and implementation of ASPs was the lack of legislation and regulation. In countries with successful ASPs, especially the UK, the USA and France, implementation of programmes or action plans directed at reducing AMR is now a requirement for registration of healthcare providers (French Ministry of Health, 2011; Public Health England, 2015b; Trivedi & Rosenberg, 2013). In the state of California, for example, it is a legal requirement that all general acute care hospitals develop programmes for evaluating judicious use of antibiotics and monitor results using appropriate quality improvement committees (Trivedi & Rosenberg, 2013). The law therefore requires hospital managers to establish active ASPs. Successful adoption and implementation of ASPs in Saudi MOH hospitals will require some form of legislation. As noted by study participants, making ASP obligatory and a prerequisite for accreditation of hospitals will facilitate ASPs.

Among the factors relating to the healthcare organisations that would prevent successful adoption of ASPs were lack of accountability, lack of administrative support, lack of expertise, lack of collaboration between staff/department, lack of education and training, lack of IT resources and rapid staff turnover. These barriers have been reported in previous studies (Cotta et al., 2015; James et al., 2013; Johannsson et al., 2011; Pakyz et al., 2014). In a study conducted in one of the GCC countries (Qatar) to identify antimicrobial stewardship activities, pharmacist involvement and perceived barriers, the authors reported the prominent barrier to implementation and expansion of ASPs was non-

availability of infectious disease specialists as well as lack of training of pharmacists and other healthcare professionals (Pawluk et al., 2015).

Successful adoption of ASPs will therefore require setting up a system that ensures individuals are held accountable for their prescribing behaviour and/or refusal to follow hospital prescribing guidelines. Successful implementation of ASPs relies on adequate support of hospital administration. As a result, the first published antibiotic stewardship guidelines, the IDSA/SHEA guidelines (Dellit et al., 2007) recommend including a hospital administrator in the antibiotic stewardship team. As noted by study participants in this study, administrative involvement is required from planning and implementation of the programme, and subsequent follow up to ensure its success. Part of role of hospital administrators in ASPs include provision of funds for recruitment of experts (clinical pharmacists, Infectious disease physicians), and other resources (such as, IT) required for successful implementation of ASP (Dellit et al., 2007). Individual MOH hospital administration therefore has critical roles to play if ASPs are to be implemented.

One of the supplementary strategies of ASPs is education and training (Centers for Disease Control and Prevention, 2014; Dellit et al., 2007). To successfully adopt and implement ASPs in Saudi MOH hospitals, there is a need for education and training programmes to create awareness among healthcare professionals, nurses and other healthcare workers. As noted by study participants, a before-training workshop with an element of compulsion is required prior to start of the programme. Also, hospitals with established programmes can act as preceptors and provide training for those that intend to start ASP. Furthermore, a system that ensures consistency and stability of staff on stewardship role should be in place. This will not only facilitate implementation of the programme, but also ensure its continuity.

Barriers to adoption and implementation of ASPs also related the healthcare professionals themselves, particularly noncompliance with antibiotic policies where such policies are available. Successful adoption of ASPs will therefore require joint meetings of professionals involved in ASPs. This will enhance

professional relationship and collaboration. There is also a need for an opinion leader or physician champion in individual hospital whose main role should be 'selling' the concept of antibiotic stewardship to team members and other healthcare professionals. Previous qualitative studies have identified inter-professional engagement and physician champion as facilitators of successful ASPs implementation (Cotta et al., 2015; Pakyz et al., 2014).

4.4.2 Implications for practice

Identifying barriers and required facilitators to adopt and implement ASPs in Saudi MOH hospitals will facilitate the implementation of the national ASP policy developed by the Saudi MOH. It will give an insight on how adoption and implementation barriers can be overcome, in order to adopt and implement the national ASP policy easily and successfully, and improve antimicrobial practice, reduce antimicrobial resistance and improve patients care.

For successful ASPs adoption and implementation in Saudi MOH hospitals, ASPs implementation should be made obligatory for hospitals to get national accreditation, hospitals leadership should provide enough support and resources and ensure enforcement of guidelines, ensure the availability of experts and adequate number of staff including ID consultants, clinical pharmacists and microbiologists to implement and monitor the work, ensure collaboration between staff, departments and organisations to discuss and share ideas and experiences and improve the practice, provide educational and training programmes for staff to increase their knowledge, skills and awareness regarding ASPs and appropriate antimicrobial use, and provide IT support and efficient communication system to facilitate daily tasks of the programme. The role of pharmacists and microbiologists should not be underestimated in antimicrobial therapy. Therefore, they should be involved in the process of antimicrobial therapy and provide recommendations on appropriateness of antimicrobial therapy to prescribers and nurses.

4.5 Conclusion

The objective of this qualitative study was to explore the implementation, barriers and facilitators of ASPs in Saudi MOH hospitals. No formal ASPs

existed in the participating hospitals and an antibiotic policy was available in some hospitals as an effort to control the use of antibiotics although awareness regarding this policy was low. The availability of administrative support, competent personnel, educational programmes, effective inter-professional collaboration & communication and information technology are key to the successful implementation of ASPs. High authorities should make an action in implementing national guidelines for antimicrobial use and resistance surveillance, and make ASPs a regulatory requirement in Saudi hospitals.

This chapter explored implementation, barriers and facilitators of ASPs in three Saudi MOH hospitals only, however the situation is unknown in other Saudi MOH hospitals. Therefore, a quantitative study was carried out in the next chapter in order to investigate the level of ASPs implementation and the barriers and facilitators for their successful implementation at national level.

Chapter 5: The Current Status of ASPs in Saudi MOH hospitals: A National Survey

5.1 Introduction

In Chapter four, semi-structured interviews were conducted with healthcare professionals in three Saudi MOH hospitals as well as with professionals in a Saudi region health directorate office and at the Saudi MOH to explore the adoption and implementation of ASPs, and factors influencing the adoption and implementation of ASPs in Saudi MOH hospitals. The findings of the qualitative study (chapter four) informed the development of this national survey to establish the status of ASPs at national level.

5.1.1 Objective

This study aims to investigate the level of implementation and factors influencing the adoption and implementation of ASPs in Saudi MOH hospitals at national level.

5.1.2 Research questions

1. What is the level of ASPs implementation and availability of core members of ASPs in Saudi MOH hospitals?

2. What are the factors (barriers and facilitators) influencing the adoption and implementation of ASPs in Saudi MOH hospitals?

3. To what extend does the hospital type influence the adoption and implementation of ASPs in Saudi MOH hospitals?

4. What are the perspectives of clinical pharmacists, hospital pharmacists, pharmacy directors, infection control specialists/consultants, infection control nurses, infectious diseases specialists/consultants and microbiologists regarding factors influencing the adoption and implementation of ASPs in Saudi MOH hospitals?

5.2 Methods

5.2.1 Design

To achieve the objective of this study, a cross-sectional self-administered survey was carried out.

5.2.2 Development and source of the national survey

The national survey (Appendix seven) was developed from the qualitative study (chapter four) and following a comprehensive review of the literature and discussion among the researcher and supervisory team. The survey has two main sections, which primarily consist of closed-ended questions. Firstly, is a section on background information (14 questions), such as location of hospital, number of beds, hospital type and position of healthcare professional. Secondly, Likert-type statements on factors influencing the adoption and implementation of ASPs to address: intention to adopt and implement ASPs in Saudi MOH hospitals (three items), legislation and regulations regarding the adoption and implementation of ASPs in Saudi MOH hospitals (four items), characteristics of hospitals (nine items) and characteristics of ASPs (twelve items).

The national survey consists of four main domains, where three domains were informed from the findings of the qualitative interviews (chapter four) and were in line with the conceptual framework including; intention to adopt and implement ASPs in hospitals, legislation and regulations regarding the adoption and implementation of ASPs in hospitals, and characteristics of hospitals. The fourth domain (characteristics of ASPs) was developed from the conceptual framework (Fleuren et al., 2014, 2004).

The items in each domain were developed from the findings of the qualitative interviews (chapter four), from the conceptual framework as well as from the literature.

Question one was adapted from validated tools (Doron et al., 2013; Howard et al., 2015). Question two was adapted from (Howard et al., 2015). Question three was adapted from (Doron et al., 2013; Enani, 2016; Howard et al., 2015).

Question four was adapted from (Doron et al., 2013; Enani, 2016). Question five was adapted from (Cotta et al., 2014; Doron et al., 2013). Question six was developed by the researchers. Questions seven, eight, nine, 10 and 11 were adapted from (Doron et al., 2013). Question 12 was adapted from (Doron et al., 2013; Enani, 2016; Howard et al., 2015). Question 13 was adapted from (Cotta et al., 2014; Doron et al., 2013). Question 14 was adapted from (Doron et al., 2013; Howard et al., 2015). Questions 15-21 were developed from the findings of the qualitative interviews (chapter four) and from the conceptual framework (Fleuren et al., 2014, 2004). Questions 22-25 were developed from the findings of the qualitative interviews (chapter four) and from the conceptual framework (Fleuren et al., 2014, 2004), and they are in line with the findings of previous studies (Avent et al., 2014; Chen, Khumra, Eaton, & Kong, 2011; Howard et al., 2015; Trivedi & Rosenberg, 2013). Questions 26, 28 and 29 were developed from the findings of the qualitative interviews (chapter four) and from the conceptual framework (Fleuren et al., 2014, 2004), and they are in line with the findings of previous studies (Avent et al., 2014; Chen et al., 2011; Doron et al., 2013; Enani, 2016; Howard et al., 2015; Johannsson et al., 2011; Trivedi & Rosenberg, 2013). Questions 27 and 30 were developed from the findings of the qualitative interviews (chapter four) and from the conceptual framework (Fleuren et al., 2014, 2004), and they are in line with the findings of previous studies (Enani, 2016; Howard et al., 2015). Questions 31-42 were developed from the conceptual frameworks (Fleuren et al., 2014, 2004).

All questions were then reviewed by the researcher and supervisory team and checked by three ASPs pharmacists (two from Saudi and one from UK), and two ID consultants from Saudi.

The survey was developed in English (Appendix seven) and then translated into Arabic (Appendix eight) through a forward and backward translation process. The researcher translated the survey from English to Arabic. Then, two independent researchers, who are bilingual (Arabic/English) speakers, translated back the survey into English. Both Arabic and English versions of the survey were compared. Any discrepancies were resolved through discussion between the three researchers. The questionnaire statements were then

entered into the SurveyMonkey online data collection tool for easier distribution and analysis.

The survey consists of four sub-scales uses a five-point Likert scale ranging across strongly disagree=1, disagree=2, neither disagree nor agree=3, agree= 4 and strongly agree=5. A total of 14 statements (Q1-Q14) examine demographic information, such as location of hospital, number of beds, hospital type and position of healthcare professional. The indications drawn from the direction of scores across the four sub-scales are as follows: whenever the survey scores increase, this means that healthcare professionals have a positive attitude towards the adoption and implementation of ASPs in Saudi MOH hospitals. In contrast, if the scores decrease, this means that the attitude of healthcare professionals towards the adoption and implementation of ASPs is negative and weak.

There are only two negative statement in this survey (item 36 and item 42). The remaining items (26) are all positive. The total number of items in the four sub-scales is 28. The participants required about 15 minutes to complete this survey. Also, two items have been designed to check the reliability of the participants. These are: 'I work in one of the MOH hospitals' and 'I work in Saudi Arabia'.

5.2.3 Pilot study of the instrument
The survey was piloted with a number of participants, including hospital pharmacists, infectious diseases physicians, infection control practitioners and microbiologists, to ensure its validity and practicality. Appropriate changes were made in accordance with participants' feedback to optimise the research tool. The purpose of a pilot study is primarily to assess the degree of validity and reliability of the research instrument. Validity and reliability are vital components of quantitative and qualitative research (L. Cohen, Manion, & Morrison, 2000). In the present study, a pilot study was carried out with 60 healthcare professionals (including 37 pharmacists, 12 infection control nurses/specialists/consultants, seven microbiologists, and four ID

specialists/consultants) from hospitals belonging to the Saudi MOH (four hospitals without ASPs and one hospital with ASP).

The pilot questionnaires were completed by a randomly selected sample. All participants received a participant information sheet and a consent form. The objectives of the pilot study are: 1) to draw on experts to ensure that the content in the instrument is relevant to the aims of the study and research questions; 2) to determine whether the organisation and structure of the instrument accords with the aims of the research and research questions; 3) to ensure that the sampling method selected is suitable; 4) to ensure that the data collected can respond sufficiently to the research questions; 5) to check whether the timing of the instrument is convenient for participants; and 6) to adjust statements and questions that require clarification or are irrelevant.

5.2.4 Validation of the questionnaire

The following steps were taken to ensure validity of the questionnaire (Bowling, 2009; Smith, 2002):

a) Face validity: the questionnaire statements were checked by the researcher and the supervisory team to ensure their relevance; reasonability and that no ambiguity exists.

b) Content validity: three ASP pharmacists (two from Saudi Arabia and one from the UK) and two ID consultants (from Saudi Arabia) checked the content of the questionnaire to ensure that the content of the instrument is logical and easy to understand.

c) Discriminant validity: to guarantee that the survey can distinguish between the participants' scores, which reflect their perspectives on the adoption and implementation of ASPs, discriminatory validity is vital. To test for this validity, the participants' scores from the pilot study are compiled in a list and the upper and bottom ends of the lists are identified. Using a T-test, the scores are compared and mean scores are calculated. The T-test reveals that the survey can effectively distinguish

between the negative and positive views of participants regarding the adoption and implementation of ASPs in Saudi hospitals. The researcher has reviewed the results to identify any significant differences between the healthcare professionals in Saudi MOH hospitals who scored highly (M: 106.23, SD: 2.029, N=30) and those who recorded low scores (M: 79.83, SD: 4.42, N=30) in relation to the questionnaire scores (t = (29.74), p=0.000). The review allows the researcher to categorise participant responses. By conducting a visual inspection of the total low and high survey scores reported by the study participants, a cut-off score can be found (94.69). This score is necessary to identify participants' positive and negative views of ASPs. A high score reflects that the healthcare professionals member has a positive take on ASPs. In contrast, reporting a low score indicates that the healthcare professionals have a negative take on ASPs.

d) Internal Consistency: the correlation test in Table 5.1 shows whether there is a significant correlation between the sub-scales of the survey in relation to each other and the overall score of the survey.

Table 5.1. Pearson correlation between the summations of dimensions and the total score of the survey (N: 60)

Sub-Scales	SS1	SS2	SS3	SS4	Total
Intention to adopt and implement ASPs **(SS1)**	-	.586**	.616**	.404**	.745**
Context of ASPs **(SS2)**	.586**	-	.584**	**.352****	.690**
Role of hospital towards ASPs **(SS3)**	.616**	.584**	-	.676**	.924**
ASPs **(SS4)**	.404**	.352**	.676**	-	**.828****
Total	.745**	.690**	.924**	.828**	-

** Pearson correlation is significant at the 0.01 level (two-tailed).

The results of the analysis of the pilot study reveal that the sub-scales from (1) -(4) have a significant and strong correlation between the dimensions of the survey with each other and with the overall score of the survey between r 0.35 and r=0.82. This shows a strong correlation between the summation of each sub-scale and with total score.

5.2.5 Reliability

The following tests were used to ensure reliability (Bowling, 2009):

split-half method and test-retest. These were administered to a group of participants to ensure the stability of the measure over a period of time. Cronbach's alpha test was used to measure the internal consistency of the instrument.

a) Split-half method: the split-half method divides the total items (28) into two groups, the first group (14 items) is from Q15-Q28, and the second group (14 items) is from Q29-Q42. This method then applies a correlation between summations of both groups of the questionnaire. The results show that there are good correlations between group (a) (M: 42.50, SD: 8.76) and group (b) (M: 50.53, SD: 6.33), where r=0.79, p<0.001, N: 60.

b) Test-retest of the questionnaire: the survey was conducted again after 15 days among the same group (60 participants) who completed the survey in its first application. The results of the Pearson correlation test show there is a significant relationship between the first application (M: 93.03, SD: 13.74) and the second application (M: 93.08, SD: 12.68) of the survey, such that r=0.93, p<0.001, N=60. The results of this test indicate that the survey has good reliability, which makes it suitable for the current study.

c) Cronbach's alpha: reliability: the Cronbach's Alpha method calculates the reliability coefficients of all items within each scale of the survey and the overall score of all items. The results of this test show that Cronbach's alpha coefficient (M: 93.03, SD: 13.74, N of items: 28) is sufficient at a level of 0.81 and the instrument thus provides an acceptable degree of reliability.

Furthermore, responses were received from more than one healthcare professional from the same hospital. Therefore, responses from the same hospital were compared (background information section), to check if the

answers of participants are correlating as a form of triangulation and for further reliability and validity.

5.2.6 Sampling, setting and size of participants

This study utilised the sampling with probability proportional to size sampling method, where the MOH hospitals were divided into groups or strata based on the hospital type (general, psychiatric, obstetrics/gynaecology and paediatrics, convalescence, eye, obstetrics, paediatrics, chest, and rehabilitation). Then the researcher ensured to receive enough responses from each group based on its proportion to the total number of hospitals, to ensure having a representative sample (on-going analysis was carried out during that data collection process and the research targeted the group of hospitals with few responses to receive more response).

All MOH hospitals (274) were contacted targeting CEOs, Clinical pharmacists, hospital pharmacists, infection control practitioners, ID physicians, medical directors, microbiologists and pharmacy directors as they are the main members of ASPs. CEOs and medical directors were required to respond to the background questions (14 questions) only due to their time limitation. The researcher also ensured to receive responses from all different healthcare workers to have a representative sample, as on-going analysis was carried out during that data collection process and the research targeted the group of healthcare workers with few responses to receive more response.

Based on the total number of MOH hospitals in Saudi Arabia, 274 hospitals (Saudi Ministry of Health, 2017a), sample size of 161 hospitals were required (margin of error: 5%, confidence level: 95% and 50% response distribution). The sample size was calculated using online SurveyMonkey® sample size calculator.

5.2.7 Distribution methods

Invitation letters (appendix nine) were sent through internal E-mails to the targeted participants in all the 274 MOH hospitals through the General Directorate for Research and Studies at the Saudi MOH (targeting CEOs and

medical directors), the general department of pharmaceutical care at the Saudi MOH (targeting Clinical pharmacists, hospitals pharmacists and pharmacy directors) and the general department of health facilities infection control at the Saudi MOH (targeting infection control practitioners, ID physicians and microbiologists). These letters introduced the study, and provided an online link for the survey to be completed. Also, social media platforms were used to distribute the survey to all Saudi MOH hospitals in order to increase response rates. These included official WhatsApp numbers and the official Twitter accounts of health regions offices and hospitals. Also, official E-mail accounts of health regions offices and hospitals and phone calls were used.

5.2.8 Data collection and reminders

Responses were mapped to the list of all MOH hospitals in Saudi to identify the responded hospitals (on-going analysis was carried out during that data collection process and the research targeted the group of hospitals with few responses to receive more response). So, the background questions (Q1, Q2, Q3 and Q4) were used to identify the responded hospitals, which was mapped to the list of all MOH hospitals to identify non-responded hospitals and response rate. More than one response (multiple questionnaires) were received from some participants working in the same hospital, all were included and analysed. Reminders were sent to non-respondent hospitals at two weekly intervals. Reminders were sent through internal E-mails and through the channels described above. Data collection started from May 2017 to August 2017.

5.2.9 Data analysis

Data were extracted from the SurveyMonkey online data collection tool and uploaded to the SPSS database (Version 23; SPSS Inc., NY, USA). Descriptive analysis was conducted to answer the research questions by using frequencies, percentages, mean and standard deviation. The minimum significance level that is considered in this part of the study is 0.05, thereby aiding in the determination of whether the similarities or differences between variables was statistically significant. In addition to the descriptive analysis, based on the distribution and nature of the data and as the data is normally distributed

(Kolmogorov-Smirnov= 0.056, p= 0.2, and Shapiro-Wilk= 0.989, p= 0.154), One-Way ANOVA analysis was used to explore the differences between perspectives on the adoption and implementation of ASPs (dependant variable) with the staff position and hospital type (independent variables). Moreover, logistic regression analysis was applied to identify the significant factors influencing the adoption of ASPs in hospitals, it was used to investigate the significance of each factor (dependent variables) on the adoption of ASPs in Saudi MOH hospitals. A T-test and correlations were used to examine the validity and reliability of analysis.

5.2.10 Ethical considerations

Official permissions were obtained from the Saudi MOH (Appendix 10). The researcher obtained online consents from the participants and provided an online information sheet explaining the nature of the study and its objectives.

5.3 Results

5.3.1 Demographics of respondents

Of the 274 Saudi MOH hospitals, 147 hospitals (response rate 53.6%) responded to the survey through 234 responses from different healthcare professionals. Of the 234 surveys returned, 20 were excluded as they were incomplete. A number of questionnaires were received from more than one respondent in the same hospital. A total of 214 responses (including CEOs and medical directors) were analysed for the background information of participating hospitals and a total of 191 responses (excluding CEOs and medical directors) were analysed to examine the factors influencing ASPs adoption and implementation in Saudi MOH hospitals. Responses were mainly from hospital pharmacists 33% (70/214) and pharmacy directors 26% (56/214) as seen in Table 5.2. The low number of responses from ID physicians is due to the shortage of ID physicians in Saudi (there are only 57 ID physicians in all Saudi MOH hospitals (274 hospitals)) (Saudi Ministry of Health, 2017a).

Table 5.2: Responses by profession

Profession	Number of responses
CEOs	15 (7%)
Clinical pharmacist	20 (9%)
Hospital pharmacist	70 (33%)
Infection control nurse	12 (5%)
Infection control specialist/consultant	8 (4%)
ID specialist/consultant	17 (8%)
Medical director	8 (4%)
Microbiologist	8 (4%)
Pharmacy director	56 (26%)
Total	**214 (100%)**

In terms of responses based on hospital type, 88% (129/147) of the responses were from general hospitals as they represent 79.5% (218/274) of total MOH hospitals as seen in Table 5.3.

Table 5.3: Responses by hospital type

Hospital type	Total number	Number of responded hospitals
General	218(79.5%)	129 (88%)
Psychiatric	18 (6.5%)	5 (3%)
Obstetrics/Gynaecology and paediatrics	16 (6%)	9 (6%)
Convalescence	7 (2.5%)	1 (0.7%)
Eye	4 (1.4%)	1 (0.7%)
Obstetrics/Gynaecology	3 (1%)	0
Paediatrics	3 (1%)	0
Chest	3 (1%)	0
Rehabilitation	2 (0.7%)	2 (1.5%)
Total	**274 (100%)**	**147**

Fourteen per cent (21/147) of responses were received from Riyadh, 10% (15/147) were from Madinah, 9% (13/147) were from Aseer, 8% (12/147) were from Eastern region and 8% (12/147) were from Qasim. A summary of responses based on each Saudi region can be seen in Table 5.4.

Table 5.4: Responses by region

Region	Number of MOH hospitals	Number of responded hospitals
Al-Hasa	11	2 (1.3)
Al-Jouf	9	4 (3%)
Al-Qunfudah	5	1 (0.7%)
Al-Qurayyat	5	2 (1.3%)

Aseer	20	13 (9%)
Baha	10	5 (3.5%)
Bishah	7	4 (3%)
Eastern region	19	12 (8%)
Hafar Al-batin	7	5 (3.5%)
Hail	12	3 (2%)
Jeddah	13	10 (7%)
Jizan	21	6 (4%)
Madinah	19	15 (10%)
Makkah	9	5 (3.5%)
Najran	12	9 (6%)
Northern border	9	7 (5%)
Qasim	20	12 (8%)
Riyadh	42	21 (14%)
Tabouk	11	8 (5%)
Taif	13	3 (2%)
Total	**274 (100%)**	**147**

5.3.2 Level of ASPs implementation and availability of core members of ASPs in Saudi MOH hospitals

Only 26% (39/147) of the hospitals reported the availability of ASPs within their hospitals (33 general hospitals, 5 Obstetrics/Gynaecology and paediatrics hospitals and 1 Rehabilitation hospital), with Only 31% (46/147) of the hospitals having ID specialists/ consultants and 33% (48/147) employing antimicrobial pharmacists, and 53% (78/147) of hospitals having microbiologists. However, infection control practitioners were available in 96% (141/147) of the hospitals.

5.3.3 Factors (barriers and facilitators) influencing the adoption and implementation of ASPs in Saudi MOH hospitals

To answer this research question, it was necessary to examine the perspectives of healthcare professionals regarding the adoption and implementation of ASPs in Saudi MOH hospitals. This study seeks to investigate the barriers and facilitators that may influence hospitals to adopt and implement ASPs to promote appropriate use of antimicrobials. This part of the questionnaire examined the adoption and implementation of ASPs in Saudi MOH hospitals in relation to four dimensions using the innovation within the healthcare organisations model (Fleuren et al., 2014, 2004): a) intention to adopt and implement ASPs; b) legislation and regulations to adopt and

implement ASPs; c) characteristics of hospitals; and d) characteristics of ASPs (tables 5.5-5.8).

a) Intention to adopt and implement ASPs

Table 5.5: Intention to adopt and implement ASPs (N = 191)

Statement	Relative Frequency Distribution					Mean	Standard Deviation
	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly Disagree %		
Q15/This hospital intends to adopt and implement ASP	**45.5**	36.1	14.7	2.6	1.0	4.23	.869
Q16/This hospital intends to follow ASP guidelines regularly in the future	**41.9**	38.2	15.2	3.1	1.6	4.16	.904
Q17/This hospital would highly recommend the adoption and implementation of ASPs in other hospitals	31.9	**40.8**	17.8	7.9	1.6	3.94	.977

Findings from this part demonstrate that 81% of healthcare professionals held positive views regarding the intention of hospitals to adopt and implement ASPs in Saudi MOH hospitals. Also, 80% of these healthcare professionals believe that their hospitals have the intention to follow ASP guidelines on a regular basis. Similarly, 72.7% state that their hospitals strongly recommend the adoption and implementation of ASPs. Therefore, it seems that all the healthcare professionals held positive views regarding the intention of ASPs implementation and had faith in their hospitals in terms of the adoption and implementation of ASPs.

b) Legislation and regulations to adopt and implement ASPs

Table 5.6: Legislation and regulations to adopt and implement ASPs (N = 191)

Statement	Relative Frequency Distribution					Mean	Standard Deviation
	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly Disagree %		
Q18/Many of our patients would expect this hospital to adopt and implement ASP.	10.5	**46.6**	24.6	12.0	6.3	3.43	1.038

Q19/The legislative regulation pledges this hospital to adopt and implement ASP.	0.5	7.9	18.3	**52.9**	20.4	2.15	.854
Q20/The compliance with the legislative regulations regarding ASP is enforced strictly.	0.0	2.6	14.1	**61.8**	21.5	1.98	.680
Q21/Our patients would consider us to be forward thinking by adopting and implementing ASP.	20.4	**44.0**	23.0	7.9	4.7	3.68	1.036

Findings from this part demonstrate that 57.1% of healthcare professionals believed that their patients expect hospitals to adopt and implement ASPs, and 64.4% thought that their patients had a serious desire to see the adoption and implementation of ASPs. However, 73.3% of healthcare professionals displayed strong negative attitudes towards the fact that their hospitals have not been pledged by legislative regulations to adopt and implement ASPs. Similarly, 83% of the healthcare professionals surveyed reported that compliance with the legislative regulations regarding ASPs is not enforced strictly in Saudi MOH hospitals.

c) characteristics of hospitals

Table 5.7: Characteristics of hospitals (N = 191)

Statement	Relative Frequency Distribution					Mean	Standard Deviation
	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly Disagree %		
22/Senior management would provide resources necessary for the adoption and implementation of ASP in this hospital.	16.8	**41.9**	26.2	11.5	3.7	3.57	1.018
23/Senior management would provide necessary support for the adoption and implementation of ASP in this hospital.	15.7	**45.0**	24.6	10.5	4.2	3.58	1.012
24/Senior management would support adherence to ASP in this hospital.	15.7	**51.3**	23.6	6.3	3.1	3.70	.918
25/Senior managers would be enthusiastic about adopting and implementing ASP in this hospital.	18.8	**45.5**	22.0	11.0	2.6	3.67	.990
26/A specific person (or group) is available for assistance with the adoption and implementation of ASP in this hospital.	1.6	5.8	15.7	**53.9**	23.0	2.09	.869
27/We have the knowledge necessary to adopt and implement ASP in this hospital.	0.5	2.1	12.6	**61.3**	23.6	1.95	.701
28/We have the resources necessary (e.g. experts and staff) to adopt and implement ASP in this hospital.	0.5	3.1	14.1	**54.5**	27.7	1.94	.769
29/This hospital has the financial resources to adopt and implement ASP.	8.4	**27.7**	30.9	22.0	11.0	3.01	1.131
30/This hospital has the technological resources to adopt and implement ASP.	0.0	2.1	13.1	**62.8**	22.0	1.95	.659

Findings on the characteristics of hospitals show that 58.7% of healthcare professionals believed that their senior management would provide the required resources to facilitate the adoption and implementation of ASPs in their hospitals; 60.7% of healthcare professionals stated that their senior management would provide the necessary support to adopt and implement ASPs; 67% of healthcare professionals reported that their senior management would support adherence to ASPs in their hospitals; and 64.3% said that their senior managers would be enthusiastic about adopting and implementing ASPs in their hospitals.

