STUDY OF PHARMACIST WORKFORCE IN PUBLIC SECTOR, OF REPUBLIC OF THE UNION OF MYANMAR

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A Thesis Submitted in Partial Fulfillment of the Requirements

for the Degree of Master of Science in Social and Administrative Pharmacy

Department of Social and Administrative Pharmacy

Faculty of Pharmaceutical Sciences

Chulalongkorn University

Academic Year 2019

การศึกษากำลังคนเภสัชกรภาครัฐของสาธารณรัฐแห่งสหภาพพม่า

น.ส.ละวิน นายอิน อีเย

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาเภสัชศาสตร์สังคมและบริหาร ภาควิชาเภสัชศาสตร์สังคมและบริหาร
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ปีการศึกษา 2562

Thesis Title	STUDY OF PHARMACIST WORKFORCE IN PUBLIC SECTOR, OF REPUBLIC OF THE UNION OF MYANMAR
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Field of Study	Social and Administrative Pharmacy
Thesis Advisor	Associate Professor PUREE ANANTACHOTI, Ph.D.

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ละวิน นายอิน อีเย : การศึกษากำลังคนเภสัชกรภาครัฐของสาธารณรัฐแห่งสหภาพพม่า. (STUDY OF PHARMACIST WORKFORCE IN PUBLIC SECTOR, OF REPUBLIC OF THE UNION OF MYANMAR) อ.ที่ปรึกษาหลัก : รศ. ภญ. ดร. ภูรี อนันตโชติ

สถานการณ์ขาดแคลนกำลังคนของบุคลากรการแพทย์เป็นสิ่งที่พบได้ทั่วโลก รวมถึงในสาธารณรัฐแห่งสหภาพเมียนมาร์ แต่ในสาธารณรัฐแห่งสหภาพเมียนมาร์แม้จะทราบว่ามีการขาดแคลนกำลังคนของบุคลากรการแพทย์ แต่ยังไม่เคยมีการศึกษาปัญหาการขาดแคลนเภสัชกรมาก่อน การศึกษานี้มีวัตถุประสงค์ที่จะวิเคราะห์สถานการณ์กำลังคนของเภสัชกรโดยเฉพาะอย่างยิ่งในภาครัฐของสาธารณรัฐแห่งสหภาพเมียนมาร์ และสร้างแบบจำลองด้านกำลังคนเพื่อให้ข้อเสนอแก่ผู้กำหนดนโยบายเพื่อพัฒนากำลังคนด้านเภสัชกรในภาครัฐของประเทศ

สำหรับการวิเคราะห์สถานการณ์กำลังคนของเภสัชกรใช้วิธีการวิจัยแบบผสมผสาน โดยใช้วิธีสัมภาษณ์แบบเผชิญหน้าแบบกึ่งโครงสร้างร่วมกับการวิเคราะห์ข้อมูลทุติยภูมิจากฐานข้อมูลกำลังคนด้านสุขภาพของกระทรวงสาธารณสุขและกีฬา โรงงานเภสัชกรรมของรัฐ และกระทรวงมหาดไทย ผลลัพธ์จากการวิเคราะห์สถานการณ์กำลังคนที่สำคัญคืออัตราส่วนของเภสัชกร/ ประชากร 10,000 คน สัดส่วนการกระจายตัวของเภสัชกรในภาครัฐ: ภาคเอกชน สัดส่วนการกระจายตัวของเภสัชกรในแต่ละเขตปกครองของประเทศ สัดส่วนการกระจายตัวของเภสัชกรในแต่ละหน่วยงาน นอกจากนี้มีการประเมินบทบาท และความรับผิดชอบของเภสัชกรในปัจจุบัน และที่คาดว่าจะเป็นในอนาคต สำหรับการสร้างแบบจำลองกำลังคนทางเภสัชกรรม จะมุ่งเน้นที่จะสร้างแบบจำลองสำหรับเภสัชกรโรงพยาบาลก่อน แบบจำลองจะทำทั้งกรณีฐาน และทำการวิเคราะห์ความอ่อนไหว ซึ่งข้อมูลที่ใช้มาจากการทบทวนวรรณกรรม และข้อมูลจากฐานข้อมูลของรัฐ โดยปรับเปลี่ยนตัวแปรที่ส่งผลกระทบต่ออุปสงค์ และอุปทานเช่น จำนวนเภสัชกรที่ผลิตต่อปี จำนวนปีที่บังคับให้ใช้ทุน ความต้องการบริการทางเภสัชกรรมคลินิก เป็นต้น

การศึกษานี้พบว่าสาธารณรัฐแห่งสหภาพเมียนมาร์มีปัญหาขาดแคลนเภสัชกรจริง โดยพบว่ามีเภสัชกร 0.73 คน/ ประชากร 10,000 เภสัชกรมีการกระจายตัวอย่างไม่เหมาะสมในแต่ละเขตปกครองของประเทศ การกระจายตัวของเภสัชกรในภาครัฐ: ภาคเอกชนเท่ากับ 15%:85% การขาดแคลนบุคลากรที่มีทักษะเฉพาะทางพบมากที่สุดในโรงพยาบาลรัฐ นอกจากนี้จากการใช้แบบจำลองด้านกำลังคนพบว่า ข้อเสนอที่จะใช้แก้ปัญหากำลังคนเภสัชกรสำหรับสาธารณรัฐแห่งสหภาพเมียนมาร์คือ เพิ่มจำนวนบัณฑิตเภสัชศาสตร์เป็น 2 เท่า บังคับให้เภสัชกรจบใหม่ทำงานในโรงพยาบาลรัฐ 3 ปี ทั้งนี้รัฐต้องหามาตรการให้เภสัชกรที่ใช้ทุนกึ่งหนึ่งยังคงทำงานต่อในโรงพยาบาลรัฐ โดยเนื้องานที่เภสัชกรทำในช่วง 10 ปีแรกยังอยู่ในระดับเบื้องต้น

สาขาวิชา	เภสัชศาสตร์สังคมและบริหาร	ลายมือชื่อนิสิต .....
ปีการศึกษา	2562	ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

6076354433 : MAJOR SOCIAL AND ADMINISTRATIVE PHARMACY

KEYWORD: PHARMACIST WORKFORCE, DISTRIBUTION, SHORTAGE, PUBLIC SECTOR, HUMAN RESOURCE PLANNING, MYANMAR

Lwin Nyein Aye : STUDY OF PHARMACIST WORKFORCE IN PUBLIC SECTOR, OF REPUBLIC OF THE UNION OF MYANMAR. Advisor: Assoc. Prof. PUREE ANANTACHOTI, Ph.D.

Health workforce shortage was common across the world including Myanmar. However, there was not previous study about the pharmacist workforce to ascertain the shortage problem in Myanmar. This study was aimed to analyze the current situation of pharmacist workforce in Myanmar especially in public sector and to construct a simulation model to suggest the appropriate policy options to the policymakers in improving the pharmacist workforce situations in the public hospitals.For the first objective, the study design was a cross-sectional survey using a mixed method which consisted of the secondary data analysis and semi-structured face-to-face interviews. The government registry data related to the human resources was obtained from the Ministry of Health and Sports, the Government Pharmaceutical Industries and the Ministry of Home Affairs. The ratio of pharmacists per 10,000 population, the distributions of pharmacists by public sector and by geographic regions and pharmacist vacancy rate across seven departments were analyzed. The current and future roles and responsibilities of pharmacists were evaluated from the semi-structured interview. For the second objective, the study design was a simulation model. The data from previous published articles and government registry database were input into the model.This study found that the numerical, distributional and skill shortage was observed in Myanmar. Pharmacist density was 0.73 pharmacist per 10,000 population. Pharmacists were mal-distributed geographically. Pharmacists were unequally distributed among public (15%) and private sectors (85%). Skill shortage was observed in public hospitals. Hospital pharmacists were limited for other pharmaceutical care functions. The simulation model found the best policy option of double graduation rate, 3-year compulsory service and 50% exit rate to deliver the clinical pharmacy service with low level of use of service.

Field of Study:	Social and Administrative Pharmacy	Student's Signature .....
Academic Year:	2019	Advisor's Signature .....

ACKNOWLEDGEMENTS

I would like to express my deep gratitude and sincere thanks to Associate Professor Puree Anantachoti, Ph.D., my advisor, for her patient guidance and enthusiastic encouragement, invaluable advice and useful critiques for this research work.

I also would like to express my sincere thanks to Professor Thein Mi, Ph.D., my local supervisor for data collection and for her helpful contribution to my preparation to the Institutional Review Board of University of Public Health, Myanmar.

I also would like to state my gratitude to Assistant Professor Anuchai Theeraroungchaisri, Ph.D., Associate Professor Wanna Sriviriyanupap, Ph.D. and Assistant Professor Khunjira Udomaksorn, Ph.D., my thesis committee, for their valuable advice, helpful comments and recommendation.

I would like to express my heartfelt thanks to Thailand International Cooperation Agency (TICA), Ministry of Foreign Affairs, Thailand for their full financial support for tuition fee, research fee and monthly allowance to study Master degree. I would like to state my special thanks to “the 90th Anniversary of Chulalongkorn University Scholarship” for the partial contribution of the research grant.

I would like to thank to the Minister of Ministry of Health and Sports and all authorities from Department of Food and Drug Administration, Myanmar for giving me an opportunity to join the Master degree program.I would like to thank all key informants from Ministry of Health and Sports, Ministry of Industry and Ministry of Home Affairs for their great support during the data collection period. I would also like to thank Mr. Stephen John Pinder for proofreading the article.

Finally, I would like to thank to my family, all lecturers in Graduate program in Social and Administrative Pharmacy, Faculty of Pharmaceutical Sciences, Chulalongkorn University and all visiting lecturers, my friends for their support and encouragement.

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CHAPTER – I

INTRODUCTION

1.1 Background and Rationale

World Health Organization (WHO) defines the health workers as people who have responsibility to protect and enhance the health status of the population.[1] Health workers are the important stakeholders of the health systems as they help reducing mortality rate. Chen's study in 2004 reported that mother and infant mortality rate decreased with increased health workers' density.[2] Among the health workers, pharmacists are one member whose responsibility is to develop and produce the pharmaceutical products and provide pharmaceutical care services to the community.

Pharmacists play a main role in the process of the drug discovery and development, clinical research, production, quality control, regulatory process, drug dispensing and patient outcome monitoring. In the past decade, their roles have expanded from the product-focused to patient-focused services. Pharmacists are the medical experts who help reducing health related costs by detecting, solving, and preventing medication errors, adverse drug events and irrational prescribing.[3] Expansion of pharmacists' role and responsibility includes (1) preventive services (screening of the diseases and Immunization) and (2) education and behavioral counseling related to health and wellness, such as tobacco cessation, or counseling related to a patient's medication therapy to improve the drug use process. [4]

The pharmacists are the third largest groups among the healthcare professionals globally. There was still a great shortage of pharmacists in many countries.[5] The International Pharmaceutical Federation (FIP) reported that pharmacist workforce density varies across the countries. Some countries experienced severe pharmacists and pharmacy assistant shortage such as African countries.

Poor distribution of the pharmacy workforce results in poor drug access. WHO has estimated that approximately 30% of the world population cannot regularly access to essential

medicines.[6] Moreover, the counterfeit and sub-standard drugs problems were proliferated due to shortfall of pharmacist workforce.[7] Unnecessary prevalence of the medication-related problems such as medication errors and irrational prescribing of drugs were found in the hospitals and community pharmacies.

Myanmar had also been experiencing pharmacist shortage for years. Although the pharmacist shortage and the problem associated with the shortage are well noticed, there was no accurate information about current situations of pharmacist workforce in Myanmar, which is needed to support the policymakers to improve the pharmacists' human resources situations. Therefore, this study was aimed to analyze the current situation of the pharmacist workforce in Myanmar and to construct a simulation model in order to inform the appropriate policy options to the policymakers in improving the pharmacist workforce situations in the public sector of Myanmar.

1.2 Objectives of the Study

This study was aimed to

- analyze the current situation of the pharmacist workforce, especially in public sector of Myanmar.
- construct a pharmacist human resource simulation model to forecast the future supply and demand of pharmacist workforce for clinical pharmacy services in the public hospitals of Myanmar.

1.3 Expected Benefits

Results from two study objectives will support the policy makers in identifying the appropriate human resource policy option to improve the human resource situations of pharmacists in Myanmar.

CHAPTER- II

LITERATURE REVIEW

2.1 Health Workforce

According to WHO report, human resources for health can be divided into two categories.[1] The first category is health service provider such as medical doctors, dentists, nurses, pharmacists, other allied health workers, community and social health workers. These health care professionals need the specific professional knowledge, training and practice. The process of developing these skilled health professionals takes time and needs financial support and, therefore, the government should allocate the budget and appropriate facilities to support them. The second category is those who do not provide the direct medical services to the patients, although they are crucial in the administrative functions. For example, they are the supporting administrative staff, accountants, clerks, drivers in the hospitals.

2.2 Global Situation of the Health Workforce

In 2006, WHO has estimated that the total density of full-time paid health workforce in the world was over 59 million workers.[1] Countries in WHO Europe and America regions had the highest health workforce density ranging from 18.9 to 24.8 health workers per 1,000 population. Countries located in WHO Eastern Mediterranean, South-East Asia and Western Pacific regions had the health workforce density ranging from 4 to 5.8 healthcare staffs per 1,000 population. Low income countries in WHO Africa region had the lowest health workforce density worldwide which was 2.3 healthcare staffs per 1,000 population.

WHO region	Total health workforce		Health service providers		Health management and support workers	
	Number	Density (per 1000 population)	Number	Percentage of total health workforce	Number	Percentage of total health workforce
Africa	1 640 000	2.3	1 360 000	83	280 000	17
Eastern Mediterranean	2 100 000	4.0	1 580 000	75	520 000	25
South-East Asia	7 040 000	4.3	4 730 000	67	2 300 000	33
Western Pacific	10 070 000	5.8	7 810 000	78	2 260 000	23
Europe	16 630 000	18.9	11 540 000	69	5 090 000	31
Americas	21 740 000	24.8	12 460 000	57	9 280 000	43
World	59 220 000	9.3	39 470 000	67	19 750 000	33

Note: All data for latest available year. For countries where data on the number of health management and support workers were not available, estimates have been made based on regional averages for countries with complete data.

Table 1 Global health workforce

Source - The World health report 2006 - Working together for health [1]

Health system is labor-intensive. It needs not only right number but also qualified people with knowledge and skills to perform timely-manner and efficient services. There were many evidences that the numbers of health workers and the quality are positively correlated with the immunization coverage, accessibility to primary care and the survival rate of infant and mother.[1] Moreover, WHO report 2006 has proved that there was an association for the numbers of doctors and their skills with the positive cardiovascular diseases outcomes.[1] Furthermore, a recent study conducted in Vietnam in 2016 has described that the attainability of different types of health workforce (doctors, nurse, midwives, pharmacists) can lead to positive health outcomes and the longer life expectancy.[8]

Health workers were highly needed in the health system. Shortage of health workers is a worldwide issue. This situation was announced as “health workforce crisis” by WHO on World Health Day in 2006.[1] There was a critical shortage estimated to 4.3 million health workers including both the health service providers and support workers in 57 countries worldwide. The numbers of health workers in these 57 countries are less than the ratio of 2.28 million physicians, midwives, nurses per 1,000 population. The numbers are also under the minimum recommended threshold of 2.5 health workers (doctors, midwives, nurses) per 1,000 population which was set by the Joint Learning Initiative (JLI) to achieve the essential health care services and health-related Million Development

Goals (MDG) which consist of improving child health and maternal health and tackling the communicable diseases such as HIV/AIDS , malaria and other diseases by 2015.[1]

The health workforce crisis impacted mostly on the poor countries in the world. Among 57 countries, 36 countries are in Africa. Sub-Saharan Africa (SSA) suffered the most severe crisis. As shown in the table 2, the estimated shortage in all WHO regions was 2.4 million which represented only for three sorts of health professionals. [1] This 2.4 million was multiplied with 1.8 which was the mean ratio of three main types of health professions (doctors, nurses and midwives) in all WHO regions in order to get the final number of 4.3 health workers shortage globally. In addition, WHO and Global Health Workforce Alliance estimated recently in a report that a global shortage of workforce in 2012 was 7.2 million and it would be to rise to 12.9 million by the year 2035.[1]

WHO region	Number of countries		In countries with shortages		
	Total	With shortages	Total stock	Estimated shortage	Percentage increase required
Africa	46	36	590 198	817 992	139
Americas	35	5	93 603	37 886	40
South-East Asia	11	6	2 332 054	1 164 001	50
Europe	52	0	NA	NA	NA
Eastern Mediterranean	21	7	312 613	306 031	98
Western Pacific	27	3	27 260	32 560	119
World	192	57	3 355 728	2 358 470	70

Table 2 Estimated shortages of health professionals (doctors, nurses and midwives)

Source - The World health report 2006 - Working together for health [1]

WHO commented on health workforce crisis in the World Health day in 2006 that the problem has occurred because the training, education, remuneration, working conditions and management of the health workers are under-invested for several years. It has also discussed the cause of the shortage problem as; retirements of ageing workers, relocation to better jobs, insufficient training, higher demand of services for the growing population, local and international migrations of health workers.[9]

2.3 Types of Health Workforce Problems

The fluctuation between the supplies and demand for the health workers with occupational skills in the labor market causes the imbalance in the health workforce, both the shortage and surplus of the health workforce.[10] The shortage problem occurs more frequently and makes a big challenge to the health policy makers and stakeholders. This is because all kinds of health professionals are the most crucial inputs of the health care sectors.

The imbalance in human resource for health can be classified into three main types; (1) numerical imbalances, (2) distributional imbalances and (3) skills imbalances.[11] Detailed explanation, examples and negative consequences are elaborated in the followings.

2.3.1 Numerical Shortage

Numerical shortage refers to the inadequate numbers of health professionals to deliver the services of health system. It means that the health sectors are lack of the minimum number of health workers needed to fulfill the health needs of the people. Numerical shortage of health workers was occurring in developing and under-developing countries so that the ratio of doctors and nurses to population showed severe health workers shortages, especially in African and Asian countries.

African countries suffered the severest shortage conditions that it has the lowest health workforce density of 2.3 health workers per 1,000 population in 2006.[12] One study which reviewed the shortage in Africa have described that three Africa countries had the lowest ratio of physicians to 1,000 population, estimating for 0.014 in Liberia(2008), 0.018in Malawi (2009) and 0.019 in Niger (2008).[13]

Many countries in Asia and Pacific region suffered from health worker shortage problem that the numbers of health workers (doctors, nurses, midwives) fell far below the lowest threshold of 2.5 per 1,000 population which was set by the Joint Learning Initiative (JIL). [14] For example in Vietnam, the average ratio of health provider (doctors, nurses, midwives) was just over 1 per 1,000 population. Although 37 out of 61 provinces in Vietnam were well below this national average ratio, one province

had occupied the ratio of four health providers per 1,000 population.[14] The density of doctor per 1,000 population in Nepal (2004), Cambodia (2012) and Lao (2012) were the lowest at 0.2 among the region. This ratio was between 0.3 and 1.2 in Indonesia (2013), Bangladesh (2011), Thailand (2010), Myanmar (2012), India (2014), Pakistan (2010), Sri Lanka (2011) and Philippine (2004). In China (2013), Japan (2014) and Korea (2014), the ratio of doctor per population was near to 2.5 per 1,000 population. Australia had the high ratio of 3.5 doctors per 1,000 population.[15]

2.3.2 Distributional shortages

The distribution shortage means that the health workers are unequally distributed according to specific characteristics such as by type of job, geographical region, public/ private sector, place of work and sex. Health workers in most of the countries are likely to work in the urban areas and there were few numbers of the health workers in the remote areas. It leads to the geographical distribution imbalances of the workforce failing to provide the health interventions to the host persons living in the remote areas, especially the poor people. One study published in 2007 has showed that 74% of physicians work in urban of India, where had only 26% of the population.[16] Chhea's study in Cambodia (2010) has expressed that the health workers were concentrated in the capital city of Cambodia, Phnom Penh with 54% of doctors although 9.3% of the people lived in that city.[17]

The unequaled allocation of health workers between public and private sectors are also common in many countries leading to mal-distribution between these sectors. The private health sectors were expanded across the world last few years ago. As a result, public sector health workers joined the private sector, and it worsened the problem of shortage in the public sector. For example, a brain drain was suffered internally in Thailand in the years from 1988 to 1997 by moving the health workers from the public hospital located in rural district and province area to the private hospitals in urban areas.[18] In Hong Kong in 2016, the public hospitals were looking after 90 % of the patients in the city, while it recruited only 40 % of the doctors. The profit-making private sector had only 10% of patients although it recruited 60% of doctors. The hospital authority in public hospitals has reported that they were operating under 700 nurses and 250 doctors shortfall. Although public hospitals

managed to recruit new candidates, health professionals choose to join the private hospitals as they want to work in more relaxed condition and better paid.[19]

2.3.3 Skill shortages

Skill shortage refers to the shortage of health workers who has adequate training to meet the skills needed by the health system. Many countries had inadequate skilled health workforce because they do not have adequate training institutes. Studies from many countries have expressed the skill shortage of health workers as a result of inadequate trainers and incapacitate education institutes. In some countries such as African countries and Cambodia, the training facilities and qualified trainers were shortfall.[11] In Oman, nurse education program cannot support training of advanced skills.[11] In Indonesia, doctors and midwives who worked in rural areas required on job training to engage the suitable health care interventions.[11] In many countries, the health workers such as doctors did not have enough public health related skills to achieve a health system that focused on prevention of the diseases.[11] In Australia, a study has confirmed that radiation oncologists and radiographers were inadequate and 10% of newly diagnosed cancer patients cannot access to radiotherapy.[20] In low and middle income countries, neurosurgeons were seriously needed to take care of over 5 million neurosurgical cases.[21]

2.4 Global Situation of Pharmaceutical Workforce

Health workforce is comprised with health care workers with diverse specialties related to medical professions to give their respective health care services in order to hit the health-related requirements of all people in the community. Among the health care workers, World health organization (WHO) has suggested that pharmacists also involve in a great position to contribute the health care services.[22] Moreover, according to International Pharmaceutical Federation (FIP) statement of policy on Good Pharmacy education practice, pharmacists has been recognized as their important roles of safe, effective and the rational use of drugs to achieve the maximum therapeutic effects of the treatments.[23] Their responsibility constitutes to well-beings of individual patient and the whole society of population.