However, 76.9% of healthcare professionals strongly believed that there is no specific person or group available to assist and facilitate the adoption and implementation of ASPs in their hospitals; 84.9% reported that they lack the necessary knowledge to adopt and implement ASPs in their hospitals; 82.2% of the healthcare professionals surveyed felt they suffer from a shortage of the necessary resources, such as experts and staff to adopt and implement ASPs; and, similarly, 84.8% of the respondents stated that their hospitals lack the required technological resources to adopt and implement ASPs in their hospitals.

d) Characteristics of ASPs

Table 5.8: Characteristics of ASPs (N = 191)

Statement	Relative Frequency Distribution					Mean	Standard Deviation
	Strongly Agree %	Agree %	Neutral %	Disagree %	Strongly Disagree %		
31/Procedures for adopting and implementing ASP are clear and understandable.	0.5	1.6	15.7	**66.0**	16.2	2.04	.656
32/I believe that it will be easy to adopt and implement ASP in this hospital.	13.1	**43.5**	22.0	16.8	4.7	3.43	1.064
33/Overall, I believe that ASP will be easy to adhere to.	12.0	**49.2**	20.9	16.2	1.6	3.54	.955
34/I believe that it will be easy for staff to follow ASP guidelines.	12.6	**48.2**	18.3	18.3	2.6	3.50	1.015
35/ASPs are adopted in other hospitals in the country.	14.1	**49.7**	31.9	3.7	0.5	3.73	.766
36/ASPs are not very visible in other hospitals.	6.8	**33.0**	51.3	8.9	0.00	2.62	.743

37/Before deciding whether to adopt ASPs, it will be essential to be able to properly try them out.	28.3	**59.2**	8.9	3.1	0.5	4.12	.731
38/It is essential to adopt ASP on a trial basis long enough to see their benefits.	39.3	**47.6**	7.3	4.2	1.6	4.19	.862
39/ASPs will improve antimicrobial use.	**69.6**	26.7	3.7	0.00	0.00	4.66	.547
40/ASPs will reduce antimicrobial resistance.	**70.2**	26.2	3.1	0.5	0.00	4.66	.566
41/ASPs will improve patient safety.	**73.3**	24.1	2.1	0.5	0.00	4.70	.533
42/ASPs will not improve patient care.	1.0	0.5	5.8	34.0	**58.6**	4.49	.724

Findings on the characteristics of ASPs show that 56.6% of the healthcare professionals surveyed believed that the adoption and implementation of ASPs in their hospitals will be easy; 61.2% stated that an ASP is easy to adhere to; 60.8% stated that staff can easily follow ASP guidelines; 63.8% believed that ASPs are adopted in other hospitals in Saudi Arabia; 87.5% agreed that it is essential to properly try out ASPs before adopting them; and 86.9% stated that it is important to adopt ASPs on a trial basis long enough to see their benefits. Similarly, 96.3% of healthcare professionals strongly agreed that ASPs can improve antimicrobial use; 96.4% stated that ASPs can reduce antimicrobial resistance; 97.4% strongly believed that ASPs improve patient safety; and 92.6% agreed that ASPs can improve patient care. However, 82.2% of healthcare professionals strongly believed that the procedures for adopting and implementing ASPs are unclear and difficult to understand; 39.8% found that ASPs are not very visible in other hospitals, and 51.3% are undecided about the visibility of ASPs in other hospitals in Saudi Arabia.

c) Summary

a) The findings in relation to the first-dimension show that most of the healthcare professionals surveyed have a positive perception of the possibilities of Saudi MOH hospitals to adopt and implement ASPs without any difficulties. Also, they believed that their hospital can manage and follow ASP guidelines without significant barriers.

b) Some of the healthcare professionals believed that their patients expect hospitals to be interested in adopting and implementing ASPs to increase their

care and safety. However, others showed that there are huge barriers to the adoption and implementation of ASPs because of lack of high authorities' enforcement to adopt and implement ASPs, and lack of legislative regulations to pledge ASPs in hospitals.

c) There are positive voices among the healthcare professionals in Saudi about the characteristics of their hospitals in the adoption and implementation of ASPs. They believed that their senior management are doing their best to facilitate the development of ASPs in order to increase the benefit of their usage through providing the required resources and support and increasing awareness so that ASPs can form part of their medical system and enhance medical safety and care among healthcare professionals and patients.

In contrast, other healthcare professionals showed their great concern about the characteristics of hospitals in facilitating the adoption and implementation of ASPs in Saudi MOH hospitals. They described some barriers to ASPs such as lack of available experts or groups to assist the process of ASPs adoption and implementation; lack of necessary awareness and knowledge about ASPs; and shortage of experts and specialist staff to take responsibility about following up the progress of ASPs in their hospitals.

d) A good number of the healthcare professionals surveyed showed a positive perspective on the characteristics of ASPs. They believed the adoption and implementation of ASPs is easy; it is simply to follow ASP guidelines; and it is easy for ASPs to be adopted and used widely across Saudi Arabia. In addition, they stated that it is important to pilot ASPs before any implementation in order to see their impact and to be able to convince others about its benefits. Similarly, the healthcare professionals believed that the adoption and implementation of ASPs can effectively reduce antimicrobial resistance and improve antimicrobial use. Similarly, the implementation of ASPs can improve patient safety and patient care.

However, other healthcare professionals criticised the process of ASPs, complaining that procedures for adopting and implementing ASPs are invisible,

unclear and difficult to understand. These issues can act as obvious barriers in the face of any progress of ASPs in Saudi MOH hospitals.

Table 5.9 shows the results of the logistic regression analysis applied to identify the significant factors influencing the adoption of ASPs in Saudi MOH hospitals. The results identified the following factors as significant for the adoption of ASPs in Saudi MOH hospitals including; Patient demand (p= 0.002), Usefulness of the programme (p= 0.002), and trialability of the programme (p= 0.013).

Table 5.9: Results of the logistic regression

Predictor	B Coefficient	Wald Statistic	Significance
TM	1.737	6.996	0.515
PD	0.867**	4.068	**0.002**
SMS	0.973	7.065	0.079
OR	-1.790*	5.935	0.050
EP	3.751**	10.303	0.029
TRI	–2.180**	8.016	**0.013**
UN	1.127**	6.424	**0.002**

TM = Team Members; PD = Patient Demand; SMS = Senior Management Support; OR = Organisation Readiness; EP= External pressure; TRI= Trialability; UN = Usefulness

5.3.4 Influence of the hospital type on the adoption and implementation of ASPs in Saudi MOH hospitals

Several tests were used to strengthen and enrich the answers for the research questions in the current study. One-way ANOVA analysis was used to examine the differences between the level of adoption and implementation of ASPs and the hospital type (general hospitals, general hospitals (referral), medical cities (specialised), obstetrics/gynaecology and paediatrics, obstetrics/gynaecology, paediatrics, eye, psychiatric, chest, convalescence, and rehabilitation). The One-Way ANOVA analysis did reveal that there were no significant differences between the adoption and implementation of ASPs and the type of hospital ($F = (6,184) = 1.20$, $p > 0.05$, $n = 191$). Therefore, it seems that the independent variable (hospital type) has no significant influence on the level of adoption and implementation (dependent variable) of ASPs. This means that hospital type of

MOH hospitals has no impact on the level of adoption and implementation of ASPs in Saudi MOH hospitals.

However, the One-Way ANOVA analysis revealed significant differences between hospital type and the sub-scale 'intention to adopt and implement ASPs', which consisted of the summation of three statements (Q15, Q16 and Q17) ($F = (6,184) = 2.63$, $p < 0.05$, n=191). A significant difference was identified through post-hoc analysis (Scheffe test). Specifically, medical cities (specialised) have a more positive attitude towards the intention to the adoption and implementation of ASPs (M = 14.33, SD = 0.77) compared with psychiatric hospitals (M = 9.50, SD = 1.00). In addition, the results show the ranking of hospitals in terms of their positive attitude towards the intention to adopt and implement ASPs: medical cities (specialised) come in first place (M = 14.33, SD = 0.77); followed by obstetrics/gynaecology and paediatrics (M = 13.10, SD = 2.42); general hospitals (M = 12.22, SD = 2.29); central hospitals (referral) (M = 12.12, SD = 3.29); convalescence (M = 12.00), rehabilitation (M = 11.67, SD = 2.88); and psychiatric (M = 9.50, SD = 1.00).

In general, the hospital type did not have any influence on the adoption and implementation process according to the healthcare professionals surveyed. However, there is one significant difference between hospital type and the sub-scale 'intention to adopt and implement ASPs', showing that ASPs are more favoured by medical cities (specialised) as compared with psychiatrist hospitals. This means that medical care and interest in terms of the intention to adopt and implement ASPs are influence by hospital type and, unfortunately, the healthcare professionals in psychiatrist hospitals are less concerned and interested in ASPs.

5.3.5 Perspectives of healthcare professionals regarding factors influencing the adoption and implementation of ASPs in Saudi MOH hospitals
One-Way ANOVA analysis was used to examine the differences between the level of adoption and implementation of ASPs and staff position (i.e. clinical

pharmacists, hospital pharmacists, pharmacy directors, infection control specialists/consultants, infection control nurses, ID specialists/consultants and microbiologists). The one-way ANOVA analysis reveals that there are no significant differences between the adoption and implementation of ASPs and staff position ($F = (6,184) = 1.71$, $p > 0.05$, $n = 191$). Therefore, it seems that the independent variable (staff position) has no significant influence on the level of adoption and implementation (dependent variable) of ASPs. This means that all healthcare professionals have similar perspectives regarding the adoption and implementation of ASPs in Saudi hospitals.

However, One-Way ANOVA analysis revealed significant differences between staff position and the sub-scale 'intention to adopt and implement ASPs' ($F = (6,184) = 2.79$, $p < 0.05$, $n=191$). The results show the ranking of staff position in terms of their positive attitude towards the intention to adopt and implement ASPs: ID specialist/consultant comes in first place (M = 13.59, SD = 1.77); followed by infection control nurse (M = 13.25 , SD = 2.09); infection control specialist/consultant (M = 13.13 , SD = 4.22); clinical pharmacist (M = 12.75 , SD = 1.62); microbiologist (M = 12.63, SD= 3.11), pharmacy director (M = 12.45 , SD = 2.18); and hospital pharmacist (M = 11.50, SD = 2.53).
Similarly, One-Way ANOVA analysis revealed significant differences between staff position and the sub-scale 'characteristics of hospital' ($F = (6,184) = 2.24$, $p < 0.05$, $n=191$). The results show the ranking of staff position in terms of their positive attitude towards the characteristics of hospitals to adopt and implement ASPs: infection control nurse comes in first place (M = 28.50, SD = 2.24); followed by microbiologist (M = 27.25 , SD = 2.71); infection control specialist/consultant (M = 26.50 , SD = 1.85); hospital pharmacist (M = 25.53, SD = 3.83); clinical pharmacist (M = 25.15, SD= 3.05), ID specialist/consultant (M = 24.76 , SD = 3.36); and pharmacy director (M = 24.61, SD = 4.66).

In general, staff position does not significantly influence the adoption and implementation of ASPs. This may indicate that all the healthcare professionals held similar perspectives on ASPs in Saudi MOH hospitals. However, it seems that infectious diseases specialists/consultants have a greater impact in both

sub-scales: intention to adopt and implement ASPs and the characteristics of hospitals.

5.4 Discussion

The objectives of this quantitative study were to investigate the level of implementation and factors influencing the adoption and implementation of ASPs in Saudi MOH hospitals at national level. To my knowledge this is the first quantitative study regarding the level of implementation and factors influencing the adoption and implementation of ASPs in Saudi MOH hospitals at a national level. This will provide further empirical evidence on ASPs adoption in the region.

Regarding the level of implementation of ASPs in in Saudi MOH hospitals, finding of this study showed that implementation of ASPs was low with only 26% (39/147) of Saudi MOH hospitals reporting the availability of ASPs. While there has been increasing calls on hospitals to implement ASPs (Public Health England, 2015b; The White House, 2014, 2015; United Kingdom Department of Health, 2013; World Health Organisation, 2015a), implementation of these programmes varies between countries. For example, in a national survey of 4184 US hospitals, only 39% (1632/4184) reported having an ASP that met all the CDC core elements for hospital ASPs (Pollack et al., 2016). In a UK-wide survey to describe UK antimicrobial stewardship strategies however, 82% (186/226) of the respondents reported having an antimicrobial management team within their hospital (Tonna, Gould, & Stewart, 2014). Similarly, a cross-sectional survey to evaluate the status of ASPs in Gulf Cooperation Council (GCC) states found out that 62% (29/47) of participating hospitals have ASPs in place (Enani, 2016). Internationally, a cross-sectional survey of 67 countries reported that ASPs existed in 58% (383/660) of the participating hospitals (Howard et al., 2015). These surveys indicate a positive response to the national and international calls (Public Health England, 2015b; The White House, 2014, 2015; World Health Organisation, 2015a) for containment of the threat of AMR through judicious use of available antibiotics. On the other hand, further improvements are still needed in such areas as, legislation and

regulations, education and provision of required resources to increase the rate of ASPs adoption.

The IDSA/SHEA antimicrobial stewardship guidelines were first published in 2007 recommending a multidisciplinary team comprising of an ID physician, a clinical pharmacist with infectious diseases training as core members as well as a clinical microbiologist, an infection control expert, a hospital epidemiologist, and a hospital administrators for an optimal ASP (Dellit et al., 2007). Findings of this study showed that only 31% (46/147), 33% (48/147) and 53% (78/147) of the hospitals had ID specialists/consultants, antimicrobial pharmacists and microbiologists respectively. Currently, there are only 57 ID physicians (Tropical medicine) (25 registrars and 32 consultants) in all Saudi MOH hospitals (274 hospital) (Saudi Ministry of Health, 2017a). In a UK-wide survey, antimicrobial pharmacists were presented in 95% (177/186) of UK hospitals. Inadequate or lack of ID consultants, antimicrobial pharmacists and microbiologists therefore is a major barrier to ASPs adoption in Saudi MOH hospitals.

In this national survey, there was an overall positive attitude towards the adoption and implementation of ASPs among healthcare professionals in the Saudi MOH participating hospitals. Up to 80% of the healthcare professionals agreed they have faith in their hospitals to adopt and implement ASPs, and intend to follow ASPs guidelines. This is particularly important as successful ASPs require cooperation and collaboration of healthcare professionals with the antimicrobial stewardship team and hospital leadership (Pakyz et al., 2014). Around 70% of participants also agreed to the willingness of senior management to provide the necessary support to adopt and implement ASPs in Saudi MOH hospitals. This is of great importance because successful implementation of ASPs depends on strong management support. Consequently, published antimicrobial stewardship guidelines recommend, not only inclusion of a hospital administrator in the stewardship team, but also support for the team by way of provision of required resources (Centers for Disease Control and Prevention, 2014; Dellit et al., 2007; Pollack et al., 2016; Public Health England, 2015b). Like participants in the qualitative study

(chapter four), up to 87% of surveyed participants agreed that ASPs adoption on a trial basis is necessary to observe the benefits of ASPs before full implementation. Even though antimicrobial stewardship interventions have been shown to reduce antibiotic use and cost, reduce AMR, and improve clinical outcomes (Davey et al., 2017), lack of awareness/knowledge among healthcare professionals in Saudi MOH hospitals on the problem of AMR and benefits of ASPs was reported as a barrier to successful ASPs adoption and implementation by 85% of respondents. This means there is need for the Saudi MOH, as part of their AMR strategy to designate hospitals that have required resources to pilot ASPs, and therefore serve as preceptors to other hospitals.

While there were overall positive views on the adoption and implementation of ASPs, like the qualitative study (chapter four), 73% of participants in the survey reported the lack of legislations as a barrier to the implementation of ASPs, 77% reported lack of expertise, 82% reported lack of education and training, and 85% reported lack of IT resources as barriers to the adoption and implementation of ASPs in Saudi MOH hospitals. These findings are in line with previous studies (Avent et al., 2014; Chen et al., 2011; Enani, 2016; Johannsson et al., 2011; Trivedi & Rosenberg, 2013), except the lack of financial resources that was not reported as a major barrier in Saudi MOH hospitals. This can be due to the increasing rates of the budget of the Saudi MOH over the past years, as the budget increased by 100% between 2009 and 2016 (Saudi Ministry of Health, 2017b).

This national survey also sought to determine the extent to which hospital type influences the adoption and implementation of ASPs in Saudi MOH hospitals. Findings show there was no significant difference between the adoption and implementation of ASPs and the type of hospital. This means the type of hospital does not have impact on the adoption and implementation of ASPs. A national survey to describe ASPs in US hospitals concluded that facilities of any size can implement ASPs with hospital leadership support (Pollack et al., 2016). While no difference existed between hospital type and adoption of ASPs, there was significant difference between hospital type and the intention to adopt and implement ASPs. Specifically, medical cities (specialised hospitals) had a more

positive attitude towards the intention to adopt and implement ASPs than other type of hospitals, including general and central hospitals. This can be due to the availability of expertise (ID consultants and pharmacists) in those hospitals who are the core members of ASPs.

Regarding the perspectives of the different stakeholders (clinical pharmacists, hospital pharmacists, pharmacy directors, infection control specialists/consultants, infection control nurses, ID specialists/consultants and microbiologists) towards the adoption and implementation of ASPs in Saudi MOH hospitals, there was no significant difference in their perspectives on the adoption and implementation of ASPs. However, this study revealed significant difference between staff position and their intention to adopt and implement ASPs". The results show infectious diseases specialists/consultants had more positive attitude towards the intention to adopt and implement ASPs followed by infection control nurses, infection control specialists/consultants, clinical pharmacists, and microbiologists. This finding showed the importance of inter-professional collaboration that could assist in implementing ASPs successfully. Resistance or opposition from prescribers and other healthcare professionals have been reported as one of the factors that hinder successful implementation of ASPs (Chen et al., 2011; Doron et al., 2013; Howard et al., 2015; Pakyz et al., 2014).

5.4.2 Implications for practice

In order to implement the national ASP guideline of the Saudi MOH, it is important to identify barriers and facilitators for successful adoption and implementation of ASPs to know how barriers can be overcome and provide recommendations for professionals, hospitals and policy makers to improve antimicrobial practice, reduce antimicrobial resistance and improve patient care.

5.5 Conclusion

The objectives of this national survey were to investigate the level of implementation and factors influencing the adoption and implementation of ASPs in Saudi MOH hospitals at national level. Less than a third of the hospitals reported the availability of ASPs within their hospitals. Legislations and regulations that require/enforce hospitals to implement ASPs, expertise (ID consultants, antimicrobial pharmacists, microbiologists), IT resources and educational programmes are key to successful implementation of ASPs in Saudi MOH hospitals. senior management commitment to provide required resource and support is essential to facilitate and empower the implementation of ASPs.

This quantitative study and the previous qualitative study (chapter four) identified lack of knowledge and awareness of staff regarding the availability of ASPs in other Saudi hospitals and how ASPs can be implemented successfully. Therefore, a case study was carried out in the next chapter in order to explore the adoption and implementation process of an ASP in a Saudi MOH hospital that has an ASP in place and identify how barriers were overcome in order to provide recommendations for hospitals without ASPs to implement ASPs easily and successfully.

Chapter 6: ASP adoption and implementation process in a Saudi MOH hospital: a case study

6.1 Introduction

The alarming rate of antibiotic resistance (Public Health England, 2015a; World Health Organisation, 2014) and the association between antibiotic use and development of resistance (Laxminarayan et al., 2013) have led to calls for action plans and strategies to control antibiotic use in human and animal health. One of the strategies to control increasing antibiotic resistance is ASPs, which are well established especially in the USA (Pollack et al., 2016) and UK (Public Health England, 2015a). Implementation of these programmes has been associated with reduction in inappropriate antibiotic use (K. a. Cairns et al., 2013); reduction in rates of resistant bacteria such as: MRSA and *Clostridium difficile* infections (Aldeyab et al., 2012; Martin et al., 2005; Yam et al., 2012) and reduction in antimicrobials expenditures (Bartlett & Siola, 2014). Implementation of ASPs has also been associated with reduction in length of hospital stay and rate of readmission (Pasquale et al., 2014).

A cross-sectional study that aimed to describe the prevalence of ASPs in GCC states reported existence of ASPs in few hospitals (Enani, 2016). Findings of Chapter four showed that there were no formal ASPs in the three Saudi MOH hospitals that participated in the study, and less than a third of hospitals (39/147) have ASPs (Chapter five). Participants in the study, however, reported that if they receive training from hospitals with established programmes and see how ASPs were adopted and implemented successfully in these hospitals, they would be willing to adopt ASPs in their hospitals. Thus, the objective of this chapter is to explore the adoption and implementation process of an established ASP (initiation, adoption decision, implementation) that can serve as a model or preceptor for Saudi MOH hospitals without ASPs with respect to:

i. Reasons/ initiatives behind ASP adoption and implementation in the medical city

ii. Adoption and implementation phases of the ASP in the medical city

iii.   Characteristics of the ASP (team members, strategies and outcomes) in the medical city

iv.   Facilitators of successful implementation and barriers to smooth running of the ASP in the medical city

6.2 Methods

6.2.1 Design

To achieve the objective of this study, in depth interviews were conducted in a hospital with an established ASP. Also, content analysis of ASP hospital documents was carried out to complement primary data.

6.2.2 Development and source of interview schedule

The interview schedule (Appendix 11) was developed following a review of the literature and discussion among the researcher and supervisory team, as well as consultation with three ASP pharmacists (two from Saudi Arabia and one from the UK) and two ID consultants (from Saudi Arabia). Questions in the schedule were all open-ended to obtain in depth views or perspectives of study participants. The interview schedule has two main sections, which primarily consist of open questions. Firstly, is a section on background information (3 questions), such as position of healthcare professionals, gender and years of experience. Secondly, open-ended questions (12 questions) were used to explore the components of the ASP in the medical city, members of the ASP and their responsibilities, the adoption and implementation process of the ASP in the medical city, and factors (barriers and facilitators) that influenced/are influencing the adoption and implementation process of the ASPs in the medical city.

Background information questions were developed after discussion between the researcher and supervisory team to explore participants demographic data (position, gender and years of experience). Questions 1-6 were developed after discussion between the researcher and supervisory team to explore characteristics and availability of ASPs in the medical city (available strategies, team members, roles of members, frequency and nature of meetings, and effectiveness of available strategies). Questions 7-10 were adapted from

published tools (Cotta et al., 2015; Pakyz et al., 2014) to explore factors (barriers and facilitators) influencing the adoption and implementation of ASPs in the medical city. Questions 11 and 12 were developed after discussion between the researcher and supervisory team to explore the adoption and implementation phases of the ASP at the medical city (reasons to adopt, stages of adoption and implementation, timeframe, outcomes, and policies).

The interview schedule was developed bearing in mind the four main domains of the conceptual framework (Fleuren et al., 2014, 2004) to cover all the different factors that affected the adoption and implementation process of the ASP in the medical city. Questions 1, 3, 5, 6 and 12 was developed based on the domain: characteristics of the ASP, to explore characteristics and availability of ASPs in hospitals. Question 2 was developed based on the domain: characteristics of healthcare organisation, to explore the availability of expertise in hospitals. Question 4 was developed based on the domain: characteristics of healthcare workers, to explore knowledge and skills of healthcare workers in regards to ASPs. Questions 7-11 was developed to explore the factors (barriers and facilitators) influencing the adoption and implementation process of the ASP in the medical city that can be under any of the four different domains: characteristics of the socio-political context, characteristics of the healthcare organisation, characteristics of the healthcare workers and characteristics of the ASP. Probing questions were also asked based on the responses of the participants to get more details.

6.2.3 Validation of interview schedule

The following steps were taken to ensure validity of the interview schedule (Bowling, 2009; Smith, 2002): Face validity: the interview schedule was checked by the researcher and the supervisory team to ensure their relevance, reasonability and that no ambiguity exists. Content validity: three ASP pharmacists (two from Saudi and one from the UK) and two ID consultants (from Saudi Arabia) checked the content of the interview schedule to ensure that the content of the instrument is logical and easy to understand.

6.2.4 Setting

This study was conducted at a 1500-bed tertiary medical city in Saudi Arabia with an established ASP. The programme was implemented in January 2016. The hospital has Coronary Care Unit (CCU), Cardiac Surgery Intensive Care Unit (CSICU) and provides cardiac, haematology, oncology, neuroscience, medical and specialised surgery services.

6.2.5 Sampling and recruitment of participants

Purposive sampling was the method of sampling for this study, which involved recruiting participants who have knowledge that is valuable to the research process. Participants in the study were the core members of the ASP and included an ID consultant (Director of the ASP), a clinical pharmacist (Manager of the ASP), a consultant clinical microbiologist, an infection control consultant and the CEO of the medical city. They play a significant role in the adoption and implementation of ASPs and the combined effort of the team can improve infection control and reduce antimicrobial resistance (Waters, 2015). Invitation letters (Appendix 12) were sent to the five targeted participants, through the head of the clinical pharmacy department (the manager of the ASP at the hospital), who was the first contact in the medical city, to introduce the study, obtain approval, and to schedule interviews.

6.2.6 Data collection

Interviews were conducted face-to-face in participants main language (Arabic or English) and audio recorded (using Sony ICD-PX333 recorder) for later transcription. Notes were taken during the interviews for non-verbal responses such as looking sad, smiling, feeling angry, etc. Interviews were conducted in a quiet area (pharmacy meeting room) to avoid any interruptions. Consent forms (Appendix four) were obtained from each participant. The interviews were conducted in July 2017. Reflexivity was considered during the interviews and analysis, so the researcher's views and opinion do not influence the participants' responses.

6.2.7 Data analysis

The interviewer used a recorder to audio record all of the interviews for later verbatim transcription and analysis. Transcripts were generated into Microsoft Word 2016 for each of the recorded interviews and labelled with a unique code for each participant. Themes and issues raised during the interviews were utilised to produce the codes, which were then organised into a framework that formed the basis of the primary coding structure. Interviews that were conducted in Arabic (3 out of 5) were analysed and coded first, then, themes, subthemes and quotes from participants were translated to English. Two independent researchers mapped and interpreted interviews data to capture the emerging themes and avoid any bias that could influence the analysis process. A third researcher screened a random sample (40% of the interviews) to check the reliability of the coding. Any discrepancies were resolved through discussion between the three researchers. A framework analysis using five sequential components was undertaken for each interview (Braun & Clarke, 2006). The five components of the analytical methodology are:

I) Familiarisation with the collected data.
II) Developing a thematic framework from the interviews and the themes emerging from the data (through the identification of main topics and subtopics).
III) Indexing (coding the data) into themes.
IV) Charting by rearranging indexed data according to the thematic framework.
V) Mapping and interpreting data.

A framework representing the major phases in ASP processes and related categories of determinants (Figure 3.6), was developed based on the determinants of innovation within the healthcare organisations model (Fleuren et al., 2014, 2004) informing the analysis. The conceptual framework was also used to develop the interview schedule. Themes and subthemes raised during the interviews and did not fit into this framework were incorporated and added to the framework, so no emerging themes and subthemes to be missed. Researchers looked for evidence of themes related to:

1) Characteristics of the socio-political context, such as; legislation, regulations, patient cooperation, patient awareness benefits, financial burden on patient and patient discomfort.

2) Characteristics of the healthcare facility, such as; decision-making process, reinforcement management, relationship with other organisations, collaboration between departments, staff turnover, staff capacity, available expertise, financial resources, administrative support, time available, opinion leader, feedback to user about innovation, material resources, and coordinator.

3) Characteristics of the healthcare workers, such as; social support colleagues, social support supervisors, self-efficacy, knowledge, skills, work-related stress, ethics problems, outcome expectations, ownership, expects patient cooperation, expects patient satisfaction.

4) Characteristics of the ASP, such as; complexity, advantages, clear procedures, compatibility, trialability, relevance for patient, risks for patient, frequency in the use, perceived prevalence of health problem.

6.2.8 Trustworthiness of interview transcript

The following tests were used to ensure reliability (Bowling, 2009):

Inter-rater: two raters coded transcribed interviews and the results were compared to measure the extent to which they agree. A third researcher screened a random 40% sample to check the reliability of the coding. Any discrepancies were resolved through discussion between the three researchers. Further reliability was ensured through verification of the transcribed data with the participants.

6.2.9 Ethical considerations

Official permissions were obtained from the participating medical city (Appendix 13). The researcher obtained written consent (Appendix four) from the participants and provided a participant information sheet explaining the nature of the study and its objectives (Appendix 14). All audio recordings were stored in locked drawers and electronic files (password protected) stored on computer to which only the researcher/supervisors have access. Audio files and

electronic/paper files of the interviews' transcripts will be destroyed three years after completion of the writing of thesis.