Pharmacists are professional specialists in drugs because they have stand for a long time between medical doctors and patients to provide medication. They have given services directly to

the patients especially in the community.[24] The traditional role of pharmacists are said to be compounding and dispensing. [24] However, there has been an increase in health demands such increasing numbers of drugs, and poor compliance to pharmacotherapy forcing the pharmacists to adopt a new role of patient-centered service.[25] In 1990, Hepler and Strand initiated the word "pharmaceutical care" which had success in both pharmacy organizations and health care institutions a few years later.[26] This process can correlate the pharmacists to the patients to build an evidence-oriented care procedure for pharmacotherapy and look into the expected treatment outcome of the patients.[25] Pharmacists became a vital membership in the healthcare team after adoption of this practice because this practice ensures effective, safe and rational use of drugs. Pharmacists are also medical professionals who can reduce health care cost, mainly on drugs because they can prevent the prevalence of medication errors, adverse drug events and inappropriate prescribing. A recent study conducted by Dalton and Byrne 2017 has proved that pharmacists were able to reduce the health care cost in many healthcare settings.[3]

Pharmacist's role is changing with high speed in accordance with the needs of patients and modern health care systems.[23] Therefore, pharmacists' role expand to a crucial role in the drug discovery and development process, quality control of drugs, clinical research, regulatory functions and patient education and counseling, etc.[27] Recently, pharmacists' role is explored in a changing healthcare environment that pharmacists are now taking part in preventive care services, especially by screening for major diseases and by promoting and administering of vaccines. [28, 29] One study has proved that pharmacists achieved higher vaccination rates than other health care professions when they delivered the same combination of education and vaccination.[28] Many studies have explored pharmacist screening for major diseases such as osteoporosis, cardiovascular disease, depression, hypercholesterolemia, and peripheral vascular disease and their findings have suggested pharmacists can feasibly perform screening services.[29]

In addition, pharmacists are now participating as their new role in educating and behavioral counseling related to “health and wellness” such as tobacco cessation, weight management, or related to improving a patient’s medication therapy such as medication adherence. They have provided the counseling services in out-patient department, post-hospital discharge and community pharmacy settings.[30-32] Some research has proved that pharmacist counseling can be beneficial in achieving patients’ health goal. For example, in a randomized control trial (RCT) study, pharmacists can improve abstinence rates for smoking by conducting the face-to-face group counseling sessions with patients.[33] In another RCT, pharmacists have achieved in reducing waist circumference, blood pressure and triglyceride level in a combination of a diet and nutrition program and dietary counseling intervention.[34] Moreover, according to WHO, it stated “seven star pharmacist” that pharmacist should cover the roles as caregiver, decision-maker, communicator, manager, life-long learner, teacher, and leader.[35]

According to the results of Global Pharmacy Workforce surveys conducted by FIP at three time points of 2006, 2009 and 2012; most of the pharmacists are pursued in community retail pharmacies, followed by hospitals, industries, researches and academia, and regulations.[5, 36] However, in developing countries, the services of pharmacists are still underutilized and the role of pharmacists seems to be insignificant compared to that of other health care professionals. [37] Moreover, another problem was also experienced by developing countries; manpower shortage problem constituted to both numbers and skills imbalance of pharmacists particularly in government health sectors. During the whole of the Third World, along with shortfall of health care services, there have been shortfalls of pharmaceutical care services together with pharmacists shortage leading to patients cannot access to the essential drugs.[35] Meanwhile, most of the drugs were ineffective or unsafe and unneeded and they are obtainable in open and uncontrolled markets.

The results of FIP surveys has also described that pharmacy workforce density diverges relatively across the countries and it is associated with the numbers of population and economic

development indicators at the country level.[5, 36] The countries which have low economic development indicators seemed to have considerably lower numbers of pharmaceutical professionals. This can be seen clearly in the countries of Africa which had fewer pharmacists, pharmacy assistants, assisted health workers and pharmacies. This problem of shortage would lead to imbalance in availability to medicines and the professional experts in medicines. The surveys suggested that processing measures are required to construct a workforce of skillful professional experts in medicines to meet the pharmaceutical health needs of the public.

WHO recommended ratio of pharmacist to population is 1 pharmacist per 2,000 populations to provide the maximum health services and interventions.[38] In general, the ratio of pharmacists to population of less than 1:100,000 are commonly found in the countries but some countries may have seriously fewer ratio. The ratio is considerably high in urban areas and seriously fewer in rural ones in some developing countries. Even in a country, the capital city may have higher density of pharmacist with the ratio of 1:12 000 but in the provinces, there may have 1:700 000 or less. The poor ratios were correlated with the shortage and poor distribution of pharmacists and lower economic development level. However, industrialized countries occupied an average ratio of about 1:2300. [39]

In the survey conducted by FIP in 2009, the ratio of pharmacist per 10,000 populations across 56 countries ranged from a minimum of 0.04 in Chad to a maximum of 18.88 in Malta. This ratio in 2012 showed ranging from at least 0.02 in Somalia to at most 25.07 in Malta and the mean value of 6.02 pharmacists per 10,000 populations in 82 countries.

2.5 Myanmar Health Care System

Myanmar is a country located in South-East Asia with the total estimated population of 54.34 million in 2019 spreading throughout in 689,000 square kilometers. Health care services are provided to the whole population through public and private health sectors. The Ministry of Health and Sport (MOHS) is the major service provider which deliver health care services related to the prevention, treatment and rehabilitation to promote the health of population in Myanmar by consuming the

human, financial and material resources in the most efficient ways. According the MOHS statistics, there are six main departments; (1) Department of Public Health and Department of Medical Services, (2) Department of Human Resource for Health (3) Department of Medical Research, (4) Department of Food and Drug Administration, (5) Department of Traditional Medicine and (6) Department of Sports and Physical Education.[40] Each department has its own objectives and strategies through which they have been working to achieve the ultimate Ministry's objective of promoting the health status and having long lives of the population. The Department of Public Health has responsibility to provide primary healthcare services and public health services related to nutrition enrichment, maternal and child health promotion, school health and environmental sanitation.[41] Under this department, there is Disease Control Division and Central Epidemiology Unit to prevent and control infectious diseases, to investigate outbreak conditions and to perform disease surveillance.[41] The Department of Medical Services is mainly responsible to deliver the curative and rehabilitation services.[41] The public hospitals are running under this department. The Department of Human Resource for Health work to train and produce all types of human resources for health, except for traditional medicine practitioners, to provide health care services to meet the health needs of population.[41] The Department of Medical Research performs national surveys and research for evidence-based medicine and policy recommendation.[41] The Department of Food and Drug Administration is responsible for the safety of food, drugs, cosmetics and medical equipment.[41] The Department of Traditional Medicine is responsible to deliver healthcare services with traditional medicines, and to train and produce traditional medicine practitioners.[41] In parallel with the public sector, non-government organizations (NGO) such as the Myanmar Red Cross Society, Internationally based NGO such as WHO, UNICEFF, and locally based organizations and religion-based societies provide healthcare services.[41] The Ministry of Defense also provides health care services not only to the armed forces and their family members but also to people in outreach areas. It has military hospitals and training universities to train doctors, nurses and other allied health workers. [42]

Public hospitals are categorized into general hospitals and specialist hospitals with the beds ranging from 25 beds to 2000 beds at the township level, district level and state/ regional level and national level.[41] In rural areas, there are hospitals (16–25 beds), rural health centers (no beds), and sub-rural health centers (no beds). There were 1,056 public hospitals with 56,748 beds in total in 2014.[41] There are 16 traditional medicine hospitals and 243 traditional medicine clinics in 2014.[41]

Private Health Statistics 2015 reported that there were 193 private hospitals, 201 private specialist clinics, 3,911 private general clinics, and 776 private dental clinics.[41]

Health workers are trained and produced by 15 universities and 50 nursing and midwifery training schools under the Department of Human Resource for health.[43] Five medical universities offer seven-year bachelor degree course, diploma course, master and PhD degrees in different medical specialties.[42] Two universities of dental medicines offer 5.5-year bachelor degree course, postgraduate diploma, master and doctoral degrees.[42] Two universities of pharmacy and two universities of medical technology and two universities of nursing offer four-year bachelor degree courses, master and doctoral degrees.[42] The university of public health in Yangon offers a Diploma course for hospital administration, and Master and doctor degree of Public Health.[42] Bachelor of Community health is provided by University of community health in Magway. [42]The 50 nursing and midwifery training schools offer Diploma course for Nursing and Certificate for Midwifery curricula.[42]

The registrations of healthcare professionals are done by the medical council according to the stated council law. [42]The respective council laws offer licensing and regulation to practice four professionals only; medical, dental and oral medicine, nursing and traditional medicine. Licensing requirements for other allied health professionals are not stated in the law yet. For medical doctors, the registration is performed by Myanmar Medical Council according to Myanmar Medical Council Law (2000). For dentists, the registration is performed by Myanmar Dental and Oral Medical Council

according to Myanmar Dental and Oral Medical Council Law (1989) Revised (2011). For nurses and midwives, the registration is performed by Myanmar Nurse and Midwife Council according to Law relating to the Nurse and Midwife (1990) Revised (2002). For traditional medical practitioners, the registration is performed by Traditional Medical Council.

The ratio of health workers (doctors, nurses and midwives) per 1,000 population was 1.27 in the year 2006 to 2007 and it increased to 1.49 between 2010 and 2011.[42] World health statistics 2013 showed this ratio as 1.36 per 1,000 population from the year 2005 to 2012.[44] Moreover, Myanmar is one the 57 countries which are identified as suffering the health workforce crisis with 1.61 doctors, nurses and midwives per 1,000 population in 2006.[45] The ratios are very much under the global standard of 2.5 health workers comprising doctors, nurses and midwives per 1,000 population which can cover sufficiently the most needed health care services of the population.[1] Dentist, pharmacists and technicians were under-produced in comparison with doctors and nurses.[42] There is also imbalance health workforce across the county so that the health care services are very limited to the people who are living in the rural, remote and hard-to-reach areas.[45] Although Myanmar has tried to achieve the Millennium Development Goals (MDGs), but some improvement was still needed to reach the 2015 MDGs targets especially on the reduction in infant and child mortality.[42] This was caused by limited access to services in rural areas due to mal-distribution of health workforce.[45] To be able to solve the problem of human resource shortage in the public sector, a master plan for human resource for health was drawn in 2012 for the next upcoming 20-30 years. [42]

Total health expenditure was 2.3% of GDP in 2014.[46] Myanmar health expenditure was the lowest among the countries in WHO regions located in South East Asia. [42] Government health care budget was set at 1% of general government expenditure in 2005 and it was increased to 1.5% in 2012[45], however this level is still low to provide sufficient health care services needed to the general population. The main sources of health expenditure revenue are the government funding,

financial charge from private society, social security system (SSS), the voluntary aids. According to world bank 2015, 73.91% of total health expenditure are now paid by out-of-pockets payments due to inadequate government health expenditure.[47]

In Myanmar, a comprehensive health insurance system does not exit.[42] The only one health insurance in Myanmar is Social Security Scheme (SSS) provided by the Ministry of Labor.[48] Among the overall population in Myanmar, SSS covers only about 600,000 people.[48] It means that it's coverage was less than 1% of the population, and it's health expenditure was accounted to 0.15% and 0.48% of total health expenditure in 2008 and 2010.[42] Eligibility is the group of employees worked in public and private sectors consisting five or more people.[48] It was established in 1956 according to the 1954 Social Security Act. Employees and employers provided the finance for the insurance.[42] Private health insurance was in the early development stage and it was noted to be very few and the size of population coverage was unknown. [42]

The services provided by public-sector health workers are paid through the government salary and the payer is the MOHS. Whereas the services provided by private-sector health workers are paid through fully fee for services using direct payment by the patients. [42] The health workers who are assigned to work in hard-to-reach areas are provided the financial incentive as an extra 100% allowance based on their basic remuneration.

2.6 Pharmacy Workforce in Myanmar

There are two universities of pharmacy in Myanmar; one in Yangon and one in Mandalay. University of Pharmacy in Yangon was established in 1992 and University of Pharmacy in Mandalay was established in 2000.[49, 50] University of Pharmacy, Yangon has produced 2,353 bachelor degree graduates, 100 master degree graduates and 6 doctoral degree graduates until to 2018. University of Pharmacy, Mandalay has produced 1425 bachelor degree graduates, 15 master degree graduates and 3 doctoral degree graduates until to 2018.[50] Therefore, the total numbers of bachelor degree graduates are 3,778 in 2018. There are 15 subjects to be studied by the students

during the 4-year bachelor degree course. [49] Among 15 subjects, 4 main major subjects related to professional field are Pharmacology, Pharmacognosy, Pharmaceutics and Pharmaceutical Chemistry.

After graduation, pharmacists work in both public sectors and private sectors. For the public sectors, pharmacists have been working in the departments under the Ministry of Health and Sport, public Pharmaceutical Industries and Chemical Examiners' office.

For the private sectors, pharmacists work in the private hospitals, pharmaceutical industries, and pharmaceutical companies. Only few percentages of pharmacists have been working as community pharmacists in the community pharmacies. Whereas other non-professional staffs employed as community pharmacists in most of the community pharmacies. Moreover, Pharmacists also work in some international non-government organizations, INGO or NGO such as WHO, UNICEFF and UNOPS. They perform as logisticians or dispensing pharmacists in some project to take care of HIV patients or TB patients or Malaria or some communicable diseases.

2.7 Factors Affecting the Health Workforce Shortage Problem

Most frequently found health workforce shortage was numerical, skills and distributional shortage. Previous studies in many countries have proved these problems in their findings. Many prior studies revealed the causes of the shortage of the workforce and the contributing factors related to shortage problem. A gap between supply and demand of the workforce is the most striking factor contributing to the shortage problem. A study which was conducted by the researchers in the Department of Human Resource for Health of WHO has identified a framework comprised of the factors affecting health workforce imbalance. This study suggested that the demand for and supply of health workers are central to this framework.[10] This is because when the supply of the health workers does not meet the needs of the health system, the shortage of the health labors will occur in the health labor market and when the supply exceeds the demand, the surplus of the health workers will occur.

2.7.1. Supply of the workforce

To study the shortage of the health workers due to inadequate supply, it is important to point out the inflows and outflows in each organization. These two factors can have impact on the supply of the workforce.

2.7.1.1 Inflows

Inflows compose of production of new health workforce (new graduates) and those who immigrated from other countries or those who return to the work after a temporary exit.

Education

Education is the main supply source from which most of the health workers come into the job market. The main reason of the insufficient supply of the health workers is concerned with the number of universities, the class size, the number of first year enrollment, the attrition rate from the education program and the numbers of new graduate each year. Many previous researches have studied these variables to analyze the current supply and to predict the future supply of the health workers.

Faculty shortage in health education programs is also one of the most important factors impacted on the supply issue of health workforce.[51] The shortage of the health workers occurred due to faculty shortage which was common in many health professions including dentistry, pharmacy, nursing and other allied health professions.[31] A recent study has found that the nursing universities were not sufficiently prepared for the new incoming students.[52] This faculty shortage problem led to the nursing workforce shortage due to lack of conditions to provide education to the

increasing demand for registered nurses with the bachelor-degree. Finally, the impact was directly on the safe patient care. This study has also identified that the main reasons of faculty shortage include the increase age of existing faculty, less salary and incentive for academic sectors than positions in clinical sectors and inadequate numbers of master and doctoral-degree nurses to recruit the required lecturer vacant positions.

Increasing enrollment of the students in the faculty or university is one alternative to solve the workforce shortage problem. In California, Lok and Dower conducted a research about education's response to workforce shortages of respiratory therapists or respiratory care practitioners and imaging technologists.[53] According to the results of the interviews with key informants in this study, many allied health educational program directors have responded and made adaption properly to the job market for graduated persons of their program. They have responded to serious shortages problem in last few years by adding space for more students to get into the programs and then finally, the programs have full and overall enrollment has been increased. The shortage problems tend to be lessened or ended in most job markets, especially in basic radiologic technology. Finally, the planning was not needed to expand by the program directors. However, the shortage of respiratory therapist still existed although the enrollment in the program has full. The program was not able to be expanded because of some limitations such as limited spaces in hospitals and other medical care sector for students to practice their training.

Education is also one of the solving methods to figure out the skill gap of the health workforce. A recent study has reported that California has suffered a skill gap of allied health workers and it was predicted to experience a shortage of more than 1.5 million health workers with some college education which is less than a bachelor's degree by 2025.[54] This study has suggested that in solving this problem, two-year education system in California's institution require to provide training opportunities for the required allied health workers to be awarded a degree which is less than a bachelor's degree.

Immigration

Immigration is also another inflow through which the health workers from one country get into the health workforce in other countries. [55] The size of the immigrant health workers is also a factor that influence on the supply of the health workforce. There has been evidence that some countries have solved the health workforce shortage problem by the aids of immigrants or foreign-trained health workers. A recent study has notified that Canada's government has addressed on the physician shortage problem by increasing the medical school enrollment but the duration of training period for physician was so long that Canada had to rely on international migrant graduates (IMGs), or foreign-trained physicians to meet the physician needs in short-term. And then, Canada has imported more physicians on a yearly basis than it educated after 1960s.

2.7.1.2 Outflows

As shown in the figure 1 below, health workers exit from works temporarily or permanently or partially due to main reasons such as retirement, emigration, sickness or death and relocation to other jobs or professions. [1]

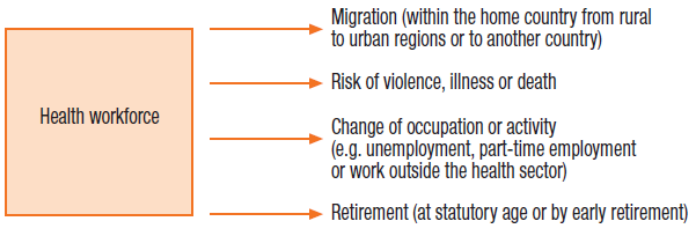

Figure 1 Exit routes from health workforce

Source- The World Health Report 2006 – Working together for health[1]

Retirements

Many studies have discussed the retirement of the health workers as an outflow from the health workforce which can reduce the existing workforce which in turn, affect the supply of the health workforce. The main reason for retirements is the ageing of the health workers. One study was conducted to analyze about how ageing population have impact on the health labor force in the United State. [56, 57] In this study, it has described that 35 million of old aged people (65 year or older) in 2000 will increase by more than 19 million to be 54 million by 2020 in United States. The growth of old aged population will have impacts on the health system in U.S., especially on the supply and demand of the health workforce. The supply of health care workers may reduce because the large amount of old aged health workers will stop their works due to retirement and their working hours will reduce.

Emigration

Health workers migrated from rural to urban areas and from low income to high income countries according to OECD information.[1] . Net supplier would be the less developed countries while the net recipients would be the other developed countries and the main recipient country was United States. [58] Less developed countries suffered the high emigration rate which worsen the situations of the health workforce crisis and incapacitate their already brittle health care systems.[59]

Sickness or Death

The attrition rates of health workers were high due to sickness and death as a consequence of high HIV/AIDS prevalence rate in some regions. For example, there were 17% of health workers losses due to AIDS in Botswana from 1999 to 2005. If health workers with HIV infection were not treated, the probability to cause death would be 40% by 2010. Death was the main leading cause of attrition in Lesotho and Malawi.[1]

Relocation to other jobs or professions

Health workers who leave the job to relocate to another job settings or other professions outside the health sectors can lead to the workforce shortage problem. [1] Attrition or losses of health workers from the health workforce can be a disturbance to countries which are trying to hit their target of the universal health coverage.[60] Previous studies have reported that resigning the job is a kind of voluntary attrition which was high in the public sectors of developing countries. Brain drain from the public to private settings may be due to many push factors such as poor remuneration, poor working environment and few incentives. [61] A study in Myanmar reported that 27.7% of academic health professionals in the medical schools quit the job voluntarily. [61] Moreover, poor willingness of health workers to practice in their professional fields caused the shortage of health workforce which led many job vacant positions to be filled in. For example, there were has about 35,000 registered nurses who were not actively practicing as nurses or unemployed in South Africa although there were 32,000 vacant positions. [1]

2.7.2 Demand for the workforce

In these days, the health care services in the health sectors are highly in demand leading to increased demand for the health workforce who will serve these services. When the supply of health workers is not enough to meet the increasing demand, it would finally face the shortage of health workers. Many factors influence the current and future demand for health services and health workforce requirements. The main leading factors are (1) demography, (2) morbidity (or epidemiology) and (3) health service utilization.