6.3 Results

All the core members of the ASP at the medical city (5/5) who were approached for recruitment had agreed to participate in this study. Five in-depth interviews (three in English and two in Arabic) were conducted with the core members of the ASP team. Length of interviews were two hours and 15 minutes (over two days) with the clinical pharmacist, 45 minutes with the ID consultant, 36 minutes with the CEO, 29 minutes with the consultant clinical microbiologist and 15 minutes with the infection control consultant. Also, content analysis of 35 ASP hospital documents was carried out.

Four main themes emerged from the data regarding ASP at the medical city (Table 6.1). They include: 1) Initiatives behind ASP adoption and implementation at the medical city, 2) ASP adoption and implementation phases at the medical city, 3) Characteristics of the ASP at the medical city (core members, strategies and expected outcomes), and 4) Factors enhanced the adoption and implementation, and barriers to smooth running of the ASP at the medical city.

Table 6.1: Themes and subthemes regarding ASP at medical city

Main themes	Subthemes
Initiatives behind ASP adoption and implementation at the medical city	
ASP adoption and implementation phases at the medical city	Adoption phase
	Implementation phase
Characteristics of the ASP at the medical city	Core members
	Strategies
	Expected outcomes
Factors enhanced the adoption and implementation of ASP at the medical city	Administrative support
	Collaboration between staff/departments
	Reinforcement management

Barriers to smooth running of the ASP at the medical city	Financial resources
	IT resource
	Staff capacity

6.3.1 Medical city initiatives of ASP adoption and implementation

At the medical city, ASP is part of the Patient Safety Portfolio (PSP). PSP was launched to promote safe environment for patients and staff. It discusses and finds solutions for issues that are presented at the medical city and can affect patient safety. The PSP consists of 10 patient safety strategic "programmes" (as highlighted in Figure 6.1). ASP is one of the portfolio programmes established to solve the issues of increasing rates of multidrug resistant organisms (MDROs) and increased healthcare cost due to inappropriate use of antimicrobials, with the aim of optimising patient management, and achieving reduction in morbidity, mortality and healthcare cost. Quotes from some participants regarding initiatives behind ASP adoption and implementation at the medical city are provided below:

"The misuse and abuse and cost and the increase in multidrug-resistant organism is worsening, that also, really encouraged us and we pushed strongly with the support of the leaders that we should start an antimicrobial Stewardship program" (Infectious diseases consultant 1)

"We have complex situation, we have neurology, oncology, so complex is there, so we should take the lead in implementing something evidenced based, also there was increasing rates of multi-drug resistance, due to people coming with complex cases" (Chief executive officer 1)

"Motivation to start this program was because we have a lot of multidrug resistant and it was talked about it a lot in the medical board" (Clinical pharmacist 1)

KAMC Patient Safety Portfolio

Infection Prevention & Control Program
- VAP Prevention Project
- Hand Hygiene Project
- CLABSI Prevention Project
- CAUTI Prevention Project

Medications Safety Program
- Medication Reconciliation Project
- Medication Prescribing Training Project
- Medication Administration Safety Project
- High Alert Medication Project
- VTE Prophylaxis Project

Environmental Safety Program
- HAZMAT Safety Project
- Fall Prevention Project
- Environmental Cleanliness Project
- Fire Safety Project
- Business Continuity Project

Surgical Safety Program
- Surgical Safety Checklist Project
- Surgical Site Infection (SSI) Prevention Project
- NSQIP Project
- FUSE Project

Evidence-Based Practice Program
- Decision Support Unit Project
- EBP Unit Project
- KAMC Dashboard Project

Teamwork (CUSP)
- CUSP Models for units
- Team STEPPS
- Crisis Resource Management

Effective Communication Program
- Patient Identification Project
- Documentation Project
- Hand-Off Improvement Project
- Clinical Consultations Project

Antibiotics Stewardship Program
- Antibiotic Stewardship project
- Enhancement of Microbiology Department Project

Patient Engagement Program
- Patient & Family Advisory Council
- Speak-up Campaign
- Electronic reporting: website, mobile app

High Reliability Organization (HRO)
- Safety Culture Transformation Project
- OVAR System
- Safety Culture Awareness Project
- Patient Safety Capacity Building Project

Figure 6.1: Patient safety portfolio programmes at the medical city (The medical city, 2016)

6.3.2 ASP adoption and implementation phases at the medical city

The process of ASP adoption and implementation at the medical city had two main phases namely a) creation of the program and b) running of the programme.

A. ASP adoption process (creation of the program):

The process commenced with a request from the patient safety committee to implement ASP at the medical city. This was followed by the recruitment of a locum ID clinical pharmacist with experience in ASP implementation for a 3-month period. The responsibility of the locum ID pharmacist was to review the situation in the medical city and provide recommendations on how to establish and run the programme. He was also expected to provide insight on how to overcome barriers or other obstacles that can be faced during the initiation process. Following this, a multidisciplinary team was formed and tasked with setting up the programme and monitoring results. The responsibilities and accountability were assigned among the ASP core members in the adoption and implementation process, which was followed by the development of ASP policies. An antimicrobial restriction form was developed, and a pilot phase was performed with ID physicians, physicians and pharmacists, to validate the form. The approval from the medical records committee for the restriction form to be used in the patient files was obtained. The approval for the ASP policies was also obtained from higher authorities including; pharmacy department, infection control department, microbiology department, ID department, Pharmacy and Therapeutics (PNT) subcommittee, other participating departments and finally the CEO to make sure that everyone is ready to run the programme.

The next step was to conduct ASP educational and training campaign (in Arabic and English) through workshops, posters, grand rounds, presentations, brochures, newsletter, media (Twitter), staff contest and booths targeting all departments and staff. Public awareness of antibiotics misuse was also conducted. The goals of the campaign were to increase awareness of antibiotic resistance and ASPs, encourage best practices among hospital staff and avoid further emergence and spread of antibiotic resistance. Some of the educational

materials used in the campaign are provided in Figures 6.2, 6.3, 6.4, and Table 6.2.

B. ASP Implementation Plan:

The plan was to start the implementation (running) of the ASP in few wards with few antimicrobial consumptions. However, with employment of more ID specialists, the ASP team decided to run the programme in all wards at the same time. Hospital leadership commitment and enforcement was very critical during the adoption and implementation process and facilitated the programme progress. Quotes from study participants regarding the implementation process are as follows:

"at the beginning, we got the order that we need to do antimicrobial Stewardship program, …. Secondly, we recruited an ID clinical pharmacist, we started to do first the policy……. Then, we did restriction form as one part of the antimicrobial stewardship program strategies and we did the workflow for the restriction form. Then we got the approval from the medical record committee" (Clinical pharmacist 1)

"We did the committees, antimicrobial sub-committee and we established the members, so we can make the policy, and after policy we started with education" (Infectious diseases consultant 1)

Figure 6.2: A postcard about ASP (The medical city, 2016)

Figure 6.3: A poster about ASP campaign (The medical city, 2016)

Figure 6.4: ASP and the medical city logos that were printed on some T-shirts
(The medical city, 2016)

Table 6.2: Some tweets that were used in the medical city twitter account
about ASP (The medical city, 2016)

The 2 core strategies of the #Antimicrobial_Stewardship are formulary restriction and Prospective audit and feedback #AntibioticResistance	الاستراتيجيتان الاساسيتان في #برنامج_ادارة_المضادات_الحيوية هما تقييد صرف المضادات الحيوية، و التدقيق التوقعي و التقييم #AntibioticResistance
#Antimicrobial_Stewardship program goals are to decrease bacterial resistance to antibiotics, reduce antibiotics consumption, and reduce healthcare costs #AntibioticResistance	أهداف #برنامج_ادارة_المضادات_الحيوية هي تقليل مقاومة البكتريا للمضادات الحيوية، تقليل استهلاك المضادات الحيوية، و تقليل تكلفة الرعاية الطبية #AntibioticResistance
Dear doctor, reduce #AntibioticResistance by keeping your patients' vaccination up to date #I_am_a_Steward	عزيزي الطبيب، قلل المقاومة ضد المضادات الحيوية بالتأكد من تطعيم مرضاك #انا_قائد #AntibioticResistance
Dear doctor, to prevent #AntibioticResistance prescribe the right antibiotic at the right dose for the right duration #I_am_a_Steward	عزيزي الطبيب، إمنع المقاومة ضد المضادات الحيوية بصرف المضاد الحيوي المناسب، بالجرعة المناسبة للمدة #AntibioticResistance _ #
Dear nurse, the most important factor to detect antibiotic sensitivity in blood cultures is the volume of blood drawn #I_am_a _Steward #AntibioticResistance	عزيزي الممرض، العامل الاهم لاكتشاف حساسية المضادات الحيوية في مزرعة الدم هو كمية الدم المسحوب #انا_قائد #AntibioticResistance
Dear nurse, draw blood specimen for antibiotic sensitivity before administering any antibiotics #I_am_a _Steward #AntibioticResistance	عزيزي الممرض، اسحب عينة الدم المخصصة لحساسية المضادات الحيوية قبل إعطاء أي مضاد حيوي للمريض #AntibioticResistance _ #

A timeline of the key steps of the ASP adoption and implementation phases at
the medical city are summarised in Figure 6.5.
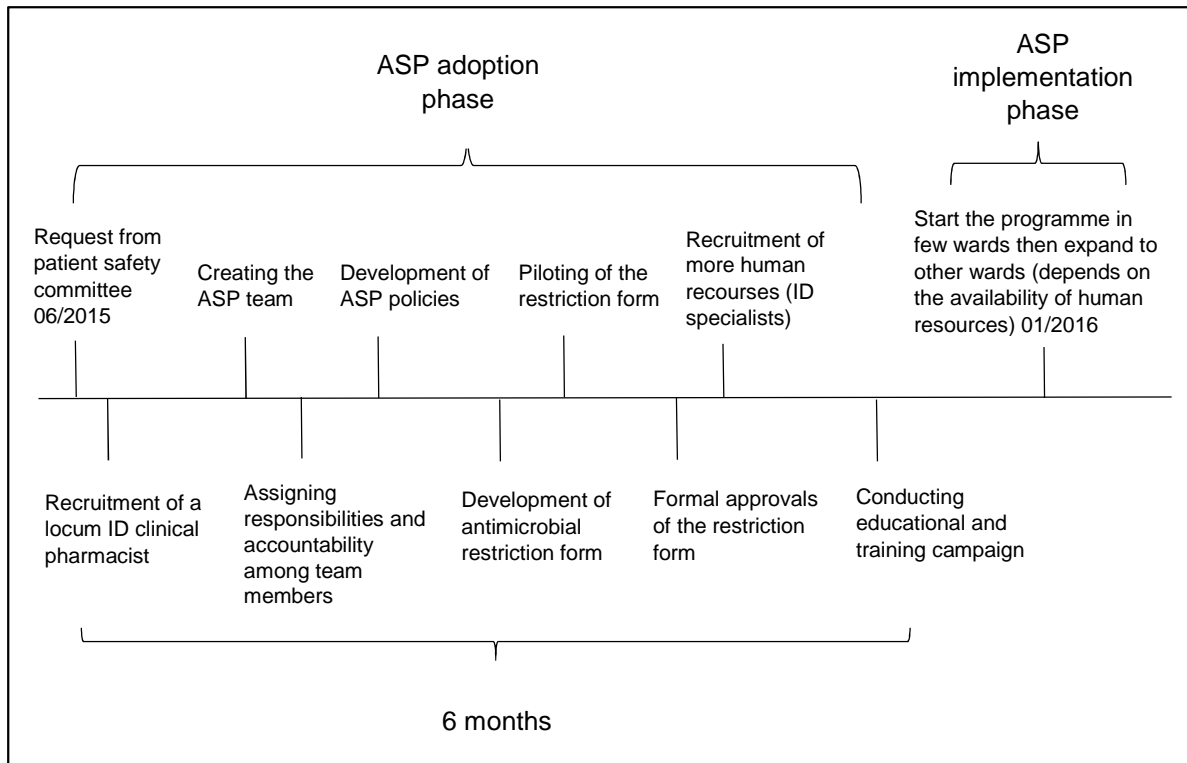
Figure 6.5: A timeline of the major steps of the ASP adoption and implementation phases at the medical city

6.3.3 Characteristics of the ASP at the medical city

A) ASP core members and their roles at the medical city

The core members of the ASP at the medical city constituted of an ID consultant and specialists, antimicrobial lead pharmacist and clinical pharmacists, consultant clinical microbiologist and infection control consultant. Each team member has a specific role, and they work in cooperation with each other.

"The team of the antimicrobial stewardship program is the ID who is the chairman, the clinical pharmacist the coordinator, other clinical pharmacists…...ah we have microbiology specialist, she's consultant, we have infection control doctor" (Clinical pharmacist 1)

Infectious diseases consultant and specialists**:**

The ID consultant is the chairman of the ASP committee and director of the ASP, he discusses ASP progress and needs with higher authorities. The ID

specialists review antimicrobial therapy during ward rounds and give recommendations on appropriate antimicrobial therapy.

"As an ID consultant, we review everyday forms. So, any antibiotic restricted prescribed, we go and review the form then we go back to the patient file and check why this patient is using this antibiotic, if we couldn't find anything on the file, we call the prescriber, discuss with them what's the justification of using restricted antibiotic, if there's no justification, we'll just restrict this antibiotic then they will choose or deescalate to another antibiotic" (Infectious diseases consultant 1)

Antimicrobial lead pharmacist and other clinical pharmacists**:**

Antimicrobial lead pharmacist is the manager of the ASP, receives and reviews daily reports for patients on antibiotics. Other clinical pharmacists review antimicrobial therapy during ward rounds and provide recommendations for ID physicians.

"I review patients who are new or old and then if it's new, I will try to find the restriction form, if for some reasons, it was missed, I will communicate with the pharmacy, I will communicate with the nursing with the physician to write the restriction form" (Clinical pharmacist 1)

Consultant clinical microbiologist:

The consultant clinical microbiologist produces yearly antibiogram, Cascade reporting, daily reports about positive cultures, and sends them to ID physicians, clinical pharmacists and infection control practitioners.

"So as the microbiologist here, we generate the antibiotics susceptibility test for the organisms isolated from clinical specimens, and then we release it on the hospital information system. I send an email at the end of the day with all the positive cultures that we have reported that day" (Consultant clinical microbiologist 1)

<u>Infection control consultant:</u>

The Infection control consultant monitors healthcare-associated infections (HAIs) rates, rates of infections, Incident rates of MDROs, shares and discusses the data with other staff and committee's members.

"As an infection control, we are mainly monitoring healthcare associated infection rates, we see the incidence rates of different multidrug resistant organisms, like the MRSA, VRE, carbapenem resistance, etc" (Infection control consultant 1)

B) ASP strategies at the medical city

Evidence based guidelines are used in the medical city to ensure safe practice and positive outcomes. Strategies employed are based on the IDSA and CDC guidelines (Centers for Disease Control and Prevention, 2014; Dellit et al., 2007) as described in the quotes below:

"We followed the IDSA guidelines for antimicrobial stewardship and also CDC" (Clinical pharmacist 1)

The two core strategies (restriction and preauthorisation, and prospective audit with intervention and feedback) of ASPs are implemented. A list of restricted antimicrobials was developed based on local antibiogram and MDROs surveillance reports. A sample of antibiotic restriction form and the process of authorisation and approval of restricted antibiotics are provided in Figures 6.6 and 6.7 respectively. Prospective audit of antimicrobial use with direct interaction and feedback to the prescriber is performed by either an infectious diseases physician or a clinical pharmacist with infectious diseases training. This is integrated with the formulary restriction at the medical city, where the infectious disease physician and the assigned pharmacists are always in contact with the medical team regarding patients on antibiotics. The assigned pharmacists are responsible for documenting the daily follow ups or recommendations on the patients' files under the title: "ASP Pharmacy Assessment".

The main supplemental ASP strategy employed at the medical city is education and seen as a fundamental component for ASP success at the medical city. The purpose of the participation in the Antibiotic Stewardship Program Awareness Week that was conducted at the medical city was to fulfil this component of ASP, with the intention of making all the medical city staff participate actively in the ASP. ASP core members launched a campaign titled: "I am a Steward". The medical city staff were requested to visit the campaign's booth to sign up and become a "STEWARD". Other supplemental strategies include: guidelines and clinical pathways, streamlining or de-escalation of therapy, dose optimisation/adjustment and parenteral to oral conversion.

"So, restriction policy, this is of course the main thing, and then we added the prospective audit and feedback. Also, the pharmacy regarding the dosing, so, this is dose optimization. …. then we also thought about the guidelines.… "

(Clinical pharmacist 1)

	PATIENT LABEL

ANTIMICROBIAL RESTRICTION FORM

Date:	Unit:

FILLED BY PHYSICIAN

Ordering Physician: Contact Number:	ID Number: Signature (or stamp):
Culture withdrawn BEFORE antimicrobials therapy: □ Yes □ No <u>Date:</u> Culture withdrawn AFTER antimicrobials therapy: □ Yes □ No <u>Date:</u> Restricted Antimicrobial □ Teicoplanin □ Voriconazole □ Linezolid □ Posaconazole □ Tigecycline □ Caspofungin □ Meropenem □ Micafungin □ Imipenem □ Anidulafungin □ Amikacin □ Amphotericin B □ Colistin Date Hospital of Admission:	Indication (please specify infection SOURCE) Justify not using narrower spectrum of activity Prescribing Rational □ Pathogen-directed therapy □ Empiric therapy □ Prophylaxis Estimated Duration of Therapy: **Contact ID Bravo for approval "0515165026 "** ID Physician Approval Status □ Approved □ ID was not contacted

FILLED BY PHARMACIST

Pharmacist:	
Dose	Concurrent Antimicrobials (other than restricted):

Culture Source	Date	Organism	Comment	Pharmacist Comments

Labs
T_{max} within 48 hours: UA:
WBC:
Neutrophil:
ProCT:
CXR:

FILLED BY INFECTIOUS DISEASE PHYSICIAN

ID Physician:
ID Physician Recommendations and Rationale

□ Approved	□ Not Approved

Re-evaluation of approval for the restricted antimicrobial after ………. Days
Comments:

Figure 6.6: The medical city antimicrobial restriction form (The medical city, 2016)

Ordering physician
- Fill out the antimicrobial restriction form
- Deliver the form to pharmacy ASAP
- Order restricted antibiotic for the estimated duration of therapy
- Contact ID for approval

Assigned pharmacist
- Review and complete the form no later than 18 hours after the pharmacy has received the form
- Deliver the form to the ID consultant
- ID will review forms by 9:30 am and 2 pm

ID specialist
- Review the form/order and reach a decision before order expiration
- Contact the ordering physician to discuss the case *(if ID was not contacted before)*
- If no response from the ordering physician, ID will contact the pharmacy to follow up with the ordering physician
- ID can decide if a formal consultation is required for approval

Assigned Pharmacist
- If ID approved, make sure that the duration of order matched the duration of therapy approved by ID.
- If ID did not approve the restricted antibiotic after 24 hours during weekdays and after 72 hours if ordered on Thursday after 12 pm, hold restricted antimicrobial agent and inform physician
- If ID is not available, continue the order until ID can review it.
- Re-assess the patient daily for dose adjustment, de-escalation or adverse drug reaction
- Document recommendation in the patient file, if applicable
- Sign off on the patient whenever the restricted antimicrobial is discontinued

Figure 6.7: Antimicrobial Restriction Workflow at the medical city

C) Expected outcomes of the ASP at the medical city

The expected outcomes of the ASP at the medical city are to reduce rates of AMR, MDROs, inappropriate antimicrobial use, and expenditure of antimicrobials. Quotes from some participants regarding expected ASP outcomes at the medical city are shown below:

"…...the goal was to reduce the consumption of antibiotics …." (Consultant clinical microbiologist 1)

"We measure it by DOT, …. second, is antibiogram and patient outcome is the most important, and also cost" (Infectious diseases consultant 1)

The medical city achieved the expected results of the ASP intervention including reduction of resistance rates through the increase of *Enterobacter spp.* isolates susceptibility to cefepime from 39% (19/48) in 2015 to 66% (35/53) in 2016 and to piperacillin/tazobactam from 48% (23/48) to 64% (34/53). *A.*baumanni isolates susceptibility also increased to colistin from 69% (62/90) to 97% (78/80) and to trimethoprim/sulfamethoxazole from 32% (29/90) to 62% (50/80). *E.coli* isolates susceptibility increased to piperacillin/tazobactam from 47% (129/274) to 77% (242/314). *S.aureus* isolates susceptibility to clindamycin increased from 45% (50/112) to 76% (91/120). A summary of the increased rates of bacterial isolates susceptibility to some antibiotics due to ASP are summarised in Table 6.3.

Table 6.3: A summary of rates of bacterial isolates susceptibility to some antibiotics in the medical city for 2015 and 2016

Bacterial isolates	Antimicrobial agents													
	Piperacillin/ tazobactam		Colistin		Trimethoprim/ sulfamethoxazole		Cefepime		Ciprofloxacin		Gentamicin		Clindamycin	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
E. coli (percentage susceptible/number of isolates)	47% (129/274)	77% (242/314)			37% (101/274	40% (126/314	45% (123/274	48% (151/314	33% (90/274)	36% (113/314	71% (194/274	65% (204/314		
A.baumannii			69% (62/90)	97% (78/80)	32% (29/90)	62% (50/80)	28% (25/90)	22% (18/80)	20% (18/90)	22% (18/80)	24% (22/90)	34% (27/80)		
Enterobacter spp.	48% (23/48)	64% (34/53)			52% (25/48)	72% (38/53)	39% (19/48)	66% (35/53)	60% (29/48)	75% (40/53)	56% (27/48)	79% (42/53)		
S. aureus					86% (96/112)	94% (112/120)			62% (69/112)	75% (90/120)	75% (84/112)	86% (103/120)	45% (50/112)	76% (91/120)
S.epidermidis					39% (34/86)	58% (52/89)			20% (17/86)	20% (18/89)	46% (40/86)	53% (47/89)		
MRSA									47% (22/47)	69% (35/51)	55% (26/47)	71% (36/51)		

In addition, the implementation of the ASP reduced the consumption of all antimicrobials (Tigecycline, Colistin, Meropenem and Imipenem) by 18.9% (Table 6.4) as the total consumption of all antimicrobials (Tigecycline, Colistin, Meropenem and Imipenem) for the 6 months period between 07-12/2015 (before the implementation of the ASP) (Table 6.5) was 7,773.5 Days of Therapy (DOT) and decreased to 6,305.1 DOT for the 6 months period between 01-06/2016 (Table 6.6) (after the implementation of the ASP).

Table 6.4: Antimicrobials consumption before and after the implementation of the ASP at the medical city

Medication	Total DOT (07-12/2015) Before ASP	Total DOT (01-06/2016) After ASP
Tigecycline	1,039.8	624.5
Colistin	2,080.9	1,417.2
Meropenem	2,287.2	2,597.3
Imipenem	2,365.6	1,666.1
TOTAL	7,773.5	6,305.1 **(-18.9%)**

Table 6.5: Antimicrobials consumption before the implementation of the ASP (07-12/2015)

Unit	Medication	DOT 07/2015	DOT 08/2015	DOT 09/2015	DOT 10/2015	DOT 11/2015	DOT 12/2015	Total DOT (07-12/2015)
ICU	Tigecycline	277.5	142.4	162.3	201.2	174.4	38.5	996.3
	Colistin	197.2	238.9	201.2	402.3	302.4	214.3	1,556.3
	Meropenem	137.9	110.3	258.1	421.4	176.0	252.7	1,356.4
	Imipenem	347.3	237.4	271.9	145.4	284.8	139.2	1,426
Haematology	Tigecycline	0.0	0.0	0.0	0.0	0.0	37.4	37.4
	Colistin	0.0	56.3	0.0	168.8	123.4	51.6	400.1
	Meropenem	38.5	56.3	134.7	168.8	123.4	338.1	859.8
	Imipenem	170.7	146.4	36.5	18.1	26.8	122.8	521.3
Oncology	Tigecycline	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Colistin	5.0	0.0	8.3	34.5	15.7	7.3	70.8
	Meropenem	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Imipenem	67.3	80.1	111.7	44.5	36.9	19.3	359.8
CCU	Tigecycline	0.0	0.0	0.0	1.5	0.0	4.6	6.1
	Colistin	3.6	2.0	0.0	1.5	14.3	32.3	53.7
	Meropenem	1.8	13.8	0.0	1.5	1.6	52.3	71.0
	Imipenem	0.0	2.0	6.5	3.0	27.0	20.0	58.5

Table 6.6: Antimicrobials consumption after the implementation of the ASP (01-06/2016)

Unit	Medication	DOT 01/2016	DOT 02/2016	DOT 03/2016	DOT 04/2016	DOT 05/2016	DOT 06/2016	**Total DOT (01-06/2016)**
ICU	Tigecycline	243.1	87.6	91.3	85.1	65.0	0.0	572.1
	Colistin	432.7	294.2	214.1	135.2	99.1	31.3	1,206.6
	Meropenem	539.7	403.8	179.6	148.6	82.1	0.0	1,353.8
	Imipenem	267.4	78.2	202.1	203.7	338.5	0.0	1,089.9
Haematology	Tigecycline	0.0	37.5	0.0	0.0	0.0	0.0	37.5
	Colistin	33.9	42.2	40.2	21.9	0.0	0.0	138.2
	Meropenem	299.4	121.8	85.4	255.5	54.7	0.0	816.8
	Imipenem	113.0	0.0	72.9	21.9	189.1	0.0	396.9
Oncology	Tigecycline	0.0	10.3	4.6	0.0	0.0	0.0	14.9
	Colistin	16.9	9.3	9.1	31.7	2.8	2.6	72.4
	Meropenem	45.0	79.4	47.5	132.4	0.0	0.0	304.3
	Imipenem	33.7	0.0	26.5	17.3	72.6	0.0	150.1
CCU	Tigecycline	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Colistin	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Meropenem	57.9	33.9	19.3	0.0	11.3	0.0	122.4
	Imipenem	0.0	0.0	16.1	13.1	0.0	0.0	29.2

This study also assessed patients' experience of antibiotic use during their hospital stay in order to evaluate the institutional role of patients' education as part of ASP. A total of 74 responses were analysed. Participants characteristics includes; 62% (46/74) of participants were male and 38% (28/74) were female, 46% (34/74) of participants were between the age of 21 and 30 years, and 48.6% (36/74) of participants hold bachelor degrees. Table 6.7 highlights the use of antibiotics by patient during hospital stay.

Table 6.7: Patients' use of antibiotics during hospital stay (N = 74)

Statement	Relative Frequency Distribution			Mean	Standard Deviation
	Agree %	Do not Know %	Disagree %		
F1- My doctor/pharmacist told me that I am being treated with antibiotics.	12.16	8.11	**79.73**	1.32	0.68
F2- I was told about how to take the antibiotic.	**77.03**	5.41	17.57	2.59	0.77
F3- This hospital is strict when it comes to prescribing antibiotics.	**39.19**	37.84	22.97	2.16	0.78
F4- This hospital provides information on antibiotic resistance.	27.03	22.97	**50.00**	1.77	0.85

F5- My hospital stay improved my awareness of antibiotic resistance.	36.49	18.92	**44.59**	1.92	0.90

The findings indicate that 77% of patients had been informed about how to take their antibiotic. Around, 40% of patients agreed that the hospital is strict when it comes to prescribing antibiotics. However, 80% of patients agreed that their doctors and pharmacists did not tell them that they were treated with antibiotics. Only 27% of patients believed that they received information about antibiotic resistance during their hospital stay. Similarly, 36.5% showed that their hospital stay did not improve their awareness of antibiotic resistance.

6.3.4 Facilitators to the successful adoption and implementation of ASP at the medical city

Data regarding the factors that enhanced successful implementation and barriers to the smooth running of the ASP in the medical city were categorised into one main theme (Characteristics of the healthcare organisation) using the innovation within the healthcare organisations model (Fleuren et al., 2014, 2004) described in page 80. Subthemes were developed from the codes.

Subthemes of the factors that enhanced successful adoption and implementation included; administrative support, collaboration between staff/departments and reinforcement management.

<u>Administrative support</u>

Hospital leadership commitment and support was reported by participants (4/5) as one of the most critical determinants that facilitated ASP adoption and implementation in the medical city.