2.7.2.1 Demography

According to Health Workforce Planning in OECD Countries, demography is defined as the size and structure of the people living in the community according to their age and sex. [55] Birth rate and death rates of the population will be affected by changes in demography of that population over time.

The age of the people in the country is a demographic factor that will impact on the demand for a health workforce.[62] In developed countries, the ageing of the population will be a great concern which constitutes to rising trend in the need of health care services and the labor who gives

these services, especially nursing home visiting services.[62] Moreover, it is expected in developed countries that the numbers older people will grow dramatically in the next coming years.[62]

Data obtained from the U.S. in 2001 have revealed that the numbers of older people aged 65 years and above are predicted to be doubled to 70 million by 2030 from 35 million in 2000. In terms of the proportion of older people, it is estimated to increase from 12.7% in 2000 to 20% in 2030. A study was conducted to know how the ageing population have impact on the health labor force in U.S.[56, 57] In this study, it has discussed that the growing population of older people will use the greater share of health care services, and therefore, there will be the increased demand to provide those services. Older people are more vulnerable to suffer from chronic diseases than younger people. At least one chronic condition will be suffered by about 84% of those older population compared to 38% of younger people. More healthcare services will be needed by older adults who are vulnerable to injuries and illness; that is, they are more likely to be bone breaking in falls and to be infected with pneumonia. Older people will consume more prescribed drugs, more hospital services, more outpatient care service in hospital, and nursing home services than younger people. It is counted to be used 706 ambulatory care visits per 100 people by older people aged 65 years and above, compared to 291 visits per 100 people by younger people aged 18-44 year. It is estimated to be average 286.6 hospital discharges per 1,000 people for older people compared to 94.8 for younger ones aged 18-44 year and it will constitute more than 70% of home health care patients for older people.[56, 57] Moreover, it has predicted that those older population will use 34% of all surgical operations, 26% of all physician visits and 90% of all nursing home services.[63]

2.7.2.2 Morbidity (or epidemiology)

Epidemiology refers to the incidence and prevalence of diseases and injuries in the population. Changes over time could lead to the changes in the burden of different diseases and it would affect on the needs for health services and finally the health workforce. Many simulation models for projecting the demand for the workforce have used the information of past trends in the

incidence and prevalence of some diseases and they have made some assumptions on these past data which will go on in the future or that they will be constant at that current levels. As the incidence and prevalence rate of diseases increased, the healthcare services would be more needed and finally, the health workforce would be more in need to deliver the required healthcare services.

2.7.2.3 Health service utilization

Health care service utilization is defined as the quantification or description of the use of services by the individual people to prevent and cure diseases, to promote the health and well-being or to perform diagnosis and prognosis.[64] The increased health services utilization rate would lead to the shortage of the services and therefore, shortage of the workforce who will serve these services. A study of pharmacists workforce in U.S. has found that pharmacists are needed at the growing rate is due to the increased numbers of prescriptions.[65]

2.7.3. Other factors

There are also many factors that can influence the shortage of health workers. These factors can contribute to make decision of health workers whether they will participate in the labor market and they may have effects on the availability of the health workers or affecting their supply. They are incentives, working conditions, workload, job satisfaction and the retention and retaining policies.

2.7.3.1 Incentive

According to report of World Health Organization (WHO), incentives are defined as “all the rewards and punishments that providers face as a consequence of the organizations in which they work, the institutions under which they operate and the specific interventions they provide”.[66] Moreover, an incentive means that a specific type of payment which supposes to change the behaviors of workers. Incentive could be mainly classified as monetary and non-monetary incentive. [67]

Monetary Incentive
Salary Other Direct financial benefits; • Pensions • Illness/health/accident/life insurance • Clothing/accommodation allowance • Travel Allowance • Child care allowance • Indirect financial benefits • subsidized meals/clothing/ accommodation • Subsidized transport • Child care subsidy
Non-Monetary Incentive
• Holiday/Vacation • Flexible working hours • Access to/support for training and education • Sabbatical/study leave • Planned carrier breaks • Occupational health counseling • Recreational facilities

Table 3 Types of monetary and Non-monetary Incentive

Source- "Health Workforce Incentive and Remuneration Strategies: A Research Review"[67]

Monetary Incentive

Monetary incentives consist of salary and salary supplements, benefits and allowances. Salary is a motivation factor which retains the health workers to be worked in the health sectors. Poor wage is repeatedly described as the initial source of the shortage of the human resources. For example, a study in Malawi has confirmed that the shortage of registered nurses occurred due to poor pay.[68]

The Salary supplements have also been suggested as an essential motivation factor for health workers, particularly in countries where public salaries and wages are not enough to meet the fundamental requirements of health workers and their families.[14].

Non-Monetary Incentive

Many studies have reported that monetary incentives alone are not enough to retain health workers. [14] Higher motivation of health workers to participate in the workforce cannot be achieved by more money. Therefore, a combination of monetary and non-monetary incentive becomes a strategy to increase the health worker motivation in developing countries. For example, an opportunity to attend training is often an important non-monetary incentive. One study in Malawi has discussed about non-monetary incentive that most of the qualified nurses can attend short refresher courses supported financially by donor and they also have the chance to enroll in the long training course to win further education achievements. Achieving a higher education is the primary way to higher position and salary range in Malawi.

Moreover, it has been suggested that the hospitals in United States applied many strategies for recruiting of new health workers. The vacation time and health insurance are the most commonly used incentives. As a non-monetary benefit, tuition reimbursement and on-site continuing education are provided as the recruitment and retention benefits. Some hospitals in United States have used the flexible work arrangements providing summer holidays for working parents and rotating work weeks. [69]

2.7.3.2. Working conditions

According to Robbins and Judge 2008[70], as cited in Wamunyu 2016 [71], work conditions are defined as the working site, instruments used, the work itself, the policy and rules of the working organization. In the working conditions, some facilitating factors are included such as temperature, lighting, ventilation, hygiene, noise, working hours, and resources. [72] Most of the employee would like to work in the facilitated working conditions which will lead to physically comfortable and

convenient feelings. Without such working conditions, the mental and physical well-being of the employee can be affected.[70, 72]

Access to material resources would be creating a better working condition that will be another retention and retaining factor that motivates the health workers to participate in the health sectors. It is also important to support the material resources such as a variety of equipment, drugs, surgical gloves and cleaning products that will be required in the hospitals. According to the interview results of one study in Malawi, all nurses have responded about the scarcity of material resources. They claimed that they had adequate knowledge, practice and skills of treating to the patients, but they have worked without having the proper equipment or drugs resulting in poor quality of care. Shortage of adequate resources would be a cause of failing to retain the nurses who felt disappointed of working in their work.[68]

2.7.3.3. Workload

It has been suggested that the workload is also one of the contributing factors of resignation from the works by the health workers. [10] According to the interview results of a study conducted in Malawi, all the respondents have raised their heavy workload and they had to work longer working hours, and they had worked without stopping for lunch or taking a short break.[68] A few nurses interviewed have also suggested that training more nurses to reduce the workload was a solution to address on the nurses workforce shortage problem.

2.7.3.4. Job Satisfaction

Job satisfaction is defined as the feeling of employees on their jobs and different characteristics of their jobs. [73] Job satisfaction and productivity are highly correlated that happy employee tends to be productive in his work.[72] According to[71], job satisfaction is essential to maintain the productivity of the job by keeping the workforce in the motivated and engaged condition.[72]

Job satisfaction in turn, can be influenced by a variety of factors such as wage, adequate number of health workers, working condition, opportunities for training, workload, supportive management, incentive and rewards, timely evaluation, responsibility, communications between the workers and leaders, secure jobs, professional development and other factors.[74]

As it has cited in (Wamunyu, 2016) [71], remuneration is an important factor of increasing the job satisfaction of workers. Diener and Seligman has suggested that many cross-sectional studies have proved a positive correlation between income and the feeling of "well-being".[75] However, the salaries of health workers are under the minimum living wage in many countries. [1]

Workload is another important factor which can influence on job satisfaction. One research studied about work satisfaction of physician has suggested that workload characteristics such as number of patients per week or time spent on management work are correlated with job satisfaction.[76] The findings of a systematic literature review have showed that the general practitioners (GPs) dissatisfied with their jobs when they worked with long working hours and low income.[77] Job dissatisfaction was a main cause of GP shortage in some regions.[78] In addition, a national pharmacist workforce survey conducted in United States in 2014 has found that the increase in services and new roles has led to more job stress and dissatisfaction for pharmacist. The most job satisfied pharmacists were those outside of patient care areas.

Another study conducted in Ethiopia has reported that no chance to attend training and to have incentive caused dissatisfaction of health worker. Moreover, poor performance rating system and poor working situations were related to the dissatisfaction of health workers.[79]

2.7.3.5. Retention and Retaining policies

The retention and retaining policies can act as the influencing factors to solve the health workers shortage problem. Governments can state the rules and regulations that essentially force health workers to work in the public sector. This approach consists of compulsory services which means that the newly graduated health workers are forced to practice in underserved areas for a

given period of time.[80] A study has reported that this intervention has been introduced in more than 70 countries.[81] In Indonesia, a policy was implemented that doctors, dentists and midwives had to serve as contracted civil servants in the remote areas for at least 6 months to 3 years depended on the distance of the area.[82] In 2007, this mandatory service in Indonesia was changed to voluntary service and this scheme was still popular among new graduates because of increased monetary incentives and shorter contracted time. In 2009, a new voluntary scheme was introduced to assign health workers in the rural areas for at least 3 months to 1 year with additional incentives including travel costs.[82] The Indonesia government have found that various policy issues have improved the health workforce situations including numerical and distributional shortage in the rural areas.[82]

Some compulsory services are implemented along with educational incentives.[81] Educational stipends are provided during the training period and the health professionals are obliged to work as government staff in the underserved area for a certain contracted period after graduation. In Japan, for example, Jichi Medical University (JMU) implemented a contract-based 'home prefecture recruiting scheme' for doctors in which students were provided tuition fees for 6-year medical courses and after graduation, they were recruited with contracted scheme in 47 prefectures in Japan for 9 years (consisting 6 years of rural services).[83] This program had achieved a high retention rate of doctors in underserved prefectures.[83] This program was also practiced in Australia.[81] In Meghalays state of India, the health workers are obliged to work for a contracted three-year period to exchange for the supported undergraduate scholarships.[81] In some countries, such as Mongolia and Vietnam, the health workers were mandated to work in underserved area as a requirement to enroll a post-graduate course.[81] In Bangladesh, serving at least 1 or 2 years in rural health centers depending on remoteness by every newly recruited medical doctor was a prerequisite to join the postgraduate medical education.[84]

Although it was popular among many countries, it may be criticized as short-term solutions to address the health workers shortage problem.[85] The evaluation of this program showed that it was associated with unfairness, low motivation and low productivity among the students and professionals and it was likely to penalize, especially women. [85] Retention and retaining strategies that emphasize on the underlying causes of the problem may serve as long term solutions. These two

types of strategies are combined to be a best way to solve the health workers shortage problem in the public sectors of underserved area.

Retention and retaining strategies that will serve as long term solutions include a set of incentives financially and non-financially including living condition, working environment and personal and professional development.

Sufficient pay is a factor that is important to retain the health workers in the public health sector. A recent study in 2006 has reported that increasing salaries by 60% could retain doctors and nurses in public sectors in Swaziland.[86] There was an evidence in Malawi that increasing 52% taxed salary top-up for health workers in government hospitals was set as long term solution for severe health workforce crisis.[87] This new payroll system could increase the enrollment of staffs in public sectors after nine months.[87]

According to the head of the Malawi Nurses and Midwives Council, health workers seek not only financial incentive but also non-financial incentive such as personal development, better housing, education for children and so on. Non-financial incentives can retain the health workers in long-term by providing their welfare and greater stability in their civil servant lives. In the previous studies, most commonly providing non-financial incentives are to support the social need, good working environment and personal and professional development.

Non-financial incentive that provide social needs are housing, staff transport in childcare facilities, free food and employee support centers.[88]

Creating a good and safe working environment by providing appropriate equipment and supplies could actually improve the retention of health workers in previous studies. In Haiti, for example, partner in Health (PIH) had supplied essential medicines and technology in the rural clinics not to be frustrated by the health workers in providing health services.

Moreover, personal and professional development such as training, continuing medical education, opportunities to attend diploma, post-graduate course and research activities are also non-financial incentive to retain health workers in the public sectors. In Malawi, a post-basic training or post-graduate training was a pull factor for health workers to work in the public sectors. [89]

2.8 Human Resource Management

Among the resources in an organization such as men, money, material and machine, human resource (men) is the most important one to run the functions of the organization effectively. Other resources are managed and utilized through human resources. Therefore, human resources should be managed efficiently before managing other resources in an organization. Human resources management becomes a vital organizational function in every organization to be able to achieve their organizational goals.

"Human resource management refers to the policies, practices, and systems that influence employee's behavior, attitudes and performance".[90] (p.4) This process ensures to utilize the current limited workforce properly and efficiently in the organization. It consists of the process of hiring people, improving their skills, motivating them to the maximum level so that they are the most suitable person to the organization.

Human resource management includes the process of managing the employee, starting from employment, until to their retirement. The human resource management practices are "analysis and design of work, human resource planning, recruiting, selection, training and development, compensation, performance management, and employee relations". [90] (p.5) Among the human resource management practices, human resource planning is the technique of analyzing the human resources requirements in the current situations and in the future within an organization, drawing plans and performing according to that plans to fulfill the gaps and monitoring the effectiveness of the plans.[91] It can link the human resource requirement to the strategic plan of an organization so that staffing is enough, skillful and competent to meet the vision and mission of the organization. By planning ahead, the organization will be ensured with right number of staff, with right skills, in the right place and at the right time.

There are a lot of advantages by conducting human resource planning. It can reduce employee turnover rates. It can ensure to have sufficient numbers of staffs in the workforce. It can

smooth out the works because employees have the required skills and they have been trained to support the work's needs. [92]

There are five steps in the human resource planning process; (1) the current situation analysis, (2) forecasting the future supply and demand of the workforce, (3) building-up the plans which synchronize the existing situation with the future requirements, (4) performing according to the plans and (5) the plans are controlled, reviewed and adjusted if they are needed.[93]

The first step in human resource planning is to analyze the current situation of the human resources in the organization. The current situation analysis consists of collecting data about total numbers of current employees in the organization and about their detailed information such as their names, job responsibility, their skills set, education level, training received, length of services and their performance. This information could be normally seen in Human resources (HR) record of HR department of the organizations. Current situation analysis can provide information about the specific skills, education level and work experience of the existing workforce which could give the organization an idea of where these employees could be employed in which department in the future.

The second step is forecasting the supply and demand of the workforce in the future. It allows the human resources management officer to consider the future orientation of the organization and to identify the skills that will be needed to meet the organizational objective, in what numbers compared to the existing skills in the organization. Forecasting supply of the workforce is estimating the availability of employees with the required skills to meet the demand of employees within an organization in the future. There are two sources of labor supply from the labor market; (1) internally and (2) externally. The internal labor market consists of the workings who are working in the institution at present and external labor market represents those outside the organization. Forecasting the internal labor market is based on the factors such as retirements, turnover and promotion within the organization. Forecasting external labor market is influenced by the factors such

as labor forces participation rates; the number of working age people available in the country or area and unemployment trends. Demand forecasting is related to predicting the estimated numbers of employees and the types of their skills which will be required by the organization in the future.

In the case of the health workforce, the supply of the workforce is concerned with the availability of the health workers currently and in the future by performing some assumptions on the inflows and outflows of the workforce. The inflows consist of future increments of the workforce from new graduates, immigrants and people who moved from other organizations. The outflows consist of the losses of the workforce for a variety of reasons such as retirements, death, moved to other organizations. To predict the demand of the workforce, there are four traditional methods; “needs-based approaches, utilization or demand-based approaches, health workforce to population ratios, and the target-setting approach”.[94] and one method is an advanced method; adjusted service target approach. The details of the model are described in the table.

The third step of human resource planning process is developing human resource plans according to the results of the forecasting future supply and demand of workforce. If the future demand tends to exceed the supply, the plans should be formulated to adjust the shortage while, if the future supply tends to exceed the demand, the plans should be drawn to adjust the surplus. The plans seek to balance the current numbers of employees and their skills with future requirements. The plans will consist of strategies to solve shortage and surplus problem of workforce and to meet the goal of organization such as training, recruitment, retention, retiring or moving to other department, rewarding and improving the employee relations.

The fourth step of human resource planning is implementing the human resource plans which were developed in the step three. Finally, the last step is controlling, reviewing and adjusting plans if needed. The implemented plans should be reviewed depending on how much extent to which human resource plans have worked out to be effective and efficient utilization of human resources and to achieve organizational goal. There are three characteristics to evaluate whether

HRH plan is effective or not. They are (1) the degree to which the outcomes of HRH plans match with the changing conditions, (2) the degree to which HRH plans acquire their costs and productivity objectives, and (3) the degree to which the strategies and plans are re-planned to match with the changing conditions. If the outcomes of plans do not achieve their objectives, it should be adjusted again. For example, if the human resource plan is to recruit graduates in a department of an organization and it does not get enough staffs, the plan should be reconsidered again and it should be adjusted to recruit both graduates and non-graduates or retrain the existing employees.

Name of model	Description	Assumption
1.Need-based approach	It estimates future services requirements based on the current level of the incidence or prevalence of diseases of the population. Future services are then converted to future workforce requirements in terms of time estimate as full-time equivalent of health workers.	-All health care needs can and should be met. -Professional judgment is used to judge whether services are the most appropriate or not, in order to predict the future services.
2.Demand or utilization-based approach	It estimates the future workforce requirement based on the current level and future expected health service utilization rates. Future demand of services utilization is based on the expected changes in demographic profile and health needs of the population. Future workforce requirement is estimated in terms of full-time-equivalent of health workers to deliver the expected health services.	-The ways of changes in demographic profile and health deficit of the population in the future are predictable with observable trends.

Name of model	Description	Assumption
3.Service target-based approach	It consists of the setting of the targets by the stakeholders to produce and deliver the specified health services considering the current and future technology, the need of certain services by population. The targeted services are then converted to the future workforce requirement by estimating their full-time equivalent to perform these services.	-The standards of the health services targeted are predictable and can be achieved within the period of the prediction.
4.Health workers to population ratio approach	It estimates the number of health workers in a given population.	-
5. Adjusted service target approach	It identifies service needs based on epidemiological and demographic profile, and programmatic targets. It identifies tasks and skills required to deliver the evidence-based strategic interventions for the specific programs, based on functional job analysis. It also estimates time requirements for each intervention, based on time-motion studies or expert opinion. It also translates the time requirements into adjusted full-time equivalents, based on productivity.	

Table 4 Models used to forecast the demand of health workforce

2.9 Health Workforce Projection Model or Simulation model

Many previous studies have estimated the future workforce requirements by using a projection model which consists of assumption on factors in the supply and demand for the health workers. The projection models are widely applied in the health system among the countries. The main aims of the projection models are to provide information to the policy makers about the possibility of future developments in supply and demand of the workforce and to support them in identifying the possible policy issues to prevent the unfortunate outcomes.

The modelling for the supply side is simple. It consists of inflow and outflow and the numbers of current health workers. The demand side in the model is more complicated. It consists of many factors such as socio-demographic factor, the disease pattern, the health service utilization rates, and the expected services. Based on these factors, five main projecting methods to estimate the demand for the health workforce have been developed as shown in the table 4.

Almost all models consider the expected changes in the population size in predicting the future demand for health workers. Some models use the simple way based on population size to estimate the workforce requirements such as the ratio of health workers to population without constructing a further model for demand side. For example, a study conducted in Ethiopia to assess the pharmacy workforce analyzed this ratio.[38] The results showed that the ratio of 2.38 pharmacists per 100,000 population. Many previous studies in Chile, France, Ireland and Israel have used this population projection models. [55] The physician workforce projection model in France used a physician-to-population ratio on the demand side, based on the projected population.[55] Moreover, in the physician and nurse projection model in Israel, the physician-to-population ratio and nurse-to-population ratio were measured based on population growth rate.[55] In addition, the population-based projection was used to predict the ratio of generalist and specialist physicians per 100,000 population in 2001 and 2006 in Louisiana.[95]

The need-based approach was used in many countries including Germany, Switzerland,

Netherland, Canada to predict the numbers of health professionals. In the Netherlands, the projection model incorporates possible future changes in population health status by using data on changes in the epidemiological trends such as the prevalence of diabetes, cancer, alcohol abuse, people with dementia and other chronic diseases over the projection period (2010 to 2028). [55] Moreover, in south Australia, a needs-based workforce model was used to estimate the health workforce to provide tertiary-level community mental health care for distressed infants, children, and adolescents. [82] In addition, the need-based approach has used as a simulation model to inform the policy options for pharmacists in public sectors of Jamaica.[96] The demand for services and pharmacist workforce was estimated based on the population size, the health need such as the incidence and prevalence of most occurring diseases, and the level of services such as the number of prescriptions per patient per year.