"There is a lot of commitment from the administration and the leadership"

(Clinical microbiologist 1)

"The CEO himself was the one insisted that we have to start antimicrobial stewardship up and running within one month. He said, "I want the policies to be ready, I want the project portfolio to be ready". Here, it was very good administrative support to be honest with you" (Clinical pharmacist 1)

Collaboration between staff/departments

Participants (5/5) reported that inter-professional and interdepartmental collaboration and communication as a key facilitator for the successful adoption and implementation of ASP. This was evident from the following viewpoints:

"There is good communication….so usually pharmacy will call us then we get the form, in the form also we added the prescriber name, with phones, with contact so we can communicate easily" (Infectious diseases consultant 1)

"But now we are one team, we have group in WhatsApp and it's named antimicrobial stewardship and we follow our patients there" (Clinical pharmacist 1)

Reinforcement management

Participants (5/5) reported that formal reinforcement by management to adopt and implement ASP facilitated the process of ASP implementation. Some of the quotes in support of this included:

"When we were talking about antibiotic stewardship, the idea was to be one of the projects under the program of medication, but I told them no, it needs to be done, antibiotic stewardship, independently, I mean stands out, to be very obvious and very evident" (Chief executive officer 1)

"I think it's only about enforcement about this programme that it has to be done. It has to be done this way, it has to be done within this time frame. This is all that we really needed" (Clinical pharmacist 1)

Although ASP has been successfully adopted and implemented at the medical city, certain factors impede the smoothing of the programme, including financial resources, IT resource and staff capacity.

Financial resources

Lack of financial resources was reported by some participants (3/5) as a barrier that prevented recruitment of more ID consultants and lack of some microbiology kits as shown in the quotes below:

"the recruitment, we had problems with financial supporting and recruiting more IDs, recruiting more people" (Clinical pharmacist 1)

"We all know that there is financial constraint currently and even some basic items we are not getting regularly" (Clinical microbiologist 1)

Resources (IT)

Inefficient IT system prevented smooth running of the programme (4/5). In particular, the available system does not allow adequate and effective data collection as reported below:

"…. the health information system in the hospital was not supported enough and until now, we have this problem of getting accurate data from the system. So, a lot of our data collected manually, it takes a lot of time and man power"
(Infection control consultant 1)

"We have some limitations in the electronic medical system or HIS (Healthcare Information system), that it cannot be generated automatically, they have to do it manually" (Clinical pharmacist 1)

<u>Staff capacity</u>

Inadequate number of staff (including ID consultants, clinical pharmacists and clinical microbiologists) was reported by participants (3/5) as a factor that is preventing smooth running of the ASP.

"If we talk about numbers, we don't have, we are working with one ID consultant, and four assistants only" (Infectious diseases consultant 1)

"One of the biggest problems that we had, and we still I think struggle with, this the microbiology lab, our microbiology lab has only one clinical consultant, clinical microbiologist" (Clinical pharmacist 1)

6.4 Discussion

To my knowledge this is the first case study to explore the process of adoption and implementation of an established ASP in a Saudi MOH hospital. In order to promote adoption and implementation of ASPs, governmental and professional bodies have produced guidelines to help hospitals (Barlam et al., 2016; Centers for Disease Control and Prevention, 2014; Dellit et al., 2007; Duguid & Cruickshank, 2011; National Institute for Health and Care Excellence, 2015; Public Health England, 2015b). These guidelines outline the basic elements that make a good ASP.

Findings of this study indicated that ASP in the medical city resides within the patient safety governance (patient safety portfolio). The IDSA/SHEA (Dellit et al., 2007) and Australian (Duguid & Cruickshank, 2011) guidelines recommend that ASP resides within the hospital's quality improvement and patient safety governance structure and be included within the hospital's quality and safety strategic plan. Inclusion of ASP in the patient safety portfolio showed that the medical city is in line with the global recommendations.

Successful implementation of ASP relies on a stewardship team or committee. The IDSA/SHEA guidelines (Dellit et al., 2007) as well as the other guidelines recommend establishment of a multidisciplinary team. Adoption and implementation of ASP in the medical city began with a review and recommendations from ID pharmacist on how to establish ASP followed by formation of multidisciplinary team. Composition of team and stewardship strategies employed is in line with the recommendations of the IDSA/ SHEA and CDC guidelines.

The primary goals of ASPs are to improve patient outcomes and minimise unintended consequences of antibiotic use, including development of resistance and *C. difficile* infection (Dellit et al., 2007). Outcomes that have been used to assess the effectiveness of ASPs include antibiotic consumption in Defined Daily Dose (DDD) ("the assumed average maintenance dose per day for a drug used for its main indication in adults") (World Health Organisation, 2003) or DOT (number of days that patient receives at least one dose of an antibiotic summed for each antibiotic), rates of resistant bacteria and *C. difficile*, antimicrobials expenditures, length of hospital stay and rate of readmission (Aldeyab et al., 2012; Bartlett & Siola, 2014; Martin et al., 2005; Yam et al., 2012). In line with recommendations for hospitals to monitor their antimicrobial stewardship activities, the stewardship team in the medical city monitors antibiotic resistance/rates of MDROs through the hospital anti-biogram, consumption of antimicrobials through the monthly reports in DOT, and cost savings of antimicrobials through the pharmacy financial reports. The ASP team decided to exclude *C. difficile* infection as an outcome of the ASP from their policy. This is because Saudi Arabia including the medical city has a very low incidence of *C. difficile* infection that can be considered not significant (Al-Tawfiq & Abed, 2010; Shajan, Hashim, & Michael, 2014). The medical city achieved the expected results of the ASP intervention. Also, the implementation of the ASP reduced the consumption of all antimicrobials. The ASP outcomes reported in this study are in line with the findings of previous studies (Al-Tawfiq et al., 2015; AlAwdah et al., 2015; K. a. Cairns et al., 2013; Jenkins et al., 2015; Vettese et al., 2013).

Patients' experience of antibiotic use during their hospital stay was also assessed in order to assess the institutional role of patients' education as part of ASP. The findings indicate that patients did not receive enough information about antibiotics use and risks of resistance during their stay in hospitals. Further research is required to evaluate and compare the situation with hospitals without ASPs to measure if there are any significant differences between hospitals with ASPs and hospitals without ASPs.

This study identified a number of facilitators that enabled the medical city to adopt and implement ASP successfully. These included strong administrative support, reinforcement management, and inter-professional collaboration and communication. The responsibility for ensuring adoption and implementation of ASPs lies with the hospital administration. Consequently, ASPs guidelines (Centers for Disease Control and Prevention, 2014; Dellit et al., 2007; Duguid & Cruickshank, 2011; National Institute for Health and Care Excellence, 2015) recommend hospital administration should provide dedicated resources needed for stewardship activities.

Seven key elements were identified as important factors for the successful implementation of ASP in a multi-site NHS Trust (Cooke, Franklin, Lawson, Jacklin, & Holmes, 2004); which also accounted for the successful implementation of ASP in the medical city. One of the elements described was strong leadership. In that Trust, the authors reported that medical director endorsed the existence of the antibiotic stewardship steering committee and supported its work, including authorising the committee to review antibiotic use and implement new initiatives on behalf of the Trust. In this study, participants reported the CEO of the hospital was the driving force behind the implementation of the ASP in the medical city. Apart from giving directives for implementation of the programmes, the CEO took the lead and participated in weekly patient safety rounds that included questions about antibiotic prescribing.

The second element reported by (Cooke et al., 2004) was dedicated individuals with responsibility for leading on antibiotic use. In the medical city, members of the ASP team have specific responsibilities. The chairman of the team (ID

consultant) for example, liaises with hospital administration regarding the progress and needs of the programme; the lead clinical pharmacist as well as other clinical pharmacists carries out daily review of patients on antibiotics, while the consultant clinical microbiologist produces yearly antibiogram, cascade reporting, and daily reports about positive cultures. Although members of the team have specific role and responsibilities, they work collaboratively to ensure success of the programme.

The third element that was important for successful implementation of ASP in the multi-site NHS Trust was integration into pre-existing structures within the trust, in their case, the Drugs and Therapeutics committee. The English stewardship guideline (Start Smart, then Focus) recommends antimicrobial stewardship activities should be reported to the hospital board through Director of Infection Prevention and Control or the Drugs and Therapeutic Committee (Public Health England, 2015b), while IDSA/SHEA and Australian guidelines recommend that ASP resides within the hospital's quality improvement and patient safety structure (Dellit et al., 2007; Duguid & Cruickshank, 2011). In the medical city, ASP resides within an existing hospital structure, the patient safety portfolio, adoption and implementation progress of the ASP was reported to the patient safety committee, while outcomes and updates are discussed with the pharmacy and therapeutic committee. Integrating ASP within an existing structure ensures accountability and efficiency.

The fourth element the authors reported was important to their success was education and training. The medical city team embarked on a massive educational campaign (through workshops, posters, grand rounds, presentations, brochures, newsletter, social media) to create awareness of antibiotic resistance and the role of antimicrobial stewardship in controlling resistance. Education and training is a persuasive or passive antimicrobial stewardship strategy that has been shown to independently increase compliance with antibiotic policies, and enhance the effect of restrictive strategies (Davey et al., 2017).

Another element reported was harnessing of existing resources (senior registrars) to obtain desired results. In the medical city, other clinical pharmacists and ID

specialists who were not necessarily core members of the ASP team were actively involved in antibiotic review and referrals to ID consultant when a restricted antibiotic is prescribed. Lack of ownership has been reported as one of the barriers to the implementation of ASPs (Pakyz et al., 2014), harnessing of existing resources ensures ownership of the programme among different healthcare professional.

(Cooke et al., 2004) also reported communication and obtaining local data on prescribing patterns and resistance were key elements of their programme. Although ASP in the medical city is relatively new, the stewardship committee aims to monitor antibiotic resistance rates as consumption of antimicrobials as outcomes of their programme. While ASP has been successfully implemented in the medical city, a number of factors however inhibit the smooth running of the programme, principal of which are inefficient IT resources, funding and staff constraints.

The medical city's ASP model closely resembles the model described by (Cooke et al., 2004). Saudi MOH hospitals without ASPs could therefore emulate the example set by the medical city, or as suggested by participants of the study in Chapter four, hospitals planning to start the programme can send their staff to understudy the medical city model. While this could enhance adoption and implementation of ASPs in such hospitals, hospital administrators of such hospitals must also take note the factors that prevent the smoothing running of the programme.

6.4.2 Implications for practice

The information acquired in this research is vital in understanding the adoption and implementation process of ASP in a healthcare facility in Saudi Arabia in order to promote and spread ASPs in Saudi hospitals. It gave an insight on how adoption and implementation barriers can be overcome, in order to adopt and implement the national ASP policy easily and successfully, and improve antimicrobial practice, reduce antimicrobial resistance and improve patients care.

6.5 Conclusion

The objective of this case study was to explore the adoption and implementation process of an established ASP (initiation, adoption decision, implementation) in a Saudi MOH hospital that can serve as a model or preceptor for MOH hospitals without ASPs. Leadership support was identified as one of the main drivers to facilitate the adoption and implementation process of ASP at the medical city, through providing required human, financial and IT resources and by including the ASP duties in the daily tasks and annual evaluation reports of related staff.

The availability of experts in antimicrobial use and ASPs was vital in developing and running of the program, monitoring and reporting outcomes and educating and training other healthcare workers. Education and training through different approaches showed a big impact on ASP progress and was one of pillars of the medical city strategy at the start of the ASP adoption process. Moreover, following evidence-based guidelines that have been developed by leading institutions was key to the successful ASP adoption and implementation at the medical city. Training and residency programs for different health specialities are really important and there are big demands by healthcare professionals to increase the number of these programs to increase the learning chance and improve healthcare services.

This chapter and previous chapters (four & five) explored and investigated the situation of ASPs in Saudi MOH hospitals from the point of view of healthcare professionals, and it was emphasised by number of participants that there is poor knowledge and practice among some patients regarding antimicrobial use and resistance. Also, in this chapter (six), patients experience of antibiotic use during their hospital stay were assessed in order to evaluate the institutional role of patients' education as part of ASP. Therefore, the next chapter evaluated patients' knowledge and perceptions on antimicrobial use and resistance in a Saudi MOH hospitals with ASP and in a Saudi MOH hospital without ASP.

Chapter 7: knowledge and Perceptions regarding antimicrobial use and resistance among adult hospital patients in Saudi MOH hospitals

7.1 Introduction

The rise in AMR has been recognised as a major public health problem that threatens effective prevention and treatment of infectious diseases (World Health Organisation, 2014). Inappropriate use of antimicrobials has been identified as one of the main driver of AMR (Laxminarayan et al., 2013). The UK National Institute for Health and Care Excellence (NICE) defines inappropriate antimicrobial use as "the way in which people may misuse antimicrobials that they have been prescribed or supplied with, and which may result in the antimicrobials becoming ineffective in treating infections" (National Institute for Health and Care Excellence, 2017).

An earlier study assessing knowledge, behavior and attitude toward antibiotics use among adult Jordanians identified the different ways people misuse antibiotics. These included using antibiotics for treatment of common cold and cough, using antibiotics as analgesics, keeping antibiotics at home for emergency use, use of antibiotics as prophylaxis against infections, use of left-over antibiotics without physicians' consultation, and use of antibiotics based on a relative advice (Shehadeh et al., 2012). Patients' and public misuse of antimicrobials therefore is a major driving force in development of AMR. This has led to international and national campaigns (Antibiotic Awareness Week) to raise public and professional awareness of AMR (Earnshaw et al., 2009; World Health Organisation, 2015c).

In Chapter four of this thesis, it was found that patients were quick to demand, and insistent on having antibiotics prescribed for treatment of common cold or sore throat; and would often not complete the course of prescribed antibiotic. The objective of this study therefore is to assess patients' knowledge and perceptions of antimicrobial use and resistance to evaluate the institutional role of patients' education about appropriate antimicrobial use. This chapter will answer the following research questions:

1. What are the patients' knowledge and perceptions regarding antimicrobial use and resistance in Saudi MOH hospitals?

2. What is the difference between patients' knowledge and perceptions regarding antimicrobial use and resistance in a hospital with ASP and a hospital without ASP?

7.2 Methods

7.2.1 Design

To achieve the objective of this study, a cross-sectional self-administered survey was used.

7.2.2 Development and source of the survey

The questionnaire statements (Appendix 15) were adapted from validated tools (André, Vernby, Berg, & Lundborg, 2010; Awad & Aboud, 2015; Oh et al., 2011), and following a comprehensive review of the literature and discussion among the researcher and supervisory team. The survey has two main sections, which primarily consist of closed questions. Firstly, is a section on background information (four questions), including hospital, gender, age and level of education. Secondly, Likert-type statements on knowledge and perceptions regarding antimicrobial use and AMR to address: access to antibiotics (three items), effect of antibiotics (six items), antibiotic resistance (six items), doctor's habits and patient/doctor relationship (six items) and patients' use of antibiotics during hospital stay (five items).

The items in each domain were adapted from validated tools and following discussions among the researcher and supervisory team. Questions one, two, three, B1, C1, C2, C5 and C6 were adapted from (André et al., 2010; Awad & Aboud, 2015; Oh et al., 2011). Questions B2, B4, C3, C4, D2 and D4 were adapted from (Oh et al., 2011). Questions B3, E1 and E2 were adapted from (André et al., 2010; Awad & Aboud, 2015). Question D1, D6, E3 and E4 were adapted from (Awad & Aboud, 2015). Questions D3, D5, E5, E6, F1-F5 were developed by the researcher and supervisory team.

All questions were then reviewed by the researcher and supervisory team and checked by two ASPs pharmacists from Saudi and one ID consultant from Saudi.

The survey was developed in English (Appendix 15) and then translated into Arabic (Appendix 16) through a forward and backward translation process. The researcher translated the survey from English to Arabic. Then, two independent researchers, who are bilingual (Arabic/English) speakers, translated back the survey to English. Both Arabic and English versions of the survey were compared. Any discrepancies were resolved through discussion between the three researchers.

The survey consisted of five sub-scales based on a three-point Likert scale, ranging across Agree=1, neither disagree nor agree=2 and Disagree =3. There were eleven negative statements in this survey. The remaining items (15) were positive. The total number of items in the five sub-scales was 26. Furthermore, two items were designed to check the reliability of the participants. These were: 'If a family member is sick, I will give him/her my antibiotic' and 'I will give my antibiotic to a family member if needed'.

The indications drawn from the direction of scores across the five sub-scales are as follows: whenever the survey scores increased, this meant that patients' knowledge and perceptions regarding antimicrobial use and resistance was high and the institutional role of patients' education was active and good. In contrast, if the scores decreased, this meant that the knowledge and perceptions of patients towards antimicrobial use and resistance was low and the institutional role of patients' education was negative and poor.

The participants required about 15 minutes to complete this survey. The researcher set the mean of the total perspectives of the knowledge and perception of patients towards the antimicrobial use and resistance in Saudi MOH hospitals at 52.46. Those with positive and good knowledge and perception towards ASPs, the 'agreement/positive group', were above the mean of 52.46, while those with negative knowledge and perception, the 'disagreement/negative group', were below the mean.

7.2.3 Pilot study of the instrument

The survey was piloted with a number of patients representing two hospitals, one with ASP and one without ASP. Appropriate changes were made in accordance with participants' feedback to optimise the research tool. The purpose of a pilot study is primarily to identify the degree of validity and reliability of a research instrument. Validity and reliability are vital components of quantitative and qualitative research (L. Cohen et al., 2000). In the present study, a pilot study was carried out with 52 patients from the two hospitals. A total of 52 responses were analysed, 57.7% (30/52) responses were from the hospital without ASP and 42.3% (22/52) were from the hospital with ASP. Participants characteristics includes 59.6% (31/52) of participants were male and 40.4% (21/52) were female, 44.2% (23/52) of participants were between the age of 21 and 30 years, and 57.7% (30/52) of participants hold bachelor degrees.

7.2.4 Validity of the questionnaire

The following steps were taken to ensure validity of the questionnaire (Bowling, 2009; Smith, 2002):

a) Face validity: the questionnaire statements were checked by the researcher and the supervisory team to ensure their relevance; reasonability and that no ambiguity exists.

b) Content validity: two ASP pharmacists (from Saudi Arabia) and one ID consultant (from Saudi Arabia) checked the content of the questionnaire to ensure that the content of the instrument is logical and easy to understand.

c) Discriminant validity: A T-test was conducted to allow comparison of the scores and determination of the mean scores. The T-test confirmed that the survey could successfully differentiate participants' positive and negative perspectives regarding antimicrobial use and resistance in Saudi hospitals. The researcher reviewed the results to identify any significant differences between patients' good and positive knowledge and perceptions towards antimicrobial use and resistance in Saudi MOH hospitals who scored highly (M: 66.00, SD: 2.209, N=26) and those who

recorded low scores (M: 46.12, SD: 4.376, N=26) in relation to the questionnaire scores (t = (20.68), p=0.000). The review allowed the researcher to categorise participant responses. By conducting a visual inspection of the total low and high survey scores reported by the study participants, a cut-off score was determined. This score was necessary to identify participants' positive and negative views towards antimicrobial use and resistance. A high score indicated that the patients had a positive knowledge and perception towards antimicrobial use and resistance. In contrast, a low score indicated that the patients had a negative knowledge and perception towards antimicrobial use and resistance.

d) Internal Consistency: the correlation test will show whether there is a significant correlation between the sub-scales of the survey in relation to each other and the overall score of the survey as highlighted in Table 7.1.

Table 7.1. Pearson correlation between the summations of dimensions and the total score of the survey (N: 52)

Sub-Scales	SS1	SS2	SS3	SS4	SS5	Total
Access to antibiotics **(SS1)**	-	.559**	.398**	.286*	.602**	.743**
Effects of antibiotics **(SS2)**	.559**	-	.320*	**.251**	.662**	.739**
Antibiotics resistance **(SS3)**	.398**	.320*	-	.308*	.490**	.695**
Doctors' habits **(SS4)**	.286*	**.251**	.308*	-	.499**	.636**
Patients' use of antibiotics **(SS5)**	.602**	.662**	.490**	.499**	-	.890**
Total	.743**	.739**	.695**	.636**	.890**	-

** Pearson correlation is significant at the 0.01 level (two-tailed).

The results of the analysis of patients' perspectives on antimicrobial use and resistance revealed that the sub-scales from (1) -(5) had a significant and strong correlation between the dimensions of the survey with each other and with the overall score of the survey between r 0.28 and r=0.89, except one insignificant correlation between effects of antibiotics (SS2) and doctors' habits (SS4), which was 0.25. This indicated a strong correlation in general between the summation of each sub-scale and with the total score.

7.2.5 Reliability

The split-half method and the test-retest method were the two types of tests performed to confirm reliability (Bowling, 2009). Several participants were subjected to this test to make sure that the measure was stable over an interval of time. The internal consistency of the tool was assessed via Cronbach's alpha test.

a) Split-half method: the split-half method divided the total items (26) into two groups; the first group (13 items) was from B1-D4, and the second group (13 items) was from D5-F5. A correlation was then applied between the summations of both groups of the questionnaire. The results showed that there were good correlations between group (a) (M: 27.10, SD: 5.710) and group (b) (M: 28.96, SD: 5.924), where r=0.80, p<0.001, N: 52.

b) Test-re-test of the questionnaire: the survey was conducted again after 7 days among the same group (52 participants) who completed the survey the first time. The results of the Pearson correlation test showed there was a significant relationship between the first application (M: 56.06, SD: 10.61) and the second application (M: 57.25, SD: 10.49) of the survey, such that r=0.79, p<0.01, N=52. The results of this test indicated that the correlation between the first and second survey performance was significant, whilst also showing only a very small difference between the two performances, meaning the survey had good reliability, making it suitable for the current study.

c) Cronbach's alpha: the Cronbach's Alpha method was used to calculate the reliability coefficients of all items in the survey. The results of this test showed that Cronbach's alpha coefficient (M: 56.06, SD: 10.61, N of items: 26) was sufficient at a level of 0.86 and the instrument thus provided an acceptable degree of reliability.

7.2.6 Sampling, setting and size of participants

Purposive/ convenience sampling was the method of sampling for this study. The two hospitals described below were selected to represent a MOH hospital without

ASP and a MOH hospital currently adopting ASP, in an effort to capture a representative sample of different hospital patients. These facilities can be broadly classified as: a central hospital (380 beds) and a tertiary medical city (1500 beds). All patients being treated with antimicrobials in medical departments were targeted. Minor patients (under 21 years of age) and psychiatric patients were excluded. A total of up to 200 participants were targeted from each hospital comprising a total of 400.

7.2.7 Distribution method and data collection period

Invitation letters (Appendix 17) were given to targeted patients through the antibiotic pharmacist at each hospital. These letters introduced the study with a copy of the survey to complete. Data was collected from June to August 2017.

7.2.8 Data analysis

Data were coded, entered manually into Microsoft Excel 2016, and uploaded to the SPSS database (Version 23; SPSS Inc., NY, USA). Descriptive analysis was conducted to answer the research questions by using frequencies, percentages, mean and standard deviation. The minimum significance level that was considered in this part of the study was 0.05, thereby aiding in the determination of whether the similarities or differences between variables were statistically significant. In addition to the descriptive analysis, based on the distribution and nature of the data and as the data is normally distributed (Kolmogorov-Smirnov= 0.047, p= 0.2, and Shapiro-Wilk= 0.985, p= 0.110), One-Way Anova analysis was used to explore the differences between perspectives on antimicrobial use and resistance (dependent variable) with the hospital type, age and level of education of participants (independent variables). A T-test and correlations were used to examine the validity and reliability of analysis.

7.2.9 Ethical considerations

Official permissions were obtained from the General Directorate of Health Affairs in AlBaha (Appendix five), and from the medical city (Appendix 13). The researcher obtained written consents (Appendix 18) from the participants and provided a participant information sheet explaining the nature of the study and its objectives (Appendix 19 & 20).

7.3 Results

7.3.1 Demographics of respondents

Of the 400 distributed questionnaires, 176 responses were collected (Response rate of 44%). Twenty-six were excluded as they were incomplete. A total of 150 responses were analysed, 50.7% (76/150) responses were from the hospital without ASP and 49.3% (74/150) were from the hospital with ASP. Participants characteristics includes 52.7% (79/150) of participants were male and 47.3% (71/150) were female, 44% (66/150) of participants were between the age of 21 and 30 years (Figure 7.1), and 48.7% (73/150) of participants hold bachelor degrees (Figure 7.2).
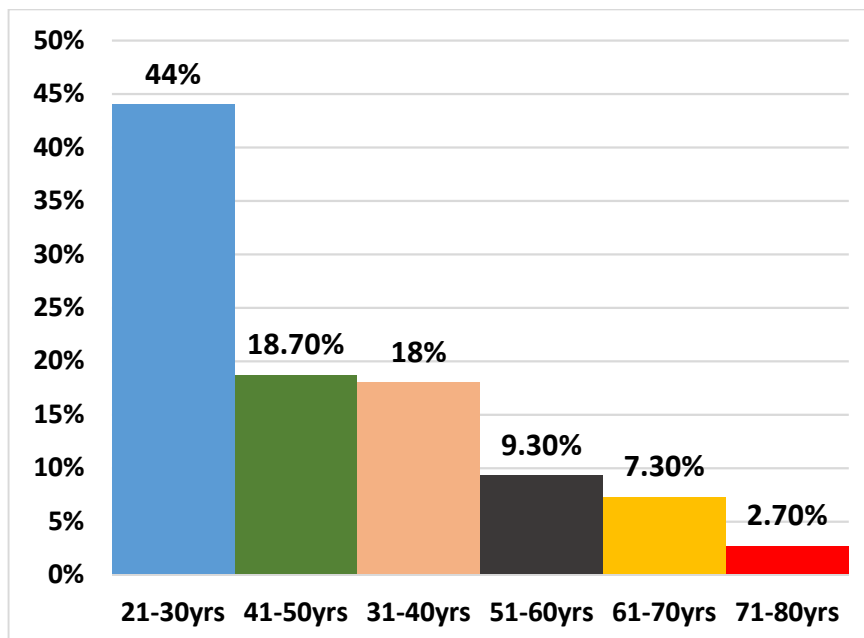
Figure 7.1: Distribution of patients' age groups
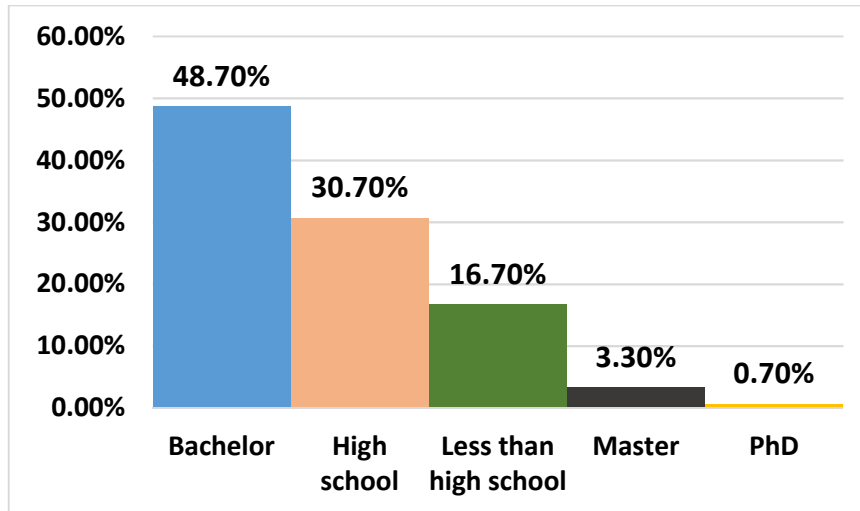
Figure 7.2: Distribution of patients' educational level

7.3.2 Patients' knowledge and perceptions regarding antimicrobial use and resistance in Saudi MOH hospitals

This part of the questionnaire examined the perspectives of patients regarding antimicrobial use and resistance in Saudi MOH hospitals in relation to five dimensions: 1) Access to antibiotics; 2) Effects of antibiotics; 3) Antibiotics resistance; 4) Doctors' habits and the relationship between doctors and patients; and 5) Patients' use of antibiotics during hospital stay (see tables 7.2-7.6).

1) Access of patients to antibiotics

Table 7.2: Access of patients to antibiotics (N = 150)

Statement	Relative Frequency Distribution			Mean	Standard Deviation
	Agree %	Do not Know %	Disagree %		
B1- Left-over antibiotics are good to keep at home in case they might be needed later on.	**79.3**	8	12.7	1.33	0.69
B2- If a family member is sick, I will give him/her my antibiotic.	20.7	1.3	**78**	2.57	0.814
B3- It is good to be able to get antibiotics from relatives, friends or pharmacy without having to see a doctor.	17.3	3.3	**79.3**	2.62	0.766

The findings in this section showed positive perception and good knowledge about getting antibiotics, as 78% of patients were against giving any antibiotics that were not prescribed by a doctor to any family member. Likewise, 79.3% were against getting any sort of antibiotics from relatives or friends without prescription. However, 79% of patients exhibited an unhealthy perception towards dealing with antibiotics, preferring to keep left-over antibiotics at home for future use.

2) Effects of antibiotics

Table 7.3: Effects of antibiotics (N = 150)

Statement	Relative Frequency Distribution			Mean	Standard Deviation
	Agree %	Do not Know %	Disagree %		
C1- When I get a cold, I will take antibiotics to help me get better quickly.	48	6	46	1.98	0.973
C2- If I feel better after a few days, I will stop taking my antibiotics before completing the course of treatment.	63.3	2.7	34	1.71	0.945
C3- Antibiotics are indicated to relieve pain/inflammation.	55.3	20	24.7	1.69	0.843
C4- Antibiotics are used to stop fever.	47.3	19.3	33.3	1.86	0.890
C5- Antibiotics are effective against bacteria.	52	41.3	6.7	2.45	0.619
C6- Antibiotics are effective against viruses.	51.3	40.0	8.7	1.57	0.649

The findings in this section showed that 52% of patients believed that antibiotics were generally effective against bacteria, which was a positive outcome. However, the majority of patients held wrong beliefs about the effects of antibiotics. 48% of patients believed that antibiotics could help them to get better quickly when they got a cold, 63.3% of patients thought that they could stop using antibiotics before completing the course of treatment if they felt better after a few days; 55.3% of patients believed wrongly that antibiotics were intended to relieve pain and inflammation; 47.3% of patients stated that antibiotics were used to bring down fever; 51.3% believed wrongly that antibiotics were effective against viruses. Surprisingly, 40%-41% of patients admitted that they did not know if antibiotics were effective against bacteria and viruses.

To conclude, the above findings show a significant lack of awareness and knowledge among Saudi MOH hospitals patients about the effects of antibiotics and safe usage.

3) Antibiotic resistance

Table 7.4: Antibiotic resistance (N = 150)

Statement	Relative Frequency Distribution			Mean	Standard Deviation
	Agree %	Do not Know %	Disagree %		
D1- Antibiotic resistance can be due to using antibiotics when they are not necessary.	**40.7**	32.7	26.7	2.14	0.811
D2- Antibiotic resistance can be due to not completing the full course of antibiotic.	5.3	10.7	**84**	1.21	0.53
D3- Antibiotic resistance can be due to using antibiotics without physician prescription (self-medication).	**48.7**	20.7	30.7	2.18	0.875
D4- Antibiotic resistance can be due to using the same antibiotic with a different brand.	24	**44.7**	**31.3**	1.93	0.743
D5- Antibiotic resistance is a problem in Saudi today.	9.3	18	**72.7**	1.37	0.65
D6- Antibiotic resistance is a problem in the rest of the world today.	**38**	**52**	10	2.28	0.636

The findings in this section revealed that 40.7% of patients showed a reasonable awareness about the reason for the occurrence of antibiotic resistance, which can be due to using antibiotics when they are not necessary. However, 84% of patients refused to accept that antibiotic resistance could be due to not completing the full course of antibiotic, revealing a lack of health and medical awareness about antibiotic medication.

Moreover, 48.7% of patients showed good understanding that antibiotic resistance could be due to using antibiotics without physician prescription (self-medication). However, this figure meant that there were about 52% of patients who either did not know or refused to accept this fact. Similarly, 38% of patients showed that they were aware that antibiotic resistance was a problem in the rest of the world today, however, about 62% of patients did not realise the risk and spread of antibiotic resistance at a global level.

31.3% of patients refused to believe the fact that antibiotic resistance could be due to using the same antibiotic from a different brand, but 44.7% of patients did know about this issue. 72.7% of patients did not believe that antibiotic resistance is a current problem in Saudi Arabia. This reflected the risks that patients exposed themselves to when they were against the medical facts and they were not careful when dealing with antibiotics. The lack of medical awareness about the causes of antibiotic resistance was clear among patients and the Saudi MOH should address this issue and encourage hospitals to adopt ASPs and conduct public campaigns in order to increase awareness about antibiotics use and resistance.

4) Doctors' habits and the relationship between doctors and patients

Table 7.5: Doctors' habits and the relationship between doctors and patients (N = 150)

Statement	Relative Frequency Distribution			Mean	Standard Deviation
	Agree %	Do not Know %	Disagree %		
E1- I trust the doctor's decision if she or he decides not to prescribe antibiotics.	**78.7**	7.3	14	2.65	0.715
E2- I trust the doctor's decision if she or he decides to prescribe antibiotics.	**80**	6.7	13.3	2.67	0.702
E3- Doctors often take time to consider carefully whether antibiotics are needed or not.	**45.3**	17.3	37.3	2.08	0.909
E4- Doctors often prescribe antibiotics because the patients expect it.	**38**	25.3	36.7	1.99	0.867
E5- A doctor who does not prescribe antibiotics when the patient thinks s/he should is a bad doctor.	14	4.7	**81.3**	2.67	0.709
E6- I consult another physician to prescribe antibiotics if my physician refuses to do so.	26	4	**70**	2.44	0.878

The findings in this section showed that 78.7%-80% of patients had good trust in their doctors when they decided to prescribe or not to prescribe antibiotics for them. Similarly, 45.3% of patients believed that their doctors often took time to consider carefully whether antibiotics were needed or not. Positively, 81.3% of patients believed that a doctor who does not prescribe antibiotics when the patient thinks s/he should is not a bad doctor, while 70% of patients believed that there was no need to consult another physician to prescribe antibiotics if their physician refused to do so.

5) Patients' use of antibiotics during hospital stay

Table 7.6: Patients' use of antibiotics during hospital stay (N = 150)

Statement	Relative Frequency Distribution			Mean	Standard Deviation
	Agree %	Do not Know %	Disagree %		
F1- My doctor/pharmacist told me that I am being treated with antibiotics.	12.7	4	**83.3**	1.29	0.68
F2- I was told about how to take the antibiotic.	**65.3**	8	26.7	2.39	0.881
F3- This hospital is strict when it comes to prescribing antibiotics.	**34.7**	34	31.3	2.03	0.814
F4- This hospital provides information on antibiotic resistance.	22.7	14.7	**62.7**	1.60	0.835
F5- My hospital stay improved my awareness of antibiotic resistance.	32	11.3	**56.7**	1.75	0.912

The findings in this section showed that 65.3% of patients had been informed about how to take their antibiotic. Similarly, 34.7% of patients agreed happily when their hospital was strict when it came to prescribing antibiotics. However, 83.3% of patients were strongly upset with their doctors and pharmacist because they did not inform them that they were being treated with antibiotics. Similarly, 62.7% of patients stated that their hospitals did not provide them with information on antibiotic resistance and 56.7% of patients showed that their hospital stay did not improve their awareness of antibiotic resistance. This means that patients do not receive enough information about antibiotics use and risks of resistance while they are staying in hospitals. Patients may expect their knowledge and awareness to be improved during their hospital stay if the healthcare professionals pay attention and supply health education about the effects of antibiotics and the risk of its misuse among healthcare professionals and patients.

In summary, the findings associated with the first research question revealed that most participants exhibited favourable knowledge and perceptions about reasonable use of antibiotics for themselves, relatives, and friends, without prescription. 50% of participants considered that antibiotics have efficiency against bacteria. 70-80% of participants trusted their doctors' decision with regard

to provision or refusal of antibiotic prescriptions. 65.3% of the participants who were hospitalised reported that they had been instructed on antibiotic usage, and 34.7% of participants confirmed their satisfaction with the strict policy implemented by their hospital with respect to antibiotic prescriptions.

On the other hand, use of antibiotics was inappropriately perceived by 79% of participants, who stated that they kept left-over antibiotics to use at a later date. Furthermore, 40-64% of participants were poorly knowledgeable about the effects and safe usage of antibiotics. A proportion of 38% of participants were of the opinion that doctors should prescribe antibiotics in order to satisfy patients' expectations. Around 60% of participants were unaware and uninformed about the risks of using antibiotics when not necessary.

84% of participants did not believe that lack of completion of a course of antibiotic could give rise to antibiotic resistance, revealing that they were not knowledgeable about antibiotics. Similarly, 72.7% of participants refused the idea that the issue of antibiotic resistance existed in Saudi Arabia. Such a view could have major implications, as patients could behave inappropriately with regard to antibiotic usage, disregarding medical facts. The significant issue of patient awareness regarding the effects of antibiotics should be dealt with by the Saudi MOH, and in particular it should promote the adoption of ASP and public campaigns among a larger number of hospitals to make patients more aware about the use of antibiotics, both at home and in the hospital.

7.3.3 Patients' knowledge and perceptions regarding antimicrobial use and resistance in a hospital with ASP and a hospital without ASP

The findings revealed significant differences between patients' knowledge and perceptions regarding antimicrobial use and resistance in the hospital with ASP (M: 54.30, SD: 4.30, N=74) and in the hospital without ASP (M: 50.67, SD: 6.43, N=76) in relation to the total of questionnaire scores (t = (4.05), p=0.000). These significant differences were in favour of the patients who registered in the hospital that has ASP. This meant that patients registered in the hospital where ASP took place showed more positive knowledge and perceptions towards antimicrobial

use and resistance than patients who were registered in hospital where ASP was not implemented.

The table below (Table 7.7) shows that only two sub-scales had significant differences in the knowledge and perceptions of patients registered in a hospital with ASP and patients registered in a hospital without ASP. The findings revealed significant differences between patients' knowledge and perceptions in the sub-scale 'Access to antibiotics' in the hospital with ASP (M: 6.89, SD: 1.32, N=74) and those who registered in the hospital without ASP (M: 6.17, SD: 1.84, N=76) in relation to the total of sub-scale scores (t = (2.74), p>0.01). This meant that patients in the hospital with ASP were more aware and knowledgeable of how to use and get access to antibiotics at home and among their family members, friends and relatives than patients in the hospital without ASP.

Furthermore, the findings showed significant differences between patients' knowledge and perceptions in the sub-scale 'Patients' use of antibiotics during hospital stay' in the hospital with ASP (M: 9.77, SD: 2.48, N=74) and in the hospital without ASP (M: 8.38, SD: 2.40, N=76) in relation to the total of sub-scale scores (t = (3.485), p>0.01). This meant that patients in the hospital with ASP were told about the issue of antibiotic resistance and were also informed about how to use the antibiotics by their doctor and pharmacist; by contrast, patients in the hospital without ASP were much less well-informed.

Table 7.7: T-test on the difference between the patients' knowledge and perceptions in a hospital with ASP and a hospital without ASP (N=150)

Patients' knowledge and perceptions	Hospital Type	Mean	SD	T	P
Access to antibiotics	With ASP	6.89	1.32	2.74	**0.007**
	Without ASP	6.17	1.84		
Effects of antibiotics	With ASP	11.55	2.31	1.560	0.121
	Without ASP	10.99	2.14		
Antibiotics resistance	With ASP	11.24	1.72	0.866	0.388
	Without ASP	10.97	2.07		
Doctors' habits	With ASP	14.84	2.08	1.795	0.075
	Without ASP	14.16	2.53		
Patients' use of antibiotics during hospital stay	With ASP	9.77	2.48	3.485	**0.001**
	Without ASP	8.38	2.40		
Total	With ASP	54.30	4.30	4.049	**0.000**
	Without ASP	50.67	6.43		

Gender influence:

The findings revealed significant gender-based differences between female patients (M: 56.55, SD: 3.69, N=71) and male patients (M: 48.78, SD: 4.72, N=79) in terms of knowledge and perceptions regarding antimicrobial use and resistance, in relation to the total questionnaire score (t = (11.14), p=0.000). This meant that female patients showed more knowledge and positive perceptions towards antimicrobial use and resistance than male patients. It seems that female patients were more careful about their health and safety and understanding the importance of the advice from healthcare professionals about using antibiotics in the hospital and at home.

Age influence:

In addition, One-Way ANOVA analysis was used to explore the impact of age group on patients' knowledge and perceptions regarding antimicrobial use and resistance in Saudi MOH hospitals. The findings did not show any significant differences in patients' knowledge and perceptions regarding antimicrobial use and resistance between different age groups (from 21 years to 80 years).

Educational influence:

One-way ANOVA analysis was used to examine the impact of patients' level of education on their knowledge and perceptions towards antimicrobial use and resistance (Less than high school; High school; Bachelor; Master; and PhD). The One-Way ANOVA analysis did reveal that there were significant differences between the patients' knowledge and perception towards antimicrobial use and resistance and their level of education (F = (4,145) = 3.33, p < 0.05, n = 150). Therefore, it seems that the patients who achieved a higher level of education, such Master's Degree, Bachelor's Degree and High School, showed more knowledge and perceptions towards using the antibiotics than the patients with a lower educational level, such as Secondary School.

In summary, the findings associated with the second research question reveal that, by comparison to patients in the hospital without ASP, patients in the hospital with ASP exhibited more favourable knowledge and perceptions towards and were better informed not only about antibiotic use and resistance, but also about how to gain access to antibiotics at home and among relatives and friends.

Furthermore, compared to patients in the hospital without ASP, the patients in the hospital with ASP had greater awareness and knowledge about antibiotic use during hospitalisation and they received more information about the problem of antibiotic resistance and how to take the antibiotics.

With regard to the influence of gender, the findings indicated that female patients were more aware and had more knowledge and perceptions about antibiotic use and resistance by comparison to male patients.

With respect to the influence of the level of education, the findings revealed a greater knowledge and positive perceptions about the use of antibiotics among participants with a higher level of education, such as Master's Degree, Bachelor's Degree and High School. By contrast, participants who finished only Secondary School were less aware and less knowledgeable. On the other hand, in terms of age, participants in different age groups (from 21 to 80 years of age) did not differ much with regard to knowledge and perceptions toward antibiotic use and resistance.

7.4 Discussion

The objectives of this quantitative study were to assess patients' knowledge and perceptions regarding antimicrobial use and resistance to evaluate the institutional role of patients' education. Findings of this study showed very poor knowledge and unhealthy perceptions about antimicrobial use and resistance among study participants. For example, almost half of the surveyed patients perceived that antibiotics could help them get rid of common cold quickly; and about 80% believed it was adequate to keep left-over antibiotics at home for future use. There were also misconceptions that antibiotics were effective in treating fever, viral infections and relieve of inflammation. This is in line with previous studies reporting that patients use antibiotics as analgesics, keep antibiotics at home for emergency use, and use of left-over antibiotics without physicians' consultation (Awad & Aboud, 2015; Oh et al., 2011; Shehadeh et al., 2012).

Furthermore, this study found that a good proportion of the surveyed patients (84%) were unaware of the local and global problem of antibiotic resistance, and that resistance could result from non-completion of a full course of antibiotic. This is in contrast with (André et al., 2010) who reported a high proportion (80%) of Swedish public perceive that bacteria could become resistant to antibiotics. These findings show a lack of patients/ public awareness of the link between antibiotic use/ misuse and the development of resistance (Laxminarayan et al., 2013). Consequently, the Saudi national AMR strategy launched in January 2017 (described in Chapter four) will be more effective when patients and the public are fully engaged through public enlightenment programmes and educational campaigns. In addition, this study found that most of the patients treated with antibiotics were not informed of what medicines they were taking, and hospitals did not make patients aware of the problem of antibiotic resistance. Therefore, individual hospitals need to have educational programmes for patients; also treating physicians, pharmacists and nurses should educate all patients prescribed antibiotics on the dangers of misuse and risks of AMR.

With respect to patients' knowledge and perceptions of antimicrobial use and resistance in a hospital with ASP and a hospital without ASP, findings of this study showed that patients in the hospital with ASP were more knowledgeable about antibiotic use than those in the hospital without ASP. Information on antibiotic use and resistance were given to patients in the hospital with ASP in contrast to the hospital without ASP. In Chapter six of this thesis, it was noted that extensive educational and training campaign (in Arabic and English) targeting both the hospital staff, patients and general public were carried out prior to the implementation of ASP. Such educational campaign is needed in hospitals intending to start the programme. This will create awareness of the problem of AMR among patients and the public who hold some misconceptions about antibiotics, and often do not complete the course of prescribed antibiotics.

In this study, patients with higher education were more knowledgeable about antibiotic use, and were more aware of the problem of antibiotic resistance than patients with lower educational levels. (Oh et al., 2011) had previously reported educational level as one of the demographic characteristics that is significantly

associated with knowledge and attitudes toward antibiotic use. In view of the threat of AMR poses in Saudi Arabia, the Saudi Ministry of Education should work towards embedding antimicrobial prescribing and stewardship competencies into undergraduate Medical, Pharmacy, Dental, Nursing and Veterinary curriculum, as well as introduction of antibiotic resistance topics. Antimicrobial stewardship principles are already included in most of the undergraduate healthcare and veterinary degrees in the UK (Castro-Sánchez, Drumright, Gharbi, Farrell, & Holmes, 2016). A survey of health education institutions to assess implementation rate of the competencies (infection prevention and control, AMR and antimicrobials, the prescribing of antimicrobials, antimicrobial stewardship and monitoring and learning) showed the average implementation rate for all universities and courses was 67% for all the dimensions (National Health Services England, 2016). Learning from the UK example will be a right step in the right direction for Saudi Arabia.

7.4.2 Implications for practice

In order to improve patients' perceptions and knowledge regarding appropriate antimicrobial use and risks of resistance, high authorities should address this issue and encourage hospitals to adopt ASPs and conduct public campaigns in order to increase awareness about antibiotics use and resistance, change patients' perceptions and culture regarding inappropriate antibiotic use, and control and monitor access to antibiotics in primary and secondary care, to improve antimicrobial practice, reduce antimicrobial resistance and improve patient care.

Patients' education regarding their antimicrobial therapy (nature, treatment and complications) is essential in the treatment process. This can be promoted through counselling patients taking antimicrobials, public health campaigns and media. Also, education of family members about appropriate use of antimicrobials and risks of AMR is important, in order to improve adherence to antimicrobial therapy and correct any wrong perceptions and practices among relatives and friends.

7.5 Conclusion

The objective of this quantitative study is to assess patients' knowledge and perceptions of antimicrobial use and resistance and to evaluate the institutional role of patients' education. It is clear from the results of this study that there are poor knowledge and perceptions regarding antimicrobial use and resistance among hospital patients in Saudi Arabia. Patients showed wrong perception towards getting access to antibiotics, they also showed lack of knowledge on the effects of antibiotics, lack of awareness and knowledge about causes of antibiotic resistance was also identified among participants, and finally patients identified that there is lack of information from hospital staff regarding antimicrobial use and risks of resistance especially in the hospital without ASP. On the other hand, good relation and trust was identified between patients and doctors when it comes to antibiotic therapy. Finally, patients in the hospital with ASP showed a better understanding and knowledge towards antimicrobial use and resistance than patients in the hospital without ASP. This shows that there is need to improve patients' educational programmes and campaigns on appropriate antibiotic use and risks of antibiotic resistance, and spread ASPs among hospitals to improve antimicrobial therapy and patients safety.

Chapter 8: Overall Discussion

8.1 Introduction

The aim of this thesis was to explore and investigate the level and process of adoption of ASPs and factors influencing their implementation in Saudi MOH hospitals. This is particularly timely since Saudi Arabia, among other Arab Gulf countries, is experiencing soaring levels of AMR and rapid emergence of novel and rare multi-drug resistant strains. This does not only have health and economic implications in the region, but could further globalise AMR and spread the rare resistant strains to other parts of the world given that Saudi Arabia hosts around 10 million pilgrims and visitors for Hajj and Umrah every year and is home to one of the largest expatriate populations in the world (Azeem et al., 2014; Kapiszewski, 2006; Memish et al., 2014; Saudi Ministry of Health, 2017a; H. M. Zowawi et al., 2013).

Despite the extensive literature addressing the adoption of ASPs in healthcare settings, little is known about the levels of ASPs adoption in the Arab Gulf region including Saudi Arabia, and the factors influencing their adoption that are particular to the Middle Eastern/ Saudi context. Therefore, this thesis had set out to enhance our understanding of ASPs in Saudi Arabia by looking at the factors that facilitate/ hinder Saudi hospitals' adoption of ASPs.

While the contributions to this area of research are appreciated, a large bulk of the literature does not address the context specific factors that drive ASPs in the Middle Eastern/ Saudi context and the factors that may influence innovation adoption in its healthcare settings. Despite the well-documented benefits of ASPs adoption in addressing inappropriate antimicrobials use (K. a. Cairns et al., 2013; Davey et al., 2017; Jorgensen et al., 2018; Wong-Beringer, Nguyen, Lee, Shriner, & Pallares, 2009) and reducing rates of AMR (Aldeyab et al., 2012; Davey et al., 2017; Martin et al., 2005; Yam et al., 2012), adoption of these strategies is still slow in healthcare settings of developing countries (Enani, 2016; Howard et al., 2015), and some developed countries (Howard et al., 2015; Pollack et al., 2016; Public Health England, 2015a, 2017). Various barriers to adoption have been identified. These include characteristics of the socio-political context such as lack

of regulations and legislation to adopt ASPs; characteristics of the healthcare organisation such as lack of administrative support, lack of expertise, lack of educational and training programmes, lack of IT systems, and lack of financial resources; characteristics of the healthcare professional such as lack of knowledge and skills and lack of ownership; and characteristics of the ASP being adopted such as trialability, clarity and advantages (Avent et al., 2014; Chen et al., 2011; Cotta et al., 2015; Enani, 2016; Johannsson et al., 2011; Pakyz et al., 2014; Trivedi & Rosenberg, 2013).

In Saudi Arabia, the MOH supervises the healthcare system including both private and public providers. It delivers care through 274 hospitals and specialised facilities which constitute 63% of hospital care provision and serves around 32 million people (Saudi Ministry of Health, 2017a). In response to the concerning levels of AMR in the country and in the region, the GCC countries introduced the strategic plan for combating AMR in 2014 (Balkhy et al., 2016), stemming from the WHO mandate to combat AMR at all levels (World Health Organisation, 2015a). Following that, Saudi Arabia has so far been the only country within the GCC region to introduce a national ASP guideline in 2014 (Saudi Ministry of Health, 2014). The progress of the implementation of this national ASP guideline is detailed in the recent review by Alomi (Yousef Ahmed Alomi, 2017). This has been highlighted in chapter 2, our review of existing evidence of ASPs adoption in the GCC region. We further highlighted that ASPs do exist in some hospitals in the region, and that Saudi tertiary hospitals and the large medical cities tend to be the main adopters of ASPs. This is not surprising given that when the national strategy was first introduced in 2014, it aimed to establish ASPs in tertiary MOH hospitals within the capital Riyadh first, then expanding further to other larger MOH hospitals (medical cities) within other localities (Yousef Ahmed Alomi, 2017). This centralised governance of ASPs could explain the slow levels of adoption in secondary hospitals, and could also explain the low level of adoption of ASPs in hospitals in other GCC member states, especially as their perspective MOHs are yet to introduce a national ASP guideline or strategy. Noteworthy, the WHO has supported several low and middle-income countries (LMIC) governments to decentralise healthcare services and devolve funding services to local authorities. However, failure of local governments to raise funds to support

local health services may jeopardise the optimum delivery of such services (Sreeramareddy & Sathyanarayana, 2013). Regional activation and delivery of ASPs within healthcare settings may be a potential approach to fastening the establishment of ASPs in Saudi hospitals, but the feasibility of such approach is uncertain, especially in the absence of local success examples.

In our review (Chapter two), we also identified the reported barriers to ASPs adoption in hospitals within the GCC region. These fall within three of the four sets of characteristics detailed in (Fleuren et al., 2014, 2004) framework of innovation within the healthcare organisation. First, characteristics of the socio-political context such as the lack of rules and legislations, especially since that Saudi has only recently introduced the national ASP strategy. Second, characteristics of the hospital such as the lack of senior management support, staff recruitment, and scarcity of resources especially IT and microbiology equipment. Third, characteristics of the healthcare professionals/hospital staff, such as physicians sense of potential clinical liability, their levels of knowledge and awareness of appropriate antimicrobial use and resistance, and the limited support from colleagues due to the common "working in slios" mentality.

These were further confirmed when healthcare professionals and staff from three MOH hospitals as well as regional and MOH central directorate were interviewed (chapter four) in relation to the factors that may facilitate or hinder ASPs adoption in healthcare settings. The same picture emerged when participants from MOH hospitals at a national level responded to the national survey (chapter five) to confirm senior management support, ASP team members and ASP benefits as significant factors affecting ASPs adoption in their organisations.

The poor enforcement of ASPs policies from the MOH and at hospital level has been blamed for lack of adherence to ASP guidelines and policies. The MOH antimicrobial stewardship committee could consider enforcing the policy as part of their nationwide effort to establish ASPs in hospitals. This will not only allow hospital management to set clear objectives, institutional mechanisms to monitor and ensure adherence to policies, and a long-term road-map for ASPs adoption and implementation, but also reduce physicians' anxiety and fears in relation to

potential clinical liability. However, a certain degree of autonomy has to be maintained to reflect local patient demand and characteristics (Blume, van Weert, Busari, & Delnoij, 2017).

The majority of the identified barriers were related to the healthcare organisation itself. These included the availability of IT infrastructure (including electronic prescribing), senior management support, shortage of ASP team members, the disintegrated multi-disciplinary teams and the lack of education and training.

Unlike the high levels of adoption of electronic prescribing and data management systems in hospitals here in the UK and many other European countries, electronic prescribing and the availability of a sophisticated IT system in hospitals in Saudi Arabia is still lagging. Electronic health records and clinical decision support systems improve clinicians' daily antimicrobial stewardship tasks (Kullar & Goff, 2014), and the lack of these systems is causing the reluctance of hospitals to adopt novel applications and practices such as ASPs. Although electronic prescribing has been reported to be in use in hospitals in all GCC countries (Enani, 2016), it is likely to be only adopted in advanced tertiary or military hospitals. UEA has only recently (March 5th 2018) announced that all healthcare facilities across the country (public and private) must only deal in printed and electronic prescriptions within six months of the announcement, suggesting the end of the hand-written prescription (Ministry of Health and Prevention, 2018; UAE News 24/7, 2018).

Senior management support has been suggested as a significant factor affecting hospitals' adoption of ASPs. This is part of the culture within hospitals in Saudi and others in the region, where managers tend to be mainly reactive rather than pro-active, and their role largely involves response to and ensuring compliance with rules and regulations set out by government (Balasubramanian & Sundarakani, 2017). Healthcare professionals suggest senior management support as a strong predictor of ASPs adoption. Like in the case of IT innovation adoption for example, managers who are aware of the seriousness of AMR and previous experience of ASPs are more likely to adopt the innovation. These managers are convinced with the benefits of ASPs, are motivated to adopt them,

can form partnerships with ASP team members, and can sustain the confidence and the stability throughout the innovation adoption journey (Ingebrigtsen et al., 2014).

The shortage of ASP team members is a significant barrier to ASPs adoption in hospitals. The lack of ID specialists and clinical pharmacists has been frequently stated. However, nurses' role in ASPs management is rarely addressed. Although their role in antimicrobial stewardship has not been very well developed, guidelines form UK, and the US clearly refer to staff nurses being part of the multidisciplinary ASP teams (Centers for Disease Control and Prevention, 2017; Edwards et al., 2011; Public Health England, 2015b; Sumner et al., 2018). Further, nurses are uniquely positioned to successfully implement ASPs (Edwards et al., 2011) in that nurses are central communicators between physicians, pharmacy, microbiology labs, discharge planners and consultants. They are also a primary source of information for patients during their hospital stay, including information about the appropriate use of antimicrobials and reducing the emergence of AMR (Olans, Olans, & Demaria, 2016). Nurses should be offered education and training, and empowered to participate in ASP teams, beyond their traditional role of infection control (Olans et al., 2016).

This lack of involvement of nurses in antimicrobial stewardship within Saudi hospitals can explain the disintegration reported as a further barrier to ASPs adoption. But it can also be explained by the nature and characteristics of the workforce within Saudi healthcare organisations.

The language barrier has been blamed for poor communication amongst healthcare staff, given that healthcare professionals consist of a large proportion of expats (A. F. Almutairi, Gardner, & McCarthy, 2013; Elsheikh, Alqurashi, Wahba, & Hodhod, 2018). This can also have implications on the communication between healthcare professionals and patients (K. M. Almutairi, 2015). Further, healthcare professionals from different countries bring different beliefs and practices to Saudi healthcare settings (Badrinath, Ghaza-Aswad, Osman, Deemas, & McIlvenny, 2004), and in the absence of strict enforcement of policies and regulations, there is no standardised practice and this could have serious

implications on the quality and safety of care delivered to patients (Bahnassi, 2016). While the value of diversity is somewhat recognised, the Saudi government and others in the region are attempting to address the heavy dependence on foreign healthcare workforce through the Saudisation (Elsheikh et al., 2018), and other workforce nationalisation strategies in the GCC states (Randeree, 2012).

Expat nurses make up around 70% of the nursing profession in Saudi Arabia (Saudi Ministry of Health, 2017a). The picture is similar in other GCC states despite the existence of nursing education and the modest governments' efforts to encourage uptake of this training by GCC nationals. However, the contribution of nurses to clinical care remains under-recognised by hospital administration and physicians and a complete absence of career progression structures (Hibbert, Al-Sanea, & Balens, 2012).

Moreover, because of the culture norms in Saudi Arabia, and the dominance of male representation in the workplace especially at strategic levels, male healthcare professionals have more interactions and socialisation with colleagues than females, presenting more opportunities for them for professional development especially in relation to education and training on antimicrobial stewardship (M. U. Khan, Shah, Ahmad, & Fatokun, 2014); hence, the female healthcare professionals may not have as much opportunities as their male counterparts. Other characteristics of healthcare professionals that hinder the adoption of ASPs are physicians attitudes towards multi-disciplinary teams (MDTs) especially with nurses, as some of the physicians feel uncomfortable as nurses suggest changes or stopping of medications (Silbermann et al., 2013).