In the service-utilization approach, the term utilization means the amount of services utilized such as the amount of dental care consumed by the patients. [97] The health workers requirement was predicted depended on the data of dental utilizations provided by the dentists, the average dental visits by the patients and the expected population growth. [97] A study also predicted the number of primary care physicians in U.S. based on the current and expected service utilization as the number of primary care visits per physician over 15 year period from 2010 to 2025. [98] Furthermore, health Resources and Services Administration (HRSA) in U.S developed a simulation model to project the national supply and demand of pharmacist from 2012 to 2025.[99, 100]The demand model took some assumptions on factors such as demographic profile, the influence of the Affordable Care Act insurance coverage impact, and health service utilization rates for prescription medications. The result showed that the demand for pharmacists was projected to increase by 16% by the growth of prescription filled and the overall projection resulted that supply would overreach the demand by 2025 and the pharmacist workforce will have adequate amount to match the demand in the future.

The service target was used by Adams and Woods (1990) to estimate the physician workforce required in Canada. [97] The future targets of services were identified by the health authorities and the health workforce requirement was estimated to perform these services.

Although the pharmacist shortage has been recognized along with health workers shortage problem, the extend and severity of the problem was not known exactly and there was no a pharmacist workforce study to know current situations pharmacist workforce in Myanmar. Therefore, this study analyzed the current situational analysis of pharmacist workforce be able to solve the root causes of problem. From the current situational analysis, the gaps in performing the functions of pharmacists were recorded. Comparing with the international functions, the limited functions were recorded and set to be future proposed functions in the public hospitals. Among these five methods of estimating health workforce requirements, service target approach has been chosen to estimate the pharmacist workforce requirement in the public hospitals of Myanmar. This is because the health services provided by the pharmacists are very limited in Myanmar compared with the other countries. Pharmacists in Myanmar are still focusing on product- oriented service. The advanced role of pharmacists called patient-centered service providing the pharmaceutical care is not available yet. Service target method can predict the pharmacist workforce requirement for the required clinical pharmacy services that are proposed to perform in the future based on the current and future technology, the needs of certain services by the population and according to the international trends. Health need-based approach and service utilization-based approach are only focusing on the existing services that have already performed in the health system. These two methods were not appropriate to adopt in Myanmar situations.

This study provided the information which was missed to be studied to fill the gaps of pharmacist workforce in Myanmar.

CHAPTER – III

METHODOLOGY

This study conducted to analyze the current situation of pharmacist workforce in Myanmar, especially in the public sector and to construct a simulation model in order to inform the appropriate policy options to the policymakers in improving the pharmacist workforce situations in the public hospitals of Myanmar.

3.1 Scope of the Study

This study framework focused only on the pharmacist workforce in the public sector of Myanmar. Public sectors included in (1) the government hospitals, (2) the Department of Food and Drug administration, (3) University of Pharmacy under the department of Human Resource for Health, (4) Department of Medical Research, (5) Department of Traditional Medicine (6) the Pharmaceutical Industries which are under the Ministry of Industry and (7) Chemical Examiners' Office under the Ministry of Home Affairs.

The methods of the study were described in details according to two objectives.

3.2 The Objective I

Study design

This research was a descriptive study and the data was collected for the objective I by using a mixed method with the government health workforce secondary data analysis and the semi-structured, face-to-face interview survey.

3.2.1. Secondary Data Analysis

The secondary data analysis was carried out to analyze the current pharmacist workforce in public sector in 2019.

3.2.1.1 Population and Sample

The registry databases of the departments in the Ministry of Health and Sports (MOHS), the pharmaceutical industries of the Ministry of Industry (MOI) and the Ministry of Home Affairs (MOA) were used as data sources on April, 2019. It was collected from the administrative division of each department in Ministry of Health and Sports (MOHS) such as Department of Medical services, Department of Food and Drug Administration (FDA), Universities of Pharmacy, Department of Traditional Medicine and Department of Medical research. It was also collected from the pharmaceutical industries in MOI and Chemical Examiners' Office in MOA. These databases are the reliable dataset of all types of health workers since they joined until they left the public workplace. The database includes the job title filled or the vacant positions and the socio-demographic profiles and the work settings. These databases are frequently updated. Among these databases, only the information related to pharmacists' job was extracted for further analysis.

3.2.1.2 Variables of interest

In this study, the variables of interest for the objective I consist of

- Total number of pharmacist job positions (workforce framework)
- Number of pharmacists currently working (number of filled positions)
- Number of pharmacist vacant positions
- Type of work
- Number of pharmacists who exit from the workforce

3.2.1.3 Measurements

Two main outcomes were measured: (1) numerical shortage and (2) distributional shortage.

1) Numerical Shortage

1.1 Number of pharmacists per 10,000 population

The density of pharmacists was measured in the number of pharmacists per 10,000 population which was the WHO core indicator. The numbers of graduated pharmacists from two universities of pharmacy until 2019 were assumed as the total numbers of pharmacists in the whole country. The numbers of population were collected from the Department of Population, Ministry of Labour, Immigration and Population, Myanmar.

2) Distributional Shortage

To measure the distributional imbalance, a WHO recommended core indicator was used. This indicator is defined as "the distribution or percent of health workers according to selected characteristics, notably by occupation, geographical region, place of work and sex". This study measured only the distribution of pharmacists by public sector, by geographical region and by place of work across settings.

2.1. Distribution of actively practicing pharmacists in public and private sectors

This indicator measured the distribution of actively practicing pharmacists who are working in the public and sector among the total workforce of pharmacists.

$$\text{Distribution of pharmacists by public sectors} = \frac{\text{Number of actively practicing pharmacists worked in public sector}}{\text{Total number of pharmacists graduated}} \times 100$$

Where, total number of pharmacists graduated refers to the total number of pharmacists who have graduated from two universities of Pharmacy from the date of establishment of these universities until to 2019. This ratio was assumed to be the total workforce of pharmacists or the total number of actively practicing pharmacists worked in both public and private sectors.

2.2. Distribution of pharmacist by geographical areas

This indicator measured the distribution of public sectors' pharmacists among the geographical regions of Myanmar; seven regions, seven states and Nay Pyi Taw Union Territory. It was described in terms of the number of pharmacists per 10,000 population in each geographical region. The number of population in each geographical region was retrieved from the Department of Population, Ministry of Labour, Immigration and Population, Myanmar. The numbers of pharmacist in each region was from the government registry databases of the departments in the Ministry of Health and Sports `(MOHS), the central office of the Ministry of Industry (MOI) and the Ministry of Home Affairs (MOA).

2.3. Distribution of actively practicing pharmacists across settings in public sector

In public pharmaceutical sector, there are many departments such as FDA, hospitals, universities, medical research and so on. This indicator measured the distribution of actively practicing pharmacists worked in each department within the public sectors. It measures how many percentages of pharmacists are working in each individual department among the public sectors. For example, the percentage of pharmacists working in FDA, the percentage of pharmacists working in the public hospitals were measured.

Distribution of pharmacists across settings=

$$\frac{\text{Number of actively practicing pharmacists worked in each department}}{\text{Total number of actively practicing pharmacists worked in the public sector}} \times 100$$

2.4. Job vacancy rate

Job vacancy rate was used to measure the shortage of the current pharmacist workforce. It was measured for numerical and distributional shortage. It is defined as the percentage of all vacant positions in the organization or department.

$$\text{Job vacancy rate} = \frac{Number\ of\ vacant\ positions}{Total\ Number\ of\ job\ positions} \times 100$$

Where,

Total number of job positions = Number of vacant positions + Number of filled Positions

A vacant position = A position which are un-filled or need to be filled with Pharmacists

A filled position = a paid position within the department to which a pharmacist has been assigned

3.2.2. Semi-Structure, Face-To-Face Interview

For semi-structured, face-to-face interview survey, study sites in the public sector were selected. Stratified simple random sampling method was used to select the size of the study site. For example, there were 239 public hospitals with (50- 2,000 beds) in 2019 and the hospitals were classified according to the size of beds such as XL, L, M, S and XS. From each class of hospitals, the hospitals were purposively selected. Other departments such as FDA were also selected according to this method. There were two Universities of Pharmacy, two branches of Department of Medical Research, two public Pharmaceutical industries in Myanmar. Therefore, both settings of these Departments were selected. The central office of Department of Traditional Medicine and Chemical Examiners' office were purposively selected.

3.2.2.1 Sample and sampling method

Key informants from the selected study sites were chosen by using purposive sampling method.

The inclusion criteria to select the key informants were –

(1) The responsible persons who were the head of each study setting or who were in the administrative level of the department such as director, medical superintendent, rector, manager and human resource management officer in the public sector.

(2) The pharmacist officers who were currently working as an in-charge of the work setting.

(3) The pharmacists who were currently working if pharmacist officers are not available.

Two key informants from each study site were interviewed. The detailed list of the key informants was attached in the APPENDIX I, Table 14.

3.2.2.2 Measurements

The semi-structure, face-to-face interview survey was used. Key informants were interviewed individually. Information during interviews was audio-recorded, transcribed verbatim and translated into English. Semi-structured questionnaires were attached in the APPENDIX II.

The in-depth interview measured whether the workforce had skill shortage. The semi-structure questionnaire included the following variables.

- Current role and responsibilities of pharmacists
- Pharmacists' Functions that delegated to other health professionals
- Future proposed functions of pharmacists

3.3 The Objective II

3.3.1 Study Design

The study design for the objective II was a simulation model which was constructed to inform the policy options to the policymakers in order to improve the pharmacist workforce situation in the public hospital of Myanmar.

Simulation model in this study consisted of two main modules; the supply module and demand module.

3.3.1.2. Supply module

The supple module consisted of (1) the existing supply of pharmacists, (2) the numbers of pharmacists who enter into the existing supply and (3) the numbers of exits from the existing supply.

The existing supply of pharmacists referred to the quantity of pharmacists who were currently working in public hospitals of Myanmar.

The numbers of pharmacists who entered into the existing supply were categorized into two types. The first category consisted of new graduates from the pharmacy education in Myanmar which were two Universities of Pharmacy in Myanmar. The second category consisted of in-migrants; pharmacists who moved from other jobs such as private jobs or from other countries. In this study, new graduates only were taken into account as inflow because there was no immigrant in the workforce currently.

The number of exits from the existing supply was the quantity of pharmacist who quitted from the existing workforce for many reasons such as retirement, moving to other jobs or death.

A net outcome from the flows of in and out of the current supply determined whether the supply increased or decreased. The supply of the workforce was measured in both headcounts and Full-time equivalent (FTE).

Supply = Existing supply +Future increment (New graduate/in-migration) – Projected losses (Retirement/relocation/death)

The number of pharmacist workforce available was then adjusted by level of activity and participation rate. The participation rate means the proportion of workforce participating in clinical service delivery; that is some pharmacists were employed but not delivered the patient care services and they were supposed to be non-participants in clinical pharmacy workforce. In this study, all incoming pharmacists were assumed to be practiced in the clinical pharmacy services (100% participation rate) for future prediction. The activity rate means the proportion of time contributed to service provision by pharmacists who will deliver the clinical pharmacy services. Among the pharmacist workforce working in government hospitals, the activity rate may or may not be the same (for example, some may work part-time hours or some full-time hours). The activity rate was then adjusted by using full-time equivalent (FTE). In this study, all pharmacists were assumed to be full-time pharmacist (1 headcount = 1 FTE pharmacist = 6.5 hour per day). The official working time in Myanmar was from 9am to 4:30 pm (7.5 hour per day). 6.5 hour per day was obtained by subtracting one hour for lunch time from a total of 7.5 hour per day. Finally, the number of

pharmacists available in the government hospital was estimated by multiplying the proportion of pharmacists who were employed in the government hospital to deliver clinical pharmacy services (level of participation) and the proportion an FTE pharmacist which has average working hours (level of activity).