Not surprising that these were reported in all the three participating hospitals (chapter four) which are all under the supervision of the MOH, reflecting a shared organisational climate. Given the potential influence of the organisational climate on hospitals' performance (Zhou, Bundorf, Le Chang, Huang, & Xue, 2011), it is imperative that these barriers are addressed strategically at ministry level as well as at hospital level before ASPs can be successfully adopted.

The adoption of ASPs has mainly been investigated in public/ government hospitals and little is known about ASPs adoption in the private sector, which according to the limited literature is still lagging. In the private sector, physicians and consultants tend to be more autonomous, and there is greater opportunity for involvement from nurses and pharmacists (Cotta et al., 2015). This may increase the chances of private hospitals adopting ASPs quicker if enforcement is central.

Interestingly, all participants perceived ASPs to be extremely beneficial in addressing inappropriate antimicrobial use and resistance. So, the fourth set of characteristics within Flueren et al. framework relating to the characteristics of the innovation, in this case ASP, do not affect Saudi hospital's decision to (or not to) adopt ASPs. Healthcare professionals in Saudi Arabia recognise the benefits of ASPs adoption and they did not identify any issues relating to the programme itself. This is similar to previous findings (Steinberg et al., 2016; Venugopalan et al., 2016).

The medical city is a 1500-bed tertiary medical city. It is one of the few MOH hospitals with an established ASP since January 2016. The hospital adopted ASP as part of an initiative to improve the patient safety portfolio of the organisation. In addition to the national ASP strategy, the medical city had to introduce and enforce their own ASP strategy, without waiting for MOH implementation of the programme which was still at its infancy at the time. This does not only fasten the process of adoption and implementation, but provides the institution with autonomy over monitoring and performance targets. Leadership was paramount to the adoption and implementation of ASP at the medical city, as the hospital board required frequent updates on antimicrobial stewardship activities. Staff there further emphasised the commitment, engagement and support of senior management as significant facilitators of ASP adoption. This is not surprising since similar factors have been proposed for the adoption of ASPs here in NHS trusts (Cooke et al., 2004).

To overcome the scarcity of ID consultants, the medical city recruited a clinical pharmacist who was tasked to undertake a clinical pharmacist-led adoption of ASP. This strategy has proven to be an effective approach to overcome the

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limitation of resources and expertise in several countries including US (Meyer et al., 2016; Waters, 2015), UK (Dunn, O'Reilly, Silke, Rogers, & Bergin, 2011) and Pakistan (Haque et al., 2018). While there was great collaboration between physicians and pharmacists under this initiative, nurses' involvement remained within the traditional remit of infection control. This lack of optimum utilisation of skills and expertise within the organisation may have contributed to the high workload and the shortage of staff perceived by participants.

Not surprisingly, the availability of IT infrastructure further hinders ASP adoption efforts. In the absence of electronic prescribing, the medical city struggle to capture prescribing patterns and antimicrobials consumption data.

It is recognised that Hajj presents further challenges to Saudi hospitals especially the ones like the medical city in Makkah (a holy city and the main pilgrimage destination). Al Somai et al. describes how antimicrobial consumption increases dramatically during Hajj and the difficulty to sustain antimicrobial stewardship during the pilgrimage season (Al-Somai et al., 2014). This problem is further exacerbated by the lack of an efficient IT system within hospitals to improve prescribing practice and ensure patient safety.

Saudis and other patients within the GCC region seek healthcare when they are ill, and do not routinely engage in preventive healthcare (El Bcheraoui, Tuffaha, Daoud, AlMazroa, et al., 2015; El Bcheraoui, Tuffaha, Daoud, Kravitz, et al., 2015). This behaviour could worsen the problem of AMR for three reasons: First, there is unrestricted access to antibiotics facilitated by various community enablers who include trained private pharmacists and untrained pharmacy attendants (Bin Nafisah et al., 2017).

Second, the lack of public awareness of appropriate antimicrobial use and resistance in Saudi Arabia (Bin Nafisah et al., 2017) and other GCC states (Alhomoud et al., 2017; Awad & Aboud, 2015), calling for a more active role of MOH to provide health education to Saudis (El Bcheraoui, Tuffaha, Daoud, AlMazroa, et al., 2015). Here is the UK for example, PHE is an executive agency of the DOH which is responsible for protecting and improving people's health and

wellbeing, and reducing health inequalities. Annual awareness initiatives such as Antibiotic Awareness Week target patients with information in various forms to highlight the issue of resistance and promote appropriate use of antibiotics (Public Health England, 2015a, 2017).

Third, prescribers behaviour in relation to potential clinical liability, patients expectations, their knowledge and level awareness as well as poor enforcement of guidelines (Al-Homaidan & Barrimah, 2018). When patients were invited to complete the patients survey (chapter seven) on their level of knowledge and perceptions of antimicrobial use and resistance, and their antibiotics usage and practices, most patients' knowledge and perceptions were low, and they demonstrated incorrect practices that contribute to AMR. This is in agreement with previous findings (Awad & Aboud, 2015; Oh et al., 2011; Shehadeh et al., 2012). However, it was found that overall, patients who were staying at the medical city, an ASP adopting hospital, demonstrated better levels of knowledge and perceptions of appropriate antimicrobial use and resistance, compared to the patients staying at a hospital without an established ASP. Although ASP is an institutional programme rather than a patient-facing practice, the outcomes of ASP adoption should address patients' knowledge and perceptions regarding antimicrobials use. In other words, the outcomes of adoption of ASPs should translate into improved patients' use of antimicrobials, especially during their hospital stay. Like in the case of smoking cessation interventions, hospitalisation offers an ideal opportunity to deliver health promotion message and educate patients on appropriate antimicrobials use and resistance as patients are more likely to be receptive of such messages, and are more likely to adhere to advice given by hospital staff (Mellon et al., 2016). This is also a key strategic objective set out in the World Health Assembly action plan to tackle AMR (World Health Organisation, 2015a).

GCC member states share a number of geographical, historical, cultural and political characteristics that make the issue of AMR more regional than local (M. Aly & Balkhy, 2012; Center for International and Regional Studies, 2017). The similar rates of AMR across the region and the familiarity of the reported barriers hindering the adoption of ASPs in GCC hospitals make the recommendations

drawn from this research not only relevant to Saudi hospitals, but also Bahrain, Kuwait, Oman, Qatar and UAE.

8.2 Conclusion

The aim of this research was to explore and investigate the level and process of adoption of ASPs and factors influencing their implementation in Saudi MOH hospitals, in order to provide evidence-based recommendations for their successful adoption and implementation. The availability of legislations and regulations that require and enforce hospitals to implement ASPs, administrative support, competent personnel, educational programmes, expertise (ID consultants, antimicrobial pharmacists, microbiologists), effective inter-professional collaboration & communication and IT resources are key to the successful implementation of ASPs. Policy makers could take the findings of this research to help in implementing national guidelines for antimicrobial use and resistance surveillance, and make ASPs a regulatory requirement in Saudi hospitals.

Leadership support was identified as one of the main drivers to facilitate the adoption and implementation process of ASP through providing required human, financial and IT resources and by including the ASP duties in the daily tasks and annual evaluation reports of related staff. Training and residency programmes on ASPs, infectious diseases and infection control for different health specialities has been found to be critical to the success of ASPs since there is big demands by healthcare professionals to improve healthcare courses. There is also need to improve patients' educational programmes and campaigns on appropriate antibiotic use and risks of antibiotic resistance, and spread ASPs among hospitals to improve antimicrobial therapy and patients' safety.

8.3 Research contribution to knowledge

What is already known regarding this topic (Figure 8.1):

⟩ The issue of increasing rates of AMR is a public health concern worldwide, but more in Saudi Arabia, due to the high number of expatriates working in the country and high number of visitors every year for Hajj and Umrah.

⟩ It is also a more serious issue due to lack of national strategies to control and monitor the use of antimicrobials and resistance rates.

⟩ Only few studies reported the availability of ASPs in big and advanced hospitals in Saudi, however, the situation in other hospitals are still unknown.

⟩ Barriers of successful adoption of ASPs have been identified in some studies worldwide and could include lack of expertise, lack of financial resources, lack of leadership support and lack of educational and training programmes.

⟩ Lack of knowledge and awareness among patients regarding appropriate antimicrobial use and risks of AMR were identified in some studies worldwide.

What this research adds to existing knowledge (Figure 8.1):

⟩ Identified the level of adoption of ASPs in Saudi MOH hospitals (chapter four and five).

⟩ Investigated barriers and facilitators of ASPs in GCC countries (through the systematic review (chapter two)), and in Saudi MOH hospitals (chapter four and five).

⟩ Explored how to adopt ASP in a Saudi MOH and how barriers can be overcome for successful adoption of ASPs in the Saudi context (chapter six).

⟩ Identified outcomes of ASPs in GCC countries (through the systematic review), and in a Saudi MOH hospital (chapter six).

⟩ Patients in the hospital with ASP showed better knowledge and perceptions regarding antimicrobial use and AMR than patients in the hospital without ASP (chapter seven).
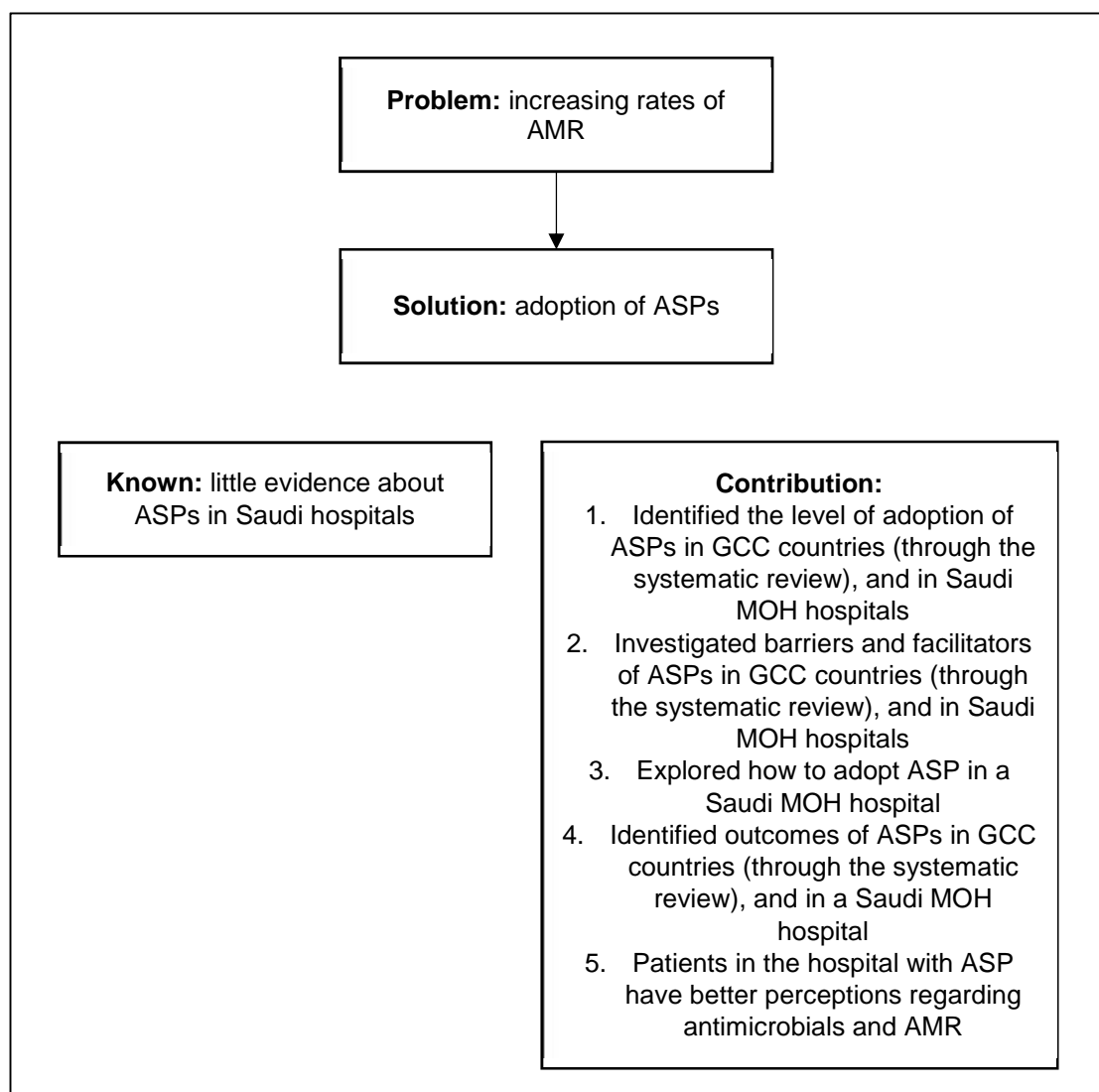
Figure 8.1: Research contribution to knowledge

8.4 Strengths and limitations of the research

8.4.1 Strengths

⟩ To the knowledge of the researcher, this is the first research to explore the situation of ASPs and identify factors influencing their adoption in Saudi MOH hospitals and explore the adoption process of an ASP in a Saudi MOH hospital.

⟩ The findings of the systematic review (chapter two) identified gaps in knowledge regarding ASPs in Saudi hospitals, that were used to develop the aim and objectives of this research.

⟩ The systematic review search was carried out in both Arabic and English languages in order to identify all the available information and gain in-depth understanding of the topic.

⟩ The researcher used a mixed methods approach (a qualitative and a quantitative methods) as a method of triangulation in order to enhance the validity and reliability of the research findings.

⟩ A sequential exploratory method was used which involved the use of a qualitative tool followed by a quantitative tool, that was developed from the findings of the qualitative study, this is to increase the generalisability of the findings and apply the findings to a wider population.

⟩ The researcher explored and investigated the situation of ASPs in Saudi MOH hospitals from the point of view of different healthcare professionals including, ID specialists/consultants, hospitals pharmacists, microbiologists, infection control practitioners/ specialists/consultants, nurses, physicians (healthcare providers), hospitals leaders, and MOH leaders (decision-makers).

⟩ The findings of the qualitative study (chapter four) informed the development of the national survey (chapter five).

⟩ The use of social media platforms such as WhatsApp and Twitter to distribute the national survey link improved the response rate.

8.4.2 Limitations

⟩ This research explored the situation of ASPs in Saudi MOH hospitals only, so the findings of this research may not be applied to other types of hospitals.

⟩ The main limitation of the qualitative study (chapter four) was that the sample size was relatively small, therefore, generalisability cannot be ensured. However, to overcome this limitation, interviews were conducted with different healthcare professionals from different hospital settings and with policy makers on regional and national levels to attempt to capture the views of personnel from different settings and levels.

⟩ The main limitation of the quantitative study (chapter five) was the response rate (53.6%) which is always one of the main limitations of

surveys. Although, reminders were sent at two weeks intervals to increase response rate, and different methods were used to distribute the survey link.

⟩ No responses were received from obstetrics/gynaecology, paediatrics and chest hospitals for the national survey, therefore the findings of the study cannot be applied to these hospitals.

⟩ Although, a national approval was obtained from the Saudi MOH to conduct the survey in all Saudi MOH hospitals, some hospitals requested to apply for their own approvals which was not applicable due to the time frame of this research.

⟩ The reliability of online self-administered surveys is lower than other methods of survey administration, as the identity of respondents cannot be ensured due to the physical absence of the researcher from the respondent. However, the online link of the survey (chapter five) was sent through official channels to ensure that the link will reach the targeted participants and no other people.

⟩ The case study (chapter six) was conducted in a hospital with some resources that may not be available in other hospitals, so resources and hospital structure in other hospitals should be considered before applying the findings of this study.

⟩ Lack of IT resources hindered the electronic collection of some data regarding outcomes of the ASP at the medical city (chapter six), as data were collected manually at some departments, which resulted in workload and in some data being unavailable.

⟩ The patients' survey (chapter seven) was conducted only in two hospitals, therefore the findings of the study may not be applied to other hospitals.

8.5 Recommendations

The prevalence of multi-drug resistant pathogens in Saudi Arabia, coupled with the widespread inappropriate use of antimicrobials put the country on a fast track to the pre-antibiotic era. This is particularly alarming since the country hosts one of the largest expatriate populations in the world, and is a destination to millions

of travellers for annual and seasonal pilgrimage rituals; increasing the risk of spreading AMR to most countries in the world.

Urgent action is needed to address the strategies priorities associated with AMR, including access to antimicrobials, antimicrobial stewardship and education and research. A key context to also consider here is Hajj and the need to reduce the risk of globalising AMR during this mass gathering.

Access

It is imperative that patients have access to antimicrobials that could improve health and save lives. But a balance has to be achieved to secure access whilst restricting excess and inappropriate use. The main drivers of AMR in Saudi include inappropriate and overuse of antimicrobials resulting from lack of knowledge by both patients and clinicians on the subject, gaps in existing policies on tackling AMR and lack or poor implementation of relevant policies. The establishment of a national antimicrobial stewardship plan and the recent introduction of legislation to prohibit the sale of antimicrobials over the counter are encouraging initiatives to reduce inappropriate and excessive use of antibiotics. However, if healthcare professionals are now aware of such initiatives, and regulations are not enforced, these efforts are likely to be futile. Therefore:

- Policy makers are required to commit to implement the national AMR strategy by establishing effective ASPs at national and regional levels both in hospitals and community care settings.
- Having ASPs should become a regulatory requirement for accreditation of hospitals in Saudi Arabia.
- The MOH is also required to restrict access to antimicrobials over the counter through enforcing the recently introduced legislations.
- Higher education institutions and teaching hospitals are required to introduce antimicrobial prescribing and stewardship competencies into undergraduate Medical, Pharmacy, Dental, Nursing and Veterinary curriculum, as well as introduction of AMR topics in order to increase knowledge and awareness of ASPs and AMR.
- The Saudi commission for Health Specialities, in partnership with higher education institutions, teaching hospital and even international

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collaborators is urgently required to increase the provision of ID and infection control residency and training programmes to meet the extreme shortage of ID physicians, pharmacists, microbiologists and infection control practitioners. The availability of specialised staff to form ASP teams is a key determinant of successful adoption and implementation of ASPs in Saudi hospitals.

ʃ The Saudi Food & Drug Administration (FDA) is required to restrict the marketing of antimicrobials especially the ones that are reserved for resistant/ life-threatening infections. This strategy can control the accessibility of antimicrobials and reduce their inappropriate use.

Stewardship

Reducing the inappropriate use of antimicrobials in Saudi hospitals has been recognised by the Saudi MOH as a top priority, through the establishment of a national ASP strategy and the planned implementation across hospitals in the kingdom. However, due to the gravity of AMR, urgent and fast actions are required to accelerate ASPs adoption and improve prescribing practices. To achieve this, it is essential that the following actions are put in place:

ʃ Disseminating of good practice by establishing collaboration between ASPs adopting and non-adopting hospitals to share implementation experience, strategies and solutions to overcome barriers.

ʃ Establishing regional surveillance systems that feed into a national surveillance programme that is able to monitor resistance rates and inform infection prevention and control practices. Laboratory-based surveillance is probably the most efficient method, but the MOH has to invest in laboratory infrastructure, and certainly robust information systems to support the surveillance programme.

ʃ Investing in health information systems that support prescribing decisions, improve communication and data sharing, and enable tracking of antimicrobial consumption not only in secondary care, but also primary care including the private sector. Data will inform local and national strategies to reduce AMR.

) Enrolling in the GLASS programme to share antimicrobials consumptions and resistance rates internationally in order to be part of the global decision-making and to drive the national plan.

The MOH has already adopted the AWaRe model (Access, Watch and Reserve) when categorising antimicrobials in their guidelines, and Saudi hospitals have these guidelines in place but they are not adhered to, as they are poorly enforced by the Ministry as well as the hospital management. A proper implementation of these guidelines requires:

) Close collaboration between the MOH, hospital management, professional regulators and healthcare professionals; and
) Hospitals providing a comprehensive and compulsory educational and training programme about ASPs, appropriate use of antimicrobials and risks of AMR to all new staff including physicians, pharmacists, microbiologists and nurses

Reducing inappropriate use of antimicrobials can also be achieved through improving the provision of preventative measures to reduce the spread of infections and optimise the role of vaccines in improving public health. Further, national campaigns and enhanced advertising through multimedia and social media channels can increase the public's awareness and knowledge of AMR and how to preserve antimicrobials. This can be similar to the UK Antibiotic Guardian that supports the UK AMR national strategy, the EAAD and the World Antibiotic Awareness Week.

Research

Although the literature relating to antimicrobial stewardship is rich, little is known about the adoption and implementation of ASPs in the context of the Middle East. It is imperative that antimicrobial stewardship is explored in Saudi Arabia and other countries in the region, mainly because, the region may become a "hot spot" of rare and virulent strains of resistant microbes; and these may find their way to every other country in the world. Multi-disciplinary research, linking all sectors of healthcare is needed to provide insightful recommendations towards intelligent,

integrated and mindful approaches to reduce the inappropriate use of antimicrobials. For that:

-) Healthcare specialised associations (such as the newly established Saudi Clinical Pharmacy Association) are needed to be part of AMR conversation and guide healthcare professionals' training and accreditation.
-) A centre in MOH is needed to share expertise, ideas, experiences, and solutions on a national level to provide implementation tools and resources to help hospitals to adopt ASPs.
-) Learning from failures is important, and therefore, introducing Failure Mode and Effects Analysis (FMEA) as a routine practice in hospitals and at a national level will ensure policies and procedures are regularly reviewed and updated to improve implementation
-) Funding of research activities, networking across disciplines and sharing research ideas and solutions will ensure that local problems have local solutions and are applicable to the local population.

Multiple stakeholders should be actively part of the conversations around tacking AMR. Primary care, secondary care, community pharmacies and policy makers should strive to create a shared culture of responsibility among all healthcare partners to improve antimicrobial therapy and reduce risks of AMR.

It is recommended that efforts to implement ASPs should follow a step-wise approach; starting at regulation level, then prescribing policies and practices in healthcare settings, parallel to integrating microbiology services and diagnostics to prescribing formularies and decisions, then at pharmacy dispensing levels and strengthening the role of pharmacists in curbing inappropriate prescribing, then should end at improving the appropriate use of antimicrobials by the end user.

The Saudi MOH has already started rolling the programme in both secondary and tertiary hospitals centrally (mainly in Riyadh) then regionally, then locally. However, no plans have yet been announced regarding the primary care sector, but these are urgently needed not to render the national ASP programme futile.

The timeline to implement antimicrobial stewardship recommendations should be agreed with stakeholders to take into account agreed milestones and length of interventions; bearing in mind that a "one size fits all" approach may not be feasible and may undermine the success of ASPs implementation. Evaluation of outcomes of ASPs interventions should be both patient and pathogen-based. These evidence of effectiveness in turn, could support the optimal design and use of ASPs interventions.

The recommendations of this research will be shared with the Saudi MOH (the infection control department and the pharmaceutical care department) and healthcare professionals who participated in this research.

8.6 Future Research

To advance research in this area, future research could:

-) Explore the situation and factors influencing ASPs in other governmental hospitals (such as Ministry of National Guard, Ministry of Defence, Ministry of Education and Ministry of Interior Hospitals), private hospitals, primary healthcare centres (PHCs) and community pharmacies.
-) Explore the adoption and implementation process of ASPs in other Saudi MOH hospitals, other governmental hospitals, private hospitals, PHCs and community pharmacies in order to gain a better understanding of the situation of ASPs in different hospitals types and provide recommendations to relevant organisations accordingly.
-) Assess patients' knowledge and perceptions regarding antimicrobial use and resistance in other MOH hospitals, governmental hospitals, private hospitals, community pharmacies and among the general public in order to gain a better understanding of the situation in different settings and provide recommendations at a national level.
-) Develop, run and assess public health campaigns to educate the general public and patients on the appropriate use of antimicrobials and risks of AMR.

8.7 Reflection on the Research Process

Reflexivity is the process of critically reflecting on the researcher himself, his role in the research, relation with the research topic and research environment. It critically explores the researcher's personal experience in relation to the research environment and context. This is essential to understand the influence of the researcher's characteristics and experiences on the research process and methods.

My educational background and work experience as a full-time hospital pharmacist at a central MOH hospital in a Saudi region has provided me with knowledge and skills that helped me to start this project. My previous work experience in a Saudi MOH hospital showed me the issue of the overuse and misuse of antimicrobials and the lack of surveillance of antimicrobials and AMR rates in Saudi hospitals. This was the motivation to start reading about international experiences in controlling the overuse and misuse of antimicrobials, which identified ASPs as one of the solutions to monitor the use of antimicrobials. As a previous member of the Saudi MOH, ethical approvals from the participating hospitals and the Saudi MOH were successfully obtained, as I used my network to help obtain hospital and MOH approvals.

Throughout this research, I have improved my research skills and learnt the different methodological approaches needed to answer specific research questions. I have also learnt about what method to use to answer a research question and why, the different methods to collect qualitative and quantitative data, how to analysis them, sampling methods, reliability and validity of data, this was done through reading different research articles and through the generic research training courses offered by the UH. The regular meetings and feedback from my supervisors, improved my personality, research and writing skills, critical thinking and communication skills.

This PhD journey has been a life learning experience. It has improved my knowledge, research skills, communication and network in the UK and Saudi, which opens doors for future research and collaboration. I am really thankful for the support and encouragement of my sponsors, university, supervisors, participants and colleagues at the Saudi MOH who helped me immensely to

collect data for this project and achieve the objectives of this research. My only hope is that this project will inform policy makers and healthcare professionals to make ASPs adoption and implementation a reality in Saudi hospitals.

9 Research Output

Publications

Alghamdi S, Shebl N, Aslanpour Z, Shibl A, Berrou I (2018). Hospital Adoption of Antimicrobial Stewardship Programmes in Gulf Cooperation Council Countries: A review of existing evidence. Journal of Global Antimicrobial Resistance, 2018.

Presentations

Department of Pharmacy, Pharmacology and Postgraduate Medicine, Postgraduate research seminars, University of Hertfordshire, 6th December 2017. The adoption of antimicrobial stewardship programmes in Ministry of Health Hospitals in Saudi Arabia.

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11 Appendices

Appendix 1: University of Hertfordshire Ethics Approval Notification

UNIVERSITY OF HERTFORDSHIRE

HEALTH AND HUMAN SCIENCES

ETHICS APPROVAL NOTIFICATION

TO	Saleh Alghamdi
CC	Dr Ilhem Berrou
FROM	Ms Kim Goode, Health and Human Sciences ECDA Vice Chairman
DATE	01/04/16

Protocol number: **LMS/PGR/UH/02344**

Title of study: The Adoption of Antimicrobial Stewardship Programmes in Saudi Arabia Hospitals

Your application for ethics approval has been accepted and approved by the ECDA for your School.

This approval is valid:

From: 01/04/16

To: 01/09/17

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: Qualitative study interview schedule

Interview schedule

Good morning/afternoon and welcome. I would like to thank you for taking the time to join this interview.

The aim of this session is to explore the prevalence and characteristics of antimicrobial stewardship practices and barriers and facilitators for their adoption to promote and monitor the judicious use of antimicrobials in Saudi hospitals.

This interview is part of my PhD research at the University of Hertfordshire to examine the adoption of antimicrobial stewardship programs in Saudi hospitals.

The interview should take **around (15) minutes to complete.**

Please note that today's discussion will be audio recorded and transcribed verbatim to ensure the full interpretation of your contribution. Only the research team, comprising of me (Mr Saleh Alghamdi), and the supervisory team comprising of Dr Ilhem Berrou, Dr Nada Atef Shebl and Dr Zoe Aslanpour, will have access to this recording and transcript.

Once the interview is transcribed I will send you a copy to make sure you are happy with the interview content and to check that we have not missed anything.

There are no right or wrong answers to the questions I am going to ask. Please feel free to share your opinion or experience.

Onto the questions,

Part A

1. Hospital………………………….
2. City…………………………….
3. Bed capacity……………………..
4. Current position?

Infectious diseases physician	◯
Clinical/hospital pharmacist	◯
Microbiologist	◯
Chief executive officer/medical officer	◯
Infection control practitioner/nurse	◯

5. Gender?   Male   Female
6. Years of experience?

Part B

1. What antimicrobial stewardship practices are you employing at your hospital to promote and monitor the judicious use of antimicrobials?
2. Who are the members involved in these practices?
3. What is the role of each member?
4. How often do those members meet?
5. How effective are those practices in promoting and monitoring the judicious use of antimicrobials? Why?
6. What policies or recommendations are implemented in your practice to help combat resistance/ or help reduce antimicrobial resistance?
7. Who do you report resistance data to?
8. Have you faced any difficulties (e.g. non-acceptance of recommendations from HCWs, lack of resources/personnel for the program) in implementing antimicrobial stewardship practices? If yes, what happened and how was the situation handled?
9. Can you give an example of meeting an antimicrobial stewardship practice specific outcome, what was the situation, and what enabled success?
10. Can you give an example of NOT meeting an antimicrobial stewardship practice specific outcome, what was the situation, and what were the reasons for not being successful?
11. Which antimicrobial stewardship practices are MORE likely to be accepted/effective at your hospital to promote and monitor the judicious use of antimicrobials? Why?
12. Which antimicrobial stewardship practices are LESS likely to be accepted at your hospital to promote and monitor the judicious use of antimicrobials? Why?
13. What do you think the main challenges/barriers are going to be in adopting antimicrobial stewardship practices to promote and monitor the judicious use of antimicrobials in your hospital?
14. What are the required facilitators for the adoption of antimicrobial stewardship practices to promote and monitor the judicious use of antimicrobials in your hospital?

Are there any other issues that you feel we haven't talked about that you would like to mention?

I would like to thank you for participating in today's discussion.

Appendix 3: Qualitative study invitation letter

Subject: <u>Invitation to participate in a research study</u>

Dear Sir/Madam

I am a PhD student at the department of Pharmacy, Pharmacology and Postgraduate Medicine at the University of Hertfordshire. My research aims to examine the adoption of antimicrobial stewardship programmes in Saudi hospitals.

I will be grateful if you agree to participate in an interview regarding antimicrobial stewardship practices in your hospital. The information you provide during the interview is strictly confidential. Further information on my study is available in the attached information sheet. This research has been approved by my university ethics committee and your hospital.

The interview will last approximately (15) minutes and will be conducted in the meeting room of your department. Please note that there is no incentive for participating in this interview, and you have the right to withdraw from the study at any time.

If you agree to participate in this study, please sign the attached consent form and return to your head of department with this letter indicating a time that is convenient for you.

Date..................   **Time..................**

Truly yours,

Saleh Alghamdi
PhD student
Department of Pharmacy, Pharmacology and Postgraduate Medicine
University of Hertfordshire
College Lane Campus
Hatfield, United Kingdom
AL10 9AB
s.alghamdi2@herts.ac.uk

Appendix 4: Written Consent Form

UNIVERSITY OF HERTFORDSHIRE

ETHICS COMMITTEE FOR STUDIES INVOLVING THE USE OF HUMAN PARTICIPANTS

('ETHICS COMMITTEE')

FORM EC3

CONSENT FORM FOR STUDIES INVOLVING HUMAN PARTICIPANTS

I, the undersigned *[please give your name here, in BLOCK CAPITALS]*

……………………………………………………………………………………………………

of *[please give contact details here, sufficient to enable the investigator to get in touch with you, such as a postal or email address]*

…..…………………………………………………………………………………………………

hereby freely agree to take part in the study entitled;

The Adoption of Antimicrobial Stewardship Programmes in Saudi MOH hospitals

…………………………………………………………………………………………………

1 I confirm that I have been given a Participant Information Sheet (a copy of which is attached to this form) giving particulars of the study, including its aim(s), methods and design, the names and contact details of key people and, as appropriate, the risks and potential benefits, and any plans for follow-up studies that might involve further approaches to participants. I have been given details of my involvement in the study. I have been told that in the event of any significant change to the aim(s) or design of the study I will be informed, and asked to renew my consent to participate in it.

2 I have been assured that I may withdraw from the study at any time without disadvantage or having to give a reason.

3 In giving my consent to participate in this study, I understand that voice, video or photo-recording will take place.

4 I have been told how information relating to me (data obtained in the course of the study, and data provided by me about myself) will be handled: how it will be kept secure, who will have access to it, and how it will or may be used.

5 I understand that if there is any revelation of unlawful activity or any indication of non-medical circumstances that would or has put others at risk, the University may refer the matter to the appropriate authorities.

6 I have been told that I may at some time in the future be contacted again in connection with this or another study.

Signature of participant………………………………...…Date………………………….

Signature of (principal) investigator……Saleh Alghamdi……Date………………………

Name of (principal) investigator*…..SALEH ALGHAMDI……………………………………*

Appendix 5: General directorate of health affairs in Albaha region Ethics Approval

Kingdom of Saudi Arabia

Ministry of Health

General Directorate of health affairs Al-Baha

To the university of Hertfordshire in the United Kingdom

Upon the request of Mr Saleh Alghamdi, a PhD student in pharmacy at the university of Hertfodshire, Uk, to conduct his research, titled (The Adoption of Antimicrobial Stewardship Programmes in Saudi Arabia hospitals), in AlBaha hospitals.

We inform you that this request is accepted.

Best regards,

General Director of health affairs in AlBaha region

This translation has been approved by the supervisor Dr Ilhem Berrou 22.02.2016

Dr Ilhem Berrou

Lecturer in Clinical Pharmacy

Department of Pharmacy Pharmacology & PG

Medicine i.berrou@herts.ac.uk

(0)1707284609

Appendix 5: General directorate of health affairs in Albaha region Ethics Approval

To the University of Hertfordshire in the United Kingdom

"The Adoption of Antimicrobial Stewardship Programmes in Saudi Arabia hospitals"

Appendix 6: Qualitative study participant information sheet

UNIVERSITY OF HERTFORDSHIRE

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

FORM EC6: PARTICIPANT INFORMATION SHEET

Title of study
The Adoption of Antimicrobial Stewardship Programmes in Saudi Arabia hospitals

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.

Thank you for reading this.

What is the purpose of this study?
The aim of this study is to explore the perspectives of physicians, pharmacists, microbiologists, infection control nurses and hospital administrators regarding:

- The prevalence and characteristics of antimicrobial stewardship practices in Saudi MOH hospitals.
- The barriers and facilitators for their adoption to promote and monitor the judicious use of antimicrobials in Saudi MOH hospitals.

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).

Are there any age or other restrictions that may prevent me from participating?
You can participate in the study if you are one of the following:

- Infectious diseases (ID) physicians.
- ID/hospital pharmacists.
- Clinical microbiologists.
- Infection control nurses.
- Chief Executive Officers
- Medical directors.
- Physician
- Nurse

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 around (15) minutes. You are free to withdraw at any stage without giving a reason.

What will happen to me if I take part?
If you decide to take part in this study, you will be given this information sheet to keep and be asked to sign a consent form. You will then attend the interview. Your approval to participate in the study does not mean that you have to complete it. You are free to withdraw at any stage without giving a reason. Withdrawing from the study will not be held against you in any way.

What are the possible disadvantages, risks or side effects of taking part?
There will be no risks or side effects.

What are the possible benefits of taking part?
You will contribute to realize the current situation about infection control and antimicrobial stewardship practices and barriers and facilitators for their adoption in Saudi hospitals.

How will my taking part in this study be kept confidential?
The data you provide will be confidential and only used for research purposes. Data reporting will also ensure that you remain anonymous and that your right of confidentiality is consistently respected. To achieve this, your name, address and other details will be excluded from the research. 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. All audio recordings will be stored in locked drawers and electronic files (password protected) stored on computer to which only the researcher/supervisors will have access. Audio files and electronic/paper files of the interviews transcripts will be destroyed 3 years after completion of the writing of thesis.

What will happen to the data collected within this study?
The data you provide will be confidential and only used for research purposes. Data reporting will also ensure that you remain anonymous and that your right of confidentiality is consistently respected. To achieve this, your name, address and other details will be excluded from the research. 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. All audio recordings will be stored in locked drawers and electronic files (password protected) stored on computer to which only the researcher/supervisors will have access. Audio files and electronic/paper files of the interviews transcripts will be destroyed 3 years after completion of the research.

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/02344**

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:

Saleh Alghamdi, Principal investigator, s.alghamdi2@herts.ac.uk 00447799914477 or 0550465081

Dr Ilhem Berrou / Principal supervisor / i.berrou@herts.ac.uk

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 7: National Survey (English version)

Hospital Survey on Antimicrobial Stewardship Programmes

This survey asks for your opinions about the barriers and facilitators that may influence your hospital to adopt and implement antimicrobial stewardship programmes to promote appropriate use of antimicrobials. It may take up 10 minutes to complete. **All information provided will be strictly confidential and will only be used for the purposes of this research**.

Thank you in advance for your co-operation and taking time out of your busy schedule to participate in this study.

> **Antimicrobial stewardship programmes (ASPs):** are hospital based programmes dedicated to improving antibiotic use, optimise the treatment of infections and reduce adverse events associated with antibiotic use. These programmes help clinicians improve the quality of patient care and improve patient safety through increased infection cure rates, reduced treatment failures and increased frequency of correct prescribing for therapy and prophylaxis. They also significantly reduce hospital rates of *Clostridium difficile* Infection and antibiotic resistance (Centers for Disease Control and Prevention, 2014).

By completing and returning this questionnaire you are giving your consent to participate in the study and for your responses to be used for the purpose of this research project.

This survey has been reviewed and approved by the General Directorate for Research and Studies at the Saudi Ministry of Health.

Please do not hesitate to ask any questions or mention any concerns, you can contact the principal investigator, Mr Saleh Alghamdi. s.alghamdi2@herts.ac.uk

You can complete this questionnaire Online on the following link
https://www.surveymonkey.co.uk/r/772244

Section 1: Background Information

This information will help in the analysis of the survey results

1. **Where is your hospital?**

Aseer	Hail	Najran	Tabouk
Al-Jouf	Jizan	Northern Border	Taif
Baha	Madinah	Qasim	Jeddah
Eastern Region	Makkah	Riyadh	Al Qurayyat
Hafar Al-Batin	Al Qunfudah	Al-Hasa	Bishah

2. **Please identify the Governorate where this hospital is located:……………………**

3. **What is the number of beds in your hospital?..............................**

4. **Please indicate if your hospital is:**

General hospital	Central hospital (Referral)	Medical city (specialised)
Obstetrics/Gynaecology and paediatrics	Obstetrics/Gynaecology	Paediatrics
Eye	Psychiatric	Chest
Convalescence	Rehabilitation	

5. **What is your staff position in this hospital?**

   Clinical pharmacist
   hospital pharmacist
   Pharmacy director
   Infection control specialist/consultant
   Infection control nurse
   Infectious diseases specialist/consultant
   Microbiologists
   Other (please specify) …………………………………….

6. **In your staff position, do you typically have direct interaction/ contact with patients taking antimicrobials?**

   Yes, I typically have direct interaction/ contact with patients taking antimicrobials
   No, typically I do NOT have direct interaction/ contact with patients taking antimicrobials

7. **Do you have an infectious diseases specialist/ consultant in your hospital?**

   Yes   No   I don' t know

8. **Do you have an infection control practitioner in your hospital?**

    Yes   No   I don' t know

9. **Do you have a microbiologist in your hospital?**

    Yes   No   I don' t know

10. **Do you have an antimicrobial pharmacist in your hospital?**

    Yes   No   I don' t know

11. **Have you heard about antimicrobial stewardship programmes before?**

    Yes   No   I don' t know

12. **Do you have an Antimicrobial Stewardship Programme (ASP) in your hospital?**

    Yes   No   I don' t know

13. **If no, would you support your hospital's intention to adopt ASP?**

    Yes, in the next year
    Yes, in the next 3 to 5 years
    No
    I don' t know

14. **If you answered (yes) to question number 12, is any of the staff below involved in the antimicrobial stewardship programme (ASP) in your hospital? (Please tick all that apply)**

    Chief executive officer
    Medical officer
    Clinical pharmacist
    hospital pharmacist
    Pharmacy director
    Infection control specialist/consultant
    Infection control nurse
    Infectious diseases specialist/consultant
    Microbiologists
    Other (please specify) …………………………………….

Section 2: The adoption and implementation of antimicrobial stewardship programmes (ASPs) in your hospital

The following questions ask you about **your opinions** of attributes that may or may not influence your hospital's intention to adopt and implement antimicrobial stewardship programmes.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Intention to adopt & implement ASPs					
15. This hospital intends to adopt and implement ASP					
16. This hospital intends to follow ASP guidelines regularly in the future					
17. This hospital would highly recommend the adoption and implementation of ASPs in other hospitals					
Context					
18. Many of our patients would expect this hospital to adopt and implement ASP					
19. The legislative regulation pledges this hospital to adopt and implement ASP					
20. The compliance with the legislative regulations regarding ASP is enforced strictly					
21. Our patients would consider us to be forward thinking by adopting and implementing ASP					
The hospital					
22. Senior management would provide resources necessary for the adoption and implementation of ASP in this hospital					
23. Senior management would provide necessary support for the adoption and implementation of ASP in this hospital					
24. Senior management would support adherence to ASP in this hospital					
25. Senior managers would be enthusiastic about adopting and implementing ASP in this hospital					
26. A specific person (or group) is available for assistance with the adoption and implementation of ASP in this hospital					
27. We have the knowledge necessary to adopt and implement ASP in this hospital					
28. We have the resources necessary (e.g. experts and staff) to adopt and implement ASP in this hospital					
29. This hospital has the financial resources to adopt and implement ASP					
30. This hospital has the technological resources to adopt and implement ASP					
ASPs					
31. Procedures for adopting and implementing ASP are clear and understandable					
32. I believe that it will be easy to adopt and implement ASP in this hospital					
33. Overall, I believe that ASP will be easy to adhere to					
34. I believe that it will be easy for staff to follow ASP guidelines					
35. ASPs are adopted in other hospitals in the country					

36. ASPs are *not* very visible in other hospitals					
37. Before deciding whether to adopt ASPs, it will be essential to be able to properly try them out					
38. It is essential to adopt ASP on a trial basis long enough to see their benefits					
39. ASPs will improve antimicrobial use					
40. ASPs will reduce antimicrobial resistance					
41. ASPs will improve patient safety					
42. ASPs will *not* improve patient care					

I would like to receive the results of this survey	**Yes**	**No**

Please complete the following section if you would like to receive the results of this survey

Name:	
E-mail:	

Please feel free to add any comments about Antimicrobial stewardship programmes at your hospital or in Saudi Arabia

………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………...………
………………………………..

Please feel free to add any comments about the survey

………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………...………
………………………………..

Thank you for taking part in this survey

Appendix 8: National Survey (Arabic version)

<div dir="rtl">

إستبيان   برامج إدارة المضادات الحيوية في المستشفيات

Hospital Survey on Antimicrobial Stewardship Programmes

هذا الإستبيان يسأل عن أرائكم حول الظروف المساعدة و العوائق
وتنفيذ   إدارة المضادات الحيوية من أجل تعزيز الإستخدام الأمثل للمضادات الحيوية. هذا الإستبيان
سيستغرق قرابة 10   . **جميع المعلومات المقدمة في هذا الإستبيان ستعامل بمنتهى السرية و سوف
تستخدم فقط من أجل أهداف هذا البحث.**

شكرا لكم مقدما على تعاونكم و إيجاد الوقت من جدولكم المزدحم للمشاركة في هذه الدراسة.

برامج إدارة المضادات الحيوية: هي برامج في المستشفيات مخصصة لتحسين إستخدام المضادات الحيوية,
تحسين علاج العدوى و تقليل الأضرار المتعلقة بإستخدام المضادات الحيوية. هذه البرامج تساعد الأطباء
لتحسين جودة رعاية المرضى و تحسين سلامة المرضى من خلال زيادة معدلات علاج العدوى, انخفاض فشل
و زيادة تكرار الوصف الصحيح للعلاج و الوقاية. كما أنها تقلل إلى حد كبير من معدلات المستشفى من
Clostridium difficile و مقاومة المضادات الحيوية (Centers for Disease Control and
Prevention. 2014).

من خلال إستكمال و إرجاع هذا الإستبيان, أنت تعطي موافقتك على المشاركة في هذه الدراسة و على إستخدام
إجاباتك من أجل هذا المشروع البحثي

هذا الإستبيان تمت مراجعته و الموافقة عليه من قبل الإدارة العامة للبحوث و الدراسات بوزارة الصحة
السعودية.

الرجاء عدم التردد في السؤال أو الإستفسار عن أي معلومة. تستطيع التواصل مع الباحث الرئيسي, صالح
الغامدي, عن طريق s.alghamdi2@herts.ac.uk

الرجاء إكمال الإستبيان عن طريق الرابط:

</div>

https://www.surveymonkey.co.uk/r/772244

1: معلومات عامة: هذه المعلومات سوف تساعد في تحليل نتائج هذا الأستبيان

1. أين يقع المستشفى الذي تعمل فيه؟

عسير

الحدود الشمالية

القصيم   المدينة المنورة

القريات   الرياض   المنطقة الشرقية

بيشة

2. الرجاء تحديد المحافظة التي يقع فيها المستشفى:..............................

3. ما هو عدد الأسرة في المستشفى الذي تعمل فيه؟..............................

4. هل المستشفى الذي تعمل فيه:

مدينة طبية (تخصصية)   (   )

صدرية   نفسية   عيون

تأهيل   نقاهة

5. ما هو منصبك الوظيفي في هذا المستشفى؟

صيدلي سريري

صيدلي

مدير الصيدلية

/

إستشاري/أخصائي أمراض معدية

أخصائي أحياء دقيقة

أخرى (الرجاء التحديد)..............................

6. من خلال وظيفتك, هل عادة لديك تعامل مباشر مع المرضى الذين يتناولون مضادات حيوية؟

, عادة لدي تعامل مباشر مع المرضى الذين يتناولون مضادات حيوية.

, عادة ليس لدي تعامل مباشر مع المرضى الذين يتناولون مضادات حيوية.

7. هل يوجد إستشاري/أخصائي أمراض معدية في المستشفى الذي تعمل فيه؟

8. هل يوجد ممارس مكافحة عدوى في المستشفى الذي تعمل فيه؟

9. هل يوجد إستشاري/أخصائي أحياء دقيقة في المستشفى الذي تعمل فيه؟

10. هل يوجد صيدلي مضادات حيوية في المستشفى الذي تعمل فيه؟

11. هل سمعت عن برنامج إدارة المضادات الحيوية من قبل؟

12. هل يوجد برنامج إدارة المضادات الحيوية في المستشفى الذي تعمل فيه ؟

13. إذا أجبت ب (لا) للسؤال السابق, هل سوف تدعم نية المستشفى الذي تعمل فيه لتبني برنامج إدارة المضادات الحيوية؟

14. ( ) 12, من من الموظفين أدناه يشاركون في برنامج إدارة المضادات الحيوية في المستشفى الذي تعمل فيه؟ (الرجاء إختيار جميع الإجابات الممكنة)

المدير التنفيذي

المدير الطبي

صيدلي سريري

صيدلي

مدير الصيدلية

/

إستشاري/أخصائي الأمراض المعدية

252

أخصائي أحياء دقيقة

أخرى (الرجاء التحديد).................................

2: تبني و تنفيذ برامج إدارة المضادات الحيوية في المستشفى الذي تعمل فيه.

الأسئلة التالية تسأل عن أرائك حول العوامل التي قد تؤثر أو لا تؤثر على رغبة المستشفى الذي تعمل فيه في تبني و تنفيذ برامج إدارة المضادات الحيوية.

		محايد			
					النية لتبني و تنفيذ برنامج إدارة المضادات الحيوية
					15. هذا المستشفى ينوي تبني و تنفيذ برنامج إدارة المضادات الحيوية
					16. هذا المستشفى ينوي إتباع قوانين برنامج إدارة المضادات الحيوية بإنتظام في
					17. هذا المستشفى سوف يوصي بقوة تبني و تنفيذ برامج إدارة المضادات الحيوية في مستشفيات أخرى
					السياق
					18. العديد من مرضانا يتوقعون من هذا المستشفى تبني و تنفيذ المضادات الحيوية
					19. الأنظمة التشريعية تلزم هذا المستشفى بتبني و تنفيذ برنامج إدارة المضادات الحيوية
					20. الإلتزام بالأنظمة التشريعية بخصوص برنامج إدارة المضادات الحيوية مفروض
					21. مرضانا سوف يعتبرون أن تفكيرنا إلى الأمام بتبني و تنفيذ برنامج إدارة المضادات الحيوية
					22. الإدارة العليا سوف توفر الموارد الضرورية من أجل تبني و تنفيذ برنامج إدارة المضادات الحيوية في هذا المستشفى
					23. الإدارة العليا سوف توفر الدعم الضروري من أجل تبني و تنفيذ برنامج إدارة المضادات الحيوية في هذا المستشفى
					24. الإدارة العليا سوف تدعم الإلتزام ببرنامج إدارة المضادات الحيوية في هذا
					25. المدراء سوف يكونون متحمسين بخصوص تبني و تنفيذ برنامج إدارة المضادات الحيوية في هذا المستشفى
					26. يوجد شخص (أو مجموعة) في هذا المستشفى للمساعدة في تبني و تنفيذ برنامج إدارة المضادات الحيوية في هذا المستشفى
					27. لدينا المعرفة الضرورية لتبني و تنفيذ برنامج إدارة المضادات الحيوية في هذا
					28. لدينا الموارد الضرورية (مثل: المتخصصين و الموظفين) لتبني و تنفيذ برنامج إدارة المضادات الحيوية في هذا
					29. هذا المستشفى لدية الموارد المالية لتبني و تنفيذ برنامج إدارة المضادات الحيوية
					30. هذا المستشفى لدية الموارد التقنية لتبني و تنفيذ برنامج إدارة المضادات الحيوية
					برنامج إدارة المضادات الحيوية
					31. إجراءات تبني و تنفيذ برنامج إدارة المضادات الحيوية واضحة و مفهومة
					32. أعتقد أنه من السهل تبني و تنفيذ برنامج إدارة المضادات الحيوية في هذا
					33. بشكل عام, أعتقد أنه من السهل إتباع برنامج إدارة المضادات الحيوية
					34. أعتقد أنه سوف يكون من السهل على الموظفين إتباع قوانين برنامج إدارة المضادات الحيوية
					35. برامج إدارة المضادات الحيوية متبناه في مستشفيات أخرى في المملكة
					36. برامج إدارة المضادات الحيوية غير واضحة في المستشفيات الأخرى

					37. إدارة المضادات الحيوية, من الضروري القدرة على تجربته
					38. من الضروري تبني برنامج إدارة المضادات الحيوية لفترة تجريبية كافية لرؤية
					39. برامج إدارة المضادات الحيوية سوف تحسن إستخدام المضادات الحيوية
					40. برامج إدارة المضادات الحيوية سوف تقلل مقاومة المضادات الحيوية
					41. برامج إدارة المضادات الحيوية سوف تحسن سلامة المرضى
					42. برامج إدارة المضادات الحيوية لن تحسن رعاية المرضى

		أود الحصول على نتيجة هذا الإستبيان

الرجاء إكمال الجزء التالي إذا كنت ترغب في الحصول على نتيجة هذا الإستبيان

	:
	الإيميل:

شكرا لإكمالك هذا الإستبيان.

Appendix 9: National survey invitation letter

Subject: <u>Invitation to participate in a research study</u>

Dear Director of Pharmacy

I am a PhD student at the department of Pharmacy, Pharmacology and Postgraduate Medicine at the University of Hertfordshire. My research aims to examine the adoption of antimicrobial stewardship programmes in Saudi hospitals.

I will be grateful if you agree to complete a questionnaire regarding antimicrobial stewardship practices in your hospital. The information you provide in this survey is strictly confidential. Further information on my study is available in the attached information sheet. This research has been approved by my university ethics committee, and Saudi Ministry of Health.

The questionnaire will take approximately (15) minutes to complete. Please note that there is no incentive for completing this questionnaire, and you have the right to withdraw from the study at any time.

Please complete the questionnaire Online on the following link:

https://www.surveymonkey.co.uk/r/772244

Truly yours,

Saleh Alghamdi
PhD student
Department of Pharmacy, Pharmacology and Postgraduate Medicine
University of Hertfordshire
College Lane Campus
Hatfield, United Kingdom
AL10 9AB
s.alghamdi2@herts.ac.uk

Appendix 10: Saudi MOH Ethics Approval Notification

Kingdom of Saudi Arabia
Ministry of Health
King Fahad Medical City
(162)

مدينة الملك فهد الطبية
King Fahad Medical City

المملكة العربية السعودية
وزارة الصحة
مدينة الملك فهد الطبية
(١٦٢)

IRB Registration Number with KACST, KSA: H-01-R-012
IRB Registration Number with OHRP/NIH, USA: IRB00010471
Approval Number Federal Wide Assurance NIH, USA: FWA00018774

April 26, 2017
IRB Log Number: 17-149E
Department: External
Category of Approval: EXEMPT

Dear Saleh Alghamdi,

I am pleased to inform you that your submission dated April 23, 2017 for the study titled 'The Adoption of Antimicrobial Stewardship Programs in Saudi MOH Hospitals' was reviewed and was approved. Please note that this approval is from the research ethics perspective only. You will still need to get permission from the head of department or unit in KFMC or an external institution to commence data collection.

To ensure complete anonymity, you are advised to ask respondents to use the online system and the telefax to return questionnaires. If they decide to use emails or whatsapp they should not use personal email addresses or personal phone numbers to avoid revealing their identity inadvertently.

We wish you well as you proceed with the study and request you to keep the IRB informed of the progress on a regular basis, using the IRB log number shown above.

Please be advised that regulations require that you submit a progress report on your research every 6 months. You are also required to submit any manuscript resulting from this research for approval by IRB before submission to journals for publication.

As a researcher you are required to have current and valid certification on protection human research subjects that can be obtained by taking a short online course at the US NIH site or the Saudi NCBE site followed by a multiple choice test. Please submit your current and valid certificate for our records. Failure to submit this certificate shall a reason for suspension of your research project.

If you have any further questions feel free to contact me.

Sincerely yours,

Prof. Omar H. Kasule
Chairman, Institutional Review Board (IRB)
King Fahad Medical City, Riyadh, KSA
Tel: + 966 1 288 9999 Ext. 26913
E-mail: okasule@kfmc.med.sa

Appendix 10: Saudi MOH Ethics Approval Notification

Appendix 10: Saudi MOH Ethics Approval Notification

المملكة العربية السعودية
وزارة الصحة
الإدارة العامة للبحوث والدراسات

الرقم:........................
التاريخ: /   /   هـ
المشفوعات: ....

وعليه، نأمل من سعادتكم التفضل بالاطلاع والإيعاز لمن يلزم بتوزيع الإستبيان المرفق على مدراء المستشفيات والمدراء الطبيين بالمستشفيات التابعة لسعادتكم بما يضمن أن لا يكون هناك أي تأثير على خدمة المراجعين مع العلم بأن وزارة الصحة تضمن حقوقها في نتائج هذا البحث من خلال إتفاقية المشاركة في البيانات والتي تم توقيعها بين الباحث الرئيس والإدارة العامة للبحوث والدراسات.

وتفضلوا بقبول خالص تحياتي ، ، ،

مرفق طيه صور للمستندات و ملخص البحث وإستبيان الدراسة، ،

مساعد مدير عام الإدارة العامة للبحوث والدراسات

ص. عذاري فيصل العتيبي

الرمز البريدي: ١١١٧٦   ضريب الرياض: ٢٧٧٥   فاكس: ٠١١٤٧٣٥٠٣٨   هاتف: ٠١١٤٧٣٥٠٣٩
e-mail: research@moh.gov.sa

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Appendix 10: Saudi MOH Ethics Approval Notification

Appendix 10: Saudi MOH Ethics Approval Notification

المملكة العربية السعودية
وزارة الصحة
الإدارة العامة للبحوث والدراسات

الموضوع: بحث الطالب/ صالح الغامدي

سعادة/ مدير عام الإدارة العامة لمكافحة عدوى المنشآت الصحية   المحترم
السلام عليكم ورحمة الله وبركاته، ، ، ،

إشارة إلى موضوع البحث المقدم من الطالب/ صالح عبدالله الغامدي، لدراسة درجة الدكتوراه في تخصص "صيدلة" بكلية الصيدلة جامعة الباحة، رقم السجل المدني (١٠٦٩٥٥٣٦٤٠)، والرقم الأكاديمي (١٣٠٣٧٧٣١) وعنوان الدراسة:

" إعتماد برامج مراقبة إستخدام المضادات الحيوية في مستشفيات وزارة الصحة السعودية "

نحيطكم علماً بأن الباحث قد استوفى كافة المستندات المطلوبة وتمت مراجعتها من قبل الإدارة العامة للبحوث والدراسات ولجنة الأخلاقيات بمدينة الملك فهد الطبية، وعليه فقد تمت الموافقة على تسهيل مهمة إجراء هذا البحث، وحيث أن جزء من الدراسة ستنفذ في الإدارة العامة لمكافحة عدوى المنشآت الصحية بوزارة الصحة.

وعليه، نأمل من سعادتكم التفضل بالإطلاع والإيعاز لمن يلزم بتوزيع الإستبيان المرفق على أطباء الأمراض المعدية، متخصصي مكافحة العدوى ومتخصصي الأحياء الدقيقة بالمستشفيات التابعة لسعادتكم بما يضمن أن لا يكون هناك أي تأثير على خدمة المراجعين مع العلم بأن وزارة الصحة تضمن حقوقها في نتائج هذا البحث من خلال إتفاقية المشاركة في البيانات والتي تم توقيعها بين الباحث الرئيس والإدارة العامة للبحوث والدراسات.

وتفضلوا بقبول خالص تحياتي ، ، ،

مرفق طيه صور المستندات و ملخص البحث وإستبيان الدراسة ، ،

مساعد مدير عام الإدارة العامة للبحوث والدراسات

ص. عذاري فيصل العتيبي

الرمز البريدي: ١١١٧٦   ص.ب الرياض: ٢٧٧٥   فاكس: ٠١١٤٧٣٥٠٣٨   هاتف: ٠١١٤٧٣٥٠٣٩
e-mail: research@moh.gov.sa

Appendix 11: Case study interview schedule

Case study Interview schedule

Good morning/afternoon and welcome. I would like to thank you for taking the time to join this interview.

The aim of this session is to explore and understand the adoption of Antimicrobial stewardship programme (initiation, adoption decision, implementation) in your hospital.

This interview is part of my PhD research at the University of Hertfordshire to examine the adoption of antimicrobial stewardship programs in Saudi hospitals.

Please note that today's discussion will be audio recorded and transcribed verbatim to ensure the full interpretation of your contribution.

Once the interview is transcribed I will send you a copy to make sure you are happy with the interview content and to check that we have not missed anything.

There are no right or wrong answers to the questions I am going to ask. Please feel free to share your opinion or experience.

The interview should take **around (20-30) minutes to complete.**

Onto the questions,
Part A
1. Current position?
2. Gender?　　　O　Male　　　　　O　Female
3. Years of experience?

Part B
1. What antimicrobial stewardship practices are you employing at your hospital to promote and monitor the judicious use of antimicrobials?
2. Who are the members involved in these practices?
3. How often do those members meet?
4. What is your role in the programme?
5. How effective are those practices in promoting and monitoring the judicious use of antimicrobials? Why?
6. How do you report resistance data?
7. Can you give an example of meeting an antimicrobial stewardship practice specific outcome, what was the situation, and what enabled success?
8. Can you give an example of NOT meeting an antimicrobial stewardship practice specific outcome, what was the situation, and what were the reasons for not being successful?
9. What were the main challenges/barriers that faced you in adopting ASP in your hospital?
10. What were the required facilitators/solutions for the adoption of ASP?

11. Can you describe step by step the adoption process of ASP at your hospital (initiation, adoption decision, implementation)?
    - Motivation/reasons to adopt
    - Time frame
    - Barriers
    - Facilitators
    - Outcomes
    - Meetings
    - Monitoring and reporting of Antibiotic use and resistance
    - Updating policies
    - Dissemination of ASP and outcomes
    - Different stages
12. What international policies/guidelines did you follow to implement ASP at your hospital?

Are there any other issues that you feel we haven't talked about that you would like to mention?

I would like to thank you for participating in today's discussion.

Appendix 12: Case study invitation letter

Subject: Invitation to participate in a research study

Dear Sir/Madam

I am a PhD student at the department of Pharmacy, Pharmacology and Postgraduate Medicine at the University of Hertfordshire. My research aims to examine the adoption of antimicrobial stewardship programmes in Saudi hospitals.

I will be grateful if you agree to participate in an interview regarding the adoption of antimicrobial stewardship programmes (initiation, adoption decision, implementation) in your hospital. The information you provide during the interview is strictly confidential. Further information on my study is available in the attached information sheet.
This research has been approved by my university ethics committee and your hospital.

The interview will last approximately (20-30) minutes and will be conducted in the meeting room of your department. Please note that there is no incentive for participating in this interview, and you have the right to withdraw from the study at any time.

If you agree to participate in this study, please sign the attached consent form and return to your head of department with this letter indicating a time that is convenient for you.

Date..................   **Time..................**

Truly yours,

Saleh Alghamdi
PhD student
Department of Pharmacy, Pharmacology and Postgraduate Medicine
University of Hertfordshire
College Lane Campus
Hatfield, United Kingdom
AL10 9AB
s.alghamdi2@herts.ac.uk

Appendix 13: King Abdullah Medical City (KAMC) Ethics Approval Notification

<table>
<tr><td colspan="2">مدينة الملك عبدالله الطبية
KING ABDULLAH MEDICAL CITY</td><td>المملكة العربية السعودية   Kingdom of Saudi Arabia
وزارة الصحة   Ministry of Health
مدينة الملك عبد الله الطبية بالعاصمة المقدسة   King Abdulla Medical City in Holy capital
اللجنة الفنية لأخلاقيات البحث   Institutional Review Board</td></tr>
</table>

Institutional Review Board Opinion Letter

Protocol Title	The Adoption of Antimicrobial Stewardship Programmes in Saudi Arabia Hospitals.
Version	1.0
Principal investigator	Dr. Eshtyag Bajnaid
IRB number	16-244
Sponsor	NA

Dear Dr. Bajnaid,

This is to inform you that the above mentioned proposal has been the subject of expedited review by KAMC IRB registered at the National BioMedical Ethics Committee, King Abdulaziz City for Science and Technology on 14-07-1433 (Registration no. H-02-K-001).

The decision for expedited review was based on the following submitted documents:

1. The protocol version 1.0
2. Data collection form version 1.0
3. Participant Information Sheet version 1.0
4. Interview schedule version 1.0
5. Invitation to participate version 1.0

The opinion of the IRB is to approve this proposal with its current design:

- The study is approved for one year from the date of this letter. Extension can be requested one month before the expiry of the approval.
- To conduct research as per the approved documents
- Amendments to the approved documents require IRB approval before implementation
- End of study report is expected before expiration of approval
- The study conduct may be subject to audits by KAMC Human Research Protection Program (HRPP)
- Research participant confidentiality should be protected at all times and may be subject to audits by KAMC HRPP
- Document retention: all study documents should be kept by the principal investigator for a period of three years from study completion
- Copy of all participants' consents should be submitted to IRB.
- Final manuscript should be submitted to IRB for review before Journal Submission

N.B.: Please note that this letter gives you ethical clearance to perform your study according to the approved documents but you will still need to obtain necessary administrative approval from the site/s where the study will be conducted.

Dr Tahani Hassan Nageeti	T. Nageeti	19/05/2016
(Name of IRB Chair)	(Signature)	DD/MM/YYYY (Date of approval)

مدينة الملك عبدالله الطبية
KING ABDULLAH MEDICAL CITY

Appendix 13: King Abdullah medical city (KAMC) Ethics Approval Notification

مدينة الملك عبدالله الطبية
KING ABDULLAH MEDICAL CITY

المملكة العربية السعودية — Kingdom of Saudi Arabia
وزارة الصحة — Ministry of Health
مدينة الملك عبد الله الطبية بالعاصمة المقدسة — King Abdulla Medical City in Holy capital
اللجنة العليا لأخلاقيات البحث — Institutional Review Board

Institutional Review Board Opinion Letter

Protocol Title	The Adoption of Antimicrobial Stewardship Programmes in Saudi Arabia Hospitals.
Version	1.0
Principal investigator	Dr. Eshtyag Bajnaid
IRB number	16-244
Sponsor	NA

Dear Dr. Bajnaid,

This is to inform you that the above mentioned proposal has been the subject of expedited review by KAMC IRB registered at the National BioMedical Ethics Committee, King Abdulaziz City for Science and Technology on 14-07-1433 (Registration no. H-02-K-001).

The decision for **expedited review** was based on:

1. Previously submitted documents (protocol version 1.0)
2. Amendment request

The opinion of the IRB is to **approve** the extension of the previously approved protocol on **19-May-2016**:

- The study is approved for another one year from the expiry date of the first approval i.e. the approval expiry date is **19-May-2018**
- Extension can be requested one month before the expiry of the approval.
- To conduct research as per the approved documents
- Amendments to the approved documents require IRB approval before implementation
- End of study report is expected before expiration of approval
- The study conduct may be subject to audits by KAMC Human Research Protection Program (HRPP)
- Research participant confidentiality should be protected at all times and may be subject to audits by KAMC HRPP
- Document retention: all study documents should be kept by the principal investigator for a period of three years from study completion
- Copy of all participants' consents should be submitted to IRB.
- Final manuscript should be submitted to IRB for review before Journal Submission.

General Approval conditions:

- **If your study involves participants consent: Copy of all consents should be submitted to IRB**
- **Final manuscript should be submitted to IRB for review before Journal Submission**
- **If patient's clinical photo would be used for publication or presentation additional patient consent will be required and should be submitted to IRB before publication.**

N.B.: Please note that this letter gives you ethical clearance to perform your study according to the approved documents; you still need to obtain necessary administrative approval from the site/s where the study will be conducted.

Dr Tahani Hassan Nageeti	T. Nageeti	07-May-2017
(Name of IRB Chair)	(Signature)	DD/MM/YYYY (Date of approval)

مدينة الملك عبدالله الطبية
KING ABDULLAH MEDICAL CITY

Appendix 14: Case study participant information sheet

UNIVERSITY OF HERTFORDSHIRE

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

FORM EC6: PARTICIPANT INFORMATION SHEET

Title of study
The Adoption of Antimicrobial Stewardship Programmes in Saudi Arabia hospitals

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.

Thank you for reading this.

What is the purpose of this study?
The aim of this study is to explore the adoption of Antimicrobial stewardship programmes (initiation, adoption decision, implementation) in your hospital.

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).

Are there any age or other restrictions that may prevent me from participating?
You can participate in the study if you are one of the following:
- Infectious diseases (ID) physicians.
- ID/hospital pharmacists.
- Clinical microbiologists.
- Infection control nurses.
- Chief Executive Officers.
- Medical directors.

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 around (20-30) minutes. You are free to withdraw at any stage without giving a reason.

What will happen to me if I take part?
If you decide to take part in this study, you will be given this information sheet to keep and be asked to sign a consent form. You will then attend the interview. Your approval to participate in the study does not mean that you have to complete it. You are free to withdraw at any stage without giving a reason. Withdrawing from the study will not be held against you in any way.

What are the possible disadvantages, risks or side effects of taking part?
There will be no risks or side effects.

What are the possible benefits of taking part?
You will contribute to understand ASP adoption (initiation, adoption decision, implementation) in Saudi hospitals in order to improve future practices.

How will my taking part in this study be kept confidential?
The data you provide will be confidential and only used for research purposes. Data reporting will also ensure that you remain anonymous and that your right of confidentiality is consistently respected. To achieve this, your name, address and other details will be excluded from the research. 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. All audio recordings will be stored in locked drawers and electronic files (password protected) stored on computer to which only the researcher/supervisors will have access. Audio files and electronic/paper files of the interviews transcripts will be destroyed 3 years after completion of the writing of thesis.

What will happen to the data collected within this study?
The data you provide will be confidential and only used for research purposes. Data reporting will also ensure that you remain anonymous and that your right of confidentiality is consistently respected. To achieve this, your name, address and other details will be excluded from the research. 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. All audio recordings will be stored in locked drawers and electronic files (password protected) stored on computer to which only the researcher/supervisors will have access. Audio files and electronic/paper files of the interviews transcripts will be destroyed 3 years after completion of the writing of thesis.

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/02344**

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:

Saleh Alghamdi, Principal investigator, s.alghamdi2@herts.ac.uk 00447799914477
0550465081

Dr Ilhem Berrou / Principal supervisor / i.berrou@herts.ac.uk

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 15: Patients' questionnaires (English)

Patient's perceptions on antimicrobial use and resistance in Saudi hospitals.

The aim of this survey is to evaluate the knowledge and awareness regarding antimicrobial use and resistance among hospital patients in Saudi hospitals. Please do not identify yourself or other individuals.

By completing and returning this questionnaire you are giving your consent to participate in the study and for your responses to be used for the purpose of this research project.

The questionnaire should take **around (10) minutes to complete.**

Part A

1. **Gender?**　　　　O Male　　　　O Female

2. **What is your age group?**
    - O 21-30 years
    - O 31-40 years
    - O 41-50 years
    - O 51-60 years
    - O 61-70 years
    - O 71-80 years

3. **What level of education have you achieved?** ....

4. **What is your condition for taking antibiotics?** ………………………

Part B

B. **Access to antibiotics:** Please read carefully each statement regarding access to antibiotics and tick, Agree, Don't agree or Don't know.

	Agree	**Don't agree**	**Don't know**
1. Left-over antibiotics are good to keep at home in case they might be needed later on.	O	O	O
2. If a family member is sick, I will give him/her my antibiotic.	O	O	O

	Agree	Don't agree	Don't know
3. It is good to be able to get antibiotics from relatives, friends or pharmacy without having to see a doctor.	O	O	O
4. I will give my antibiotic to a family member if needed.	O	O	O

C. Effect of antibiotics: Please read carefully each statement regarding effect of antibiotics and tick, Agree, Don't agree or Don't know.

	Agree	Don't agree	Don't know
1. When I get cold, I will take antibiotics to help me get better quickly.	O	O	O
2. If I feel better after a few days, I will stop taking my antibiotics before completing the course of treatment.	O	O	O
3. Antibiotics are indicated to relieve pain/inflammation.	O	O	O
4. Antibiotics are used to stop fever.	O	O	O
5. Antibiotics are effective against bacteria.	O	O	O
6. Antibiotics are effective against viruses.	O	O	O

D. Antibiotics resistance: Please read carefully each statement and tick, Agree, Don't agree or Don't know.

	Agree	Don't agree	Don't know
1. Antibiotic resistance can be due to using antibiotics when they are not necessary.	O	O	O
2. Antibiotic resistance can be due to not completing the full course of antibiotic.	O	O	O
3. Antibiotic resistance can be due to using antibiotics without physician prescription (self-medication).	O	O	O

	Agree	Don't agree	Don't know
4. Antibiotic resistance can be due to using the same antibiotic with a different brand.	O	O	O
5. Antibiotic resistance is a problem in Saudi today.	O	O	O
6. Antibiotic resistance is a problem in the rest of the world today.	O	O	O

E. Doctor's habits and the patient/doctor relationship: Please read carefully each statement and tick, Agree, Don't agree or Don't know.

	Agree	Don't agree	Don't know
1. I trust the doctor decision if she or he decides not to prescribe antibiotics.	O	O	O
2. I trust the doctor decision if she or he decides to prescribe antibiotics.	O	O	O
3. Doctors often take time to consider carefully whether antibiotics are needed or not.	O	O	O
4. Doctors often prescribe antibiotics because the patient expects it.	O	O	O
5. A doctor who doesn't prescribe antibiotics when the patient thinks s/he should, is a bad doctor.	O	O	O
6. I consult another physician to prescribe antibiotics if my physician disagreed to do so.	O	O	O

F. Patients' use of antibiotics during hospital stay: Please read carefully
each statement and tick, Agree, Don't agree or Don't know

	Agree	**Don't agree**	**Don't know**
1. My doctor/pharmacist told me that I am being treated with antibiotics.	○	○	○
2. I was told about how to take the antibiotic.	○	○	○
3. This hospital is strict when it comes to prescribing antibiotics.	○	○	○
4. This hospital provides information on antibiotic resistance.	○	○	○
5. My hospital stay improved my awareness of antibiotic resistance.	○	○	○

Thank you for completing this survey.

Appendix 16: Patients' questionnaires (Arabic)

درجة معرفة و وعي المرضى في المستشفيات السعودية بخصوص استخدام المضادات الحيوية و مقاومتها.

الهدف من هذا الإستبيان هو تقيم معرفة و وعي المرضى في المستشفيات السعودية بخصوص استخدام المضادات الحيوية و مقاومتها. الرجاء عدم التعريف بنفسك أو أي شخص اخر.

إكمال و إعادة هذا الإستبيان يعتبر موافقة منكم على المشاركة في هذه الدراسة و على استخدام ردودكم في هذا
.

يستغرق إكمال هذا الإستبيان ما يقارب 10 .

1.

2. ما هي الفئة العمرية الخاصة بك؟

- ○ 21 -30
- ○ 31 – 40
- ○ 41 – 50
- ○ 51 – 60
- ○ 61 – 70
- ○ 71 – 80

3. ما هو مستواك التعليمي؟ ....

4. سبب الأستخدام الحالي للمضاد الحيوي؟ ....

. الحصول على المضادات الحيوية: الرجاء قراءة كل عبارة بخصوص الحصول على المضادات الحيوية
وإختيار:

	/	/	.

1. الحيوية الزائدة عن الحاجة مفيد في حالة الحاجة لها .	○	○	○
2. بإعطائه المضاد الحيوي .	○	○	○
3. من المفيد الحصول على المضادات الحيوية	○	○	○

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الصيدلية بدون الحاجة لرؤية الطبيب.

4. المضاد الحيوي الخاص بي
مرضه.

○　　　○　　　○

. تأثير المضادات الحيوية: الرجاء قراءة كل عبارة بخصوص تأثير المضادات الحيوية وإختيار: أوافق / لا أوافق / لا
.

1.
الحيوي من أجل الشفاء
.

○　　　○　　　○

2.
عدة أيام سوف اقوم
بالتوقف عن إكمال الكمية
المتبقية من المضاد
الحيوي.

○　　　○　　　○

3. المضادات الحيوية
الإلتهابات.

○　　　○　　　○

4.　　　الحيوية
.

○　　　○　　　○

5. المضادات الحيوية فعالة
ضد البكتيريا.

○　　　○　　　○

6. المضادات الحيوية فعالة
ضد الفيروسات.

○　　　○　　　○

. مقاومة المضادات الحيوية (قدرة الكائن الحي الدقيق المعروف بالبكتيريا على تحمل مفعول المضاد الحيوي مما يؤدي على عدم فعالية المضاد الحيوي في جسم الإنسان): الرجاء قراءة كل عبارة بخصوص مقاومة المضادات الحيوية وإختيار: أوافق / لا أوافق / لا أعلم.

1.
الحيوية قد تكون بسبب
إستخدام المضاد الحيوي
عندما لا يكون هناك حاجة
.

○　　　○　　　○

2.
الحيوية قد تكون بسبب عدم

○　　　○　　　○

○	○	○	تناول المضاد الحيوي حتى نهاية الفترة الموصوفة من الطبيب.
○	○	○	3. الحيوية قد تكون إستخدام المضاد الحيوي بدون وصفة طبية (العلاج).
○	○	○	4. الحيوية قد تكون بسبب الحيوي لكن من شركة .
○	○	○	5. الحيوية تعتبر أحد المشاكل الصحية في السعودية في .
○	○	○	6. الحيوية تعتبر أحد المشاكل الصحية في العالم في .

. الرجاء قراءة كل عبارة بخصوص عادات الأطباء و علاقة المريض و الطبيب وإختيار: أوافق / لا أوافق / لا أعلم.

○	○	○	1. أثق في قرار الطبيب عندما لا يوصف مضاد حيوي.
○	○	○	2. أثق في قرار الطبيب عندما يوصف مضاد حيوي.
○	○	○	3. غالبا يأخذ الأطباء وقتهم في التاكد اذا كان المريض يحتاج او لا يحتاج المضاد الحيوي.
○	○	○	4. غالبا يوصف الأطباء المضادات الحيوية لأن المرضى يتوقعون الحصول عليها.
○	○	○	5. الطبيب الذي لا يستجيب لطلب المريض بوصف

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المضادات الحيوية يعتبر
طبيبا سيئا.

○	○	○	6. أستشير طبيبا اخر لوصف المضادات الحيوية عندما لا يوصفها طبيبي.

. الرجاء قراءة كل عبارة بخصوص إستخدام المريض للمضادات الحيوية خلال فترة التنويم في المستفشيات و إختيار: أوافق / لا أوافق / لا أعلم.

○	○	○	1. يقوم الطبيب / الصيدلي بإخباري بأنه يتم علاجي بالمضادات الحيوية.
○	○	○	2. الطبيب/الصيدلي أخبرني عن طريقة إستخدام المضاد الحيوي.
○	○	○	3. هناك تشدد في صرف المضادات الحيوية في هذا .
○	○	○	4. هذا المستشفى يزود المضادات الحيوية و مقاومتها.
○	○	○	5. إقامتي في هذا المستشفى المضادات الحيوية و مقاومتها.

شكرا لإكمالك هذا الإستبيان.

Appendix 17: Patients questionnaires Invitation Letter

Subject: <u>Invitation to participate in a research study</u>

Dear Sir/Madam

I am a PhD student at the University of Hertfordshire in the UK. I am conducting research into infection prevention and control in Saudi hospitals.

I will be grateful if you agree to complete a questionnaire regarding your perceptions and awareness of infection control and antimicrobial use in hospital. The information you provide in this questionnaire is strictly confidential. Further information on my study is available in the attached information sheet. This research has been approved by my university and this hospital.

The questionnaire will take approximately (10) minutes to complete. Please note that there is no incentive for completing this questionnaire, and you have the right to withdraw from the study at any time.

If you agree to participate in this study, please sign the attached consent form and complete the questionnaire.

Truly yours,

Saleh Alghamdi
PhD student
Department of Pharmacy, Pharmacology and Postgraduate Medicine
University of Hertfordshire
College Lane Campus
Hatfield, United Kingdom
AL10 9AB
s.alghamdi2@herts.ac.uk

Appendix 18: Written Consent Form (Arabic)

إستمارة الموافقة للدراسات التي تحتوي على مشاركة بشرية

أتعهد انا.. بموجب هذه الاستمارة على المشاركة بحرية في الدراسة بعنوان (اعتماد برامج مراقبة المضادات الحيوية في المستشفيات السعودية).

1- أؤكد بانه تم اعطائي ملعومات عن الدراسة و تشمل: الهدف, طرق جمع البيانات, اسماء و ارقام الذ مع القائمين على الدراسة وتم شرح فوائد و نتائج هذه الدراسة. وتم إبلاغي بدوري في هذه الدراسة. كما أنه تم إبلاغي أنه و في حالة أي تغير مهم على الهدف او تصميم الدراسة سوف يتم إبلاغي و سوف يطلب مني إعادة
.

2- تم التأكيد لي بأنه لي الحق بالإنسحاب من الدراسة خلال أي وقت و بدون أي سلبيات و بدون الحاجة
.

3- لقد تم إبلاغي عن طريقة التعامل مع بياناتي, و كيف سوف تحفظ بأمان, ومن يستطيع الوصول إليها و كيف سوف يتم إستخدامها.

توقيع المشارك .... التاريخ.....................................

توقيع الباحث الرئيسي .... التاريخ ....

إسم الباحث الرئيسي .... التاريخ ....

Appendix 19: Patients' questionnaires participant information sheet

UNIVERSITY OF HERTFORDSHIRE

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

FORM EC6: PARTICIPANT INFORMATION SHEET

Title of study
The Adoption of Antimicrobial Stewardship Programmes in Saudi Arabia hospitals

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.

Thank you for reading this.

What is the purpose of this study?
The aim of this study is to evaluate the perceptions and awareness regarding antimicrobial use and resistance among patients in Saudi hospitals.

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).

Are there any age or other restrictions that may prevent me from participating?
You can participate in the study if you are:
- A hospital patient taking antibiotics.
- 18 years old and more.

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 around (10) minutes. You are free to withdraw at any stage without giving a reason.

What will happen to me if I take part?
If you decide to take part in this study, you will be given this information sheet to keep and be asked to sign a consent form. You will then complete the questionnaire. Your approval to participate in the study does not mean that you have to complete it. You are free to withdraw at any stage without giving a reason. Withdrawing from the study will not be held against you in any way.

What are the possible disadvantages, risks or side effects of taking part?
There will be no risks or side effects.

What are the possible benefits of taking part?
You will contribute to realize the current situation about the perceptions and awareness regarding antimicrobial use and resistance among hospital patients in Saudi MOH general hospitals in order to improve antimicrobial practice and use.

How will my taking part in this study be kept confidential?
The data you provide will be confidential and only used for research purposes. Data reporting will also ensure that you remain anonymous and that your right of confidentiality is consistently respected. To achieve this, your name, address and other details will be excluded from the research. 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. All files will be stored in locked drawers and electronic files (password protected) stored on computer to which only the researcher/supervisors will have access. Electronic/paper files will be destroyed 3 years after completion of the writing of thesis.

What will happen to the data collected within this study?
The data you provide will be confidential and only used for research purposes. Data reporting will also ensure that you remain anonymous and that your right of confidentiality is consistently respected. To achieve this, your name, address and other details will be excluded from the research. 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. All files will be stored in locked drawers and electronic files (password protected) stored on computer to which only the researcher/supervisors will have access. Electronic/paper files will be destroyed 3 years after completion of the writing of thesis.

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/02344**

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:

Saleh Alghamdi / Principal investigator, s.alghamdi2@herts.ac.uk 00447799914477 or 0550465081
Dr Ilhem Berrou / Principal supervisor / i.berrou@herts.ac.uk

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 20: Patient questionnaires participant information sheet (Arabic)

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نموذج إرشادات للمشتركين

اعتماد برامج مراقبة المضادات الحيوية في المستشفيات السعودية

أنت مدعو للمشاركة في هذه الدراسة. وقبل إتخاذ القرار بالمشاركة من المهم أن تعرف عن هذا البحث و طبيعة مناقشتها مع الاخرين عند الحاجة لذلك.
الرجاء عدم التردد بالسؤال عن أي شي غير واضح أو من أجل أي معلومات إضافية لمساعدتك في إتخاذ قرار المشاركة. الرجاء أخذ الوقت الكافي لإتخاذ القرار بالمشاركة من عدمها.

ما هو الغرض من هذه الدراسة؟
إن الهدف من هذه الدراسة هو تقييم تصورات و وعي المرضى في المستشفيات السعودية بخصوص استخدام المضادات الحيوية و مقاومتها.

هل يجب علي المشاركة في هذه الدراسة؟
لديك الحق في المشاركة في هذه الدراسة من عدمها. عند إتخاذك القرار بالمشاركة في هذه الدراسة سوف يتم إ هذه الورقة و سوف يتطلب منك توقيع تعهد المشاركة. موافقتك على المشاركة في هذه الدراسة لا يعني بالضرورة وجوب إكمالها. لديك الحق في الإنسحاب من الدراسة في أي وقت و بدون إبداء أي سبب. عدم المشاركة أو الإنسحاب من الدراسة في أي وقت لن يؤثر على علاجك أو رعاي .

هل يوجد هناك أي عمر محدد أو غيرها من القيود التي قد تمنعني من المشاركة؟
تستطيع المشاركة في الدراسة إذا كنت:
أ‌   مريض منوم
أ‌   18 سنه أو أكبر

ما هي مدة مشاركتي في الدراسة؟
في حالة موافقتك على المشاركة في الدراسة, سوف يستغرق زمن المشاركة على ما يقارب 10   . كما يحق لك
.

ماذا سوف يحصل عند المشاركة في الدراسة؟
عند إتخاذك القرار بالمشاركة في هذه الدراسة, سوف يتم إعطائك هذه الورقة و سوف يتطلب منك توقيع تعهد المشاركة, ثم يتوجب عليك إكمال الإستبيان. موافقتك على المشاركة في هذه الدراسة لا يعني بالضرورة وجوب إكمالها. لديك الحق
.

يؤثر على علاجك أو رعايتك.

ما هي المساوء , المخاطر أو الاثار الجانبية المتوقعه من المشاركة في هذه الدراسة؟
لا يوجد هناك أي مخاطر أو اثار جانبية من هذه الدراسة

ما هي الفوائد المتوقعه من هذه الدراسة؟
سوف تساعد على فهم و تقيم الوضع الحالي لتصورات و وعي المرضى في المستشفيات السعودية بخصوص استخدام المضادات الحيوية و مقاومتها من أجل تحسين إستخدام المضادات الحيوية وتحسين بيئة العمل.

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كيف سوف يتم حفظ سرية مشاركتي في هذه الدراسة؟ و ماذا سوف يحدث للبيانات التي سوف يتم الحصول عليها في هذا الدارسة؟

المعلومات التي تقوم بتزويدها ستكون سرية و تستخدم فقط من أجل أهداف البحث. عرض و نقل البيانات سوف يحفظ خصوصيتك وإبقائك غير معرف بإستمرار. و من أجل تحقيق ذلك : إسمك و بياناتك الشخصية لن تذكر في البحث. كما أن تخزين و إستخدام المعلومات سوف يتبع قوانين حفظ البيانات. جميع الملفات سوف تحفظ في أدراج مقفلة وملفات إلكترونية (محمية بأرقام سرية) محفوظة في جهاز حاسب الي لا يستخدمه الا الباحث و المشرفين الدراسيين. الأوراق والملفات الإلكترونية سوف تتلف بعد 3 سنوات من نهاية كتابة هذا .

من قام بمراجعة هذه الدراسة؟

قام بمراجعة هذه الدراسة لجنة أخلاقيات العلوم الصحية و الإنسانية بجامعة Hertfordshire
رقم الطلب في الجامعه:
LMS/PGR/UH/02344

مع من أستطيع التواصل في حالة وجود أي إستفسار؟

إذا كنت في حاجة معلومات إضافية أو تود مناقشة أي أمور شخصية, المرجو التواصل معي من خلال:
صالح الغامدي / الباحث الرئيسي / s.alghamdi2@herts.ac.uk / 0550465081
00447799914477
د. الهام برو / المشرف الرئيسي / i.berrou@herts.ac.uk

في حالة وجود أي شكوى أو مخاوف من طريقة الوصول أو التعامل معك خلال هذه الدراسة المرجو التواصل مع إدارة الجامعه أو المستشفى.

شكرا جزيلا لقراءة هذه المعلومات و التفكير في المشاركة في هذه الدراسة.