Baseline value

According to the government data from MOHS, 289 pharmacists worked in the Department of Medical services, under which the public hospitals are managed. Among 289 pharmacists, 270 pharmacists were assigned to work in the public hospitals for the hospital pharmacy management services. In this study, these 270 pharmacists were 93% participation rate among the public hospital pharmacist workforce (289 pharmacists) in the hospital for baseline data.

According to the statistics from two universities of pharmacy in Myanmar, an average of 229 graduated pharmacists have been producing per year. There were no immigrants who graduated or moved from other countries in the public sector until 2019. The MOHS data reported that 5.15% of the public sector's pharmacists exited the work annually due to retirement, relocation to other jobs and death.

Assumptions on the supply module

Three main factors are assumed in the supply module. They are (1) the graduation rate, (2) compulsory service and (3) the exit rate after compulsory service.

The graduation rate was the percentage of students who graduated from the university. The graduation rate was assumed as 100% (normal rate), 150%, and 200% (double rate). The compulsory service was the mandatory service needed to be performed by all graduates in the public sector for a specific year period. It was assumed to be 2-year and 3-year which is the time taken by the graduated pharmacists to work in the public sectors. The participation rate was assumed to be 100% that all

pharmacist graduates are obliged to work in the public sectors for the specified years with the policy of compulsory services. The exit rate after compulsory service was the number of pharmacists who exited from the public sector after they completed their compulsory services. It was set to be 50%, 75% and 85% respectively.

The hospital pharmacists were assumed to work as full-time (6.5 hour per day x 5days per week x 52 weeks per year = 1690 hours per year) and the activity rate of hospital pharmacists was equal to 100% and it was then adjusted as 1 FTE pharmacist.

How to calculate the supply module

The way how to calculate the supply module was demonstrated in the following table 5.

The current number of pharmacists in the public hospitals (B) was 270 and the number of graduates produced per year (C) was 229. The total workforce of the pharmacists (E) was the sum of the current number of pharmacist (B) and the number of new graduates enter into the workforce or inflow (D). The regular exit rate due to retirement, relocation to other job or death was (F). The projected supply of the pharmacists (H) was the difference between the total workforce (E) and the number of exits (G). The exit due to compulsory services are also assumed in the simulation model (50%, 75%, 85%). In this example, the exit rate 50% was extracted from the projected supply (H) after every 2-year of compulsory service.

Number of Year (A)	Current No. of Pharmacist in Public Hospital (B)	No. of graduates per year (from university) (C)	No. of New graduates who enter to hospital workforce (inflow) (D)	Total workforce (E)	Regular Loss rate (F)	No. of exit (G)	Projected supply (H)	Projected supply with Exit rate (50%) after 2yr (I)
(A)	(B)	(C)	(D)= (C)* (A)	(E)= (B)+(D)	(F)	(G)=(E)*(F)	(H)=(E)-(G)	(I3) =(H3) - (H1*50%)
0	270	229	0	270	5.15%	13.905	256.095	256.095
1	270	229	229	499	5.15%	25.6985	H1=473.3015	473.3015
2	270	229	458	728	5.15%	37.492	690.508	690.508
3	270	229	687	957	5.15%	49.2855	H3=907.7145	I3=779.667
4	270	229	916	1186	5.15%	61.079	1124.921	888.27025
5	270	229	1145	1415	5.15%	72.8725	1342.1275	996.8735
6	270	229	1374	1644	5.15%	84.666	1559.334	1105.47675
7	270	229	1603	1873	5.15%	96.4595	1776.5405	1214.08
8	270	229	1832	2102	5.15%	108.253	1993.747	1322.68325
9	270	229	2061	2331	5.15%	120.0465	2210.9535	1431.2865
10	270	229	2290	2560	5.15%	131.84	2428.16	1539.88975
11	270	229	2519	2789	5.15%	143.6335	2645.3665	1648.493
12	270	229	2748	3018	5.15%	155.427	2862.573	1757.09625
13	270	229	2977	3247	5.15%	167.2205	3079.7795	1865.6995
14	270	229	3206	3476	5.15%	179.014	3296.986	1974.30275
15	270	229	3435	3705	5.15%	190.8075	3514.1925	2082.906

Table 5 Illustration of how to calculate the supply module

3.3.1.2. Demand Module

The service target method was used to forecast the pharmacist workforce demand in this study. In the service target method, specific targeted services were set to perform in the future.

From the semi-structured, face to face interview, the current functions and the limited functions were recorded. The standardized clinical services were searched in the previous published researches and they were compared with the current functions. One study in United States described the core clinical pharmacy services which have evidence of improving the health

outcomes of the population.[101] These clinical pharmacy services were still limited in public hospitals in Myanmar and they were targeted as new proposed services to deliver in the government hospitals in Myanmar.

The numbers of annual clinical pharmacy services were calculated based on the level of use of services (the number of services who would be utilized by the patients), which in turn was estimated based on the number of patients attended in the hospitals. This latter data was obtained from the hospital statistic report in 2016. According to the MOHS's hospital statistics report in 2016, there were 10,423,516 total patient days and 6,357,312 out-patients in 241 specialist and general hospitals with beds ranged from 50 beds to 2000 beds. Total numbers of admission in these hospitals were 1,889,669 in 2016.

The time requirement per service was obtained from the previous studies conducted in U.S. and Thailand.[101, 102] The workload (man hours (hours/year)) to perform the new clinical services was calculated by multiplying the number of annual services and the mean time requirement(hour/year) per service. It was then converted to FTE (full-time equivalent) pharmacists. One FTE is equal to 1690 working hours per year (6.5 hour per day x 5days per week x 52 weeks per year). The pharmacist workforce requirement to deliver each new service was then calculated by dividing the total number of workloads required for each service by the working hour of one FTE (1690 hours per year). Population growth rate and the level of health status of population were set at constant over time in this study.

Number of Clinical pharmacy services x Time requirement for each service = Workload (Man hour (hr/year))

$$\text{Total FTE pharmacist required} = \frac{Workload\ (Total\ working\ hours\ per\ year\ per\ each\ clinical\ pharamcy\ service(hr/yr))}{Total\ Working\ hour\ of\ One\ FTE\ pharmacist\ (hr/man\ /year)}$$

Baseline value

The clinical pharmacy services were new services which were proposed to function in the public hospitals of Myanmar. The past utilization rate of these services were not available as baseline values in the study.

Assumptions on the demand module

The assumptions were made on the level of use of services or the utilization rate of services to predict the future workforce in the demand module. It means that the amount or quantity of the use of services by patients to prevent and cure diseases.[103] In this study, it was the quantity or the number of the clinical pharmacy services utilized by the patients. It was assumed to have two levels of utilization rate; high and low quantity or level of use of clinical pharmacy services.

Two levels of utilization rate of services were set by doing some adjustments in such a way that; the utilization rate of a total of eight clinical pharmacy services were estimated based on the number of patients who would utilize services. It was assumed that the first four clinical pharmacy services such as (1) admission drug histories, (2) drug counseling, (3) inpatient dispensing and (4) outpatient dispensing, should be delivered to all patients in the hospitals. Therefore, the utilization rate of these services were assumed to be 100%. The second three services such as (1) drug protocol management, (2) medical round participation and (3) drug therapy monitoring were assumed to be utilized by not all patients. The utilization rate of these services were assumed to 25% for low level and 50% for high level respectively in the simulation model. Moreover, the adverse drug reaction (ADR) prevalence rate was 15.1% in the previous meta-analysis of prospective studies.[104] Therefore, the utilization rate of ADR management service was assumed to be 15.1%.

Moreover, the utilization rate of the remaining two services such as drug Information services and drug use evaluation services were not based on the number of patients who utilized the

services. However, it was based on the mean time requirement of each service (hours per week per hospital). Therefore, there was no assumption on the utilization rate for that services.

Moreover, among ten core clinical services, the first eight services were estimated for a total of 128 hospitals including the 32 specialist hospitals (50-2000 beds) and 96 general hospitals (100-2000 beds). Then, two services such as inpatient and outpatient dispensing were calculated for 241 hospitals comprising the general and specialist hospitals with beds ranged from 50 beds to 2000 beds.

No.	Name of services	High level of use of service	Low level of use of service	Mean time
1	Drug Information services	0.%	0.%	17.71 hr/week
2	Drug use evaluation	0.%	0.%	37.57 hr/week
3	ADR management	15.1%	15.1%	20.97min/patient
4	Drug protocol management	25%	50%	27.76min/patient
5	Medical round participation	25%	50%	17.43min/patient
6	Drug therapy monitoring	25%	,50%	16.84min/patient
7	Admission drug histories	100%	100%	16.71min/patient
8	Drug counseling	100%	100%	18.35min/patient
9	Inpatient Dispensing	100%	100%	4.8 min/patient
10	Outpatient Dispensing	100%	100%	4.8 min/patient

Table 6 Name of clinical pharmacy services, their mean time requirement and the method to classify the low and high level of use of services

How to calculate the demand module

The number of services (F) were calculated by multiplying the total number of patients(D) and the number of services who would be utilized by the patients (E). The workload of pharmacist or the working hours to perform the clincial pharmacist services per year was measured in Man hours (H). It was the multiplication of the number of the services (F) and their mean time requirement (G). It was then converted to FTE (full -time equivalent) of pharmacist (I) by dividing with one FTE pharmacist (1690 hour per year). The table 7 below showed the example of calculation of the demand of pharmacist to deliver the low level of use of services.

No.	Name of services (A)	Number of hospital(B)	Type of hospitals(C)	Total number of inpatients(D)	No. of service used by patients(E)	Remark	Number of services (F)	Mean time (G)	Man hour (hr/yr) (H)	FTE (I)
	(A)	(B)	(C)	(D)	(E)		(F)=(D)*(E)	(G)	(H)=(F*G) /60	(I)= (H)/1690
1	Drug Information services	128	XL,L,M,S general and XL,L,M,S,XS specialist	128 hospitals	_	hr/week	_	17.71 Hr/week	117878	70
2	Drug use evaluation	128	XL,L,M,S general and XL,L,M,S,XS specialist	128 hospitals	_	hr/week	_	37.57 Hr/ week	250066	148
3	ADR management	128	XL,L,M,S general and XL,L,M,S,XS specialist	1,549,947	15%	No. of admitted patients	234041.997	20.97 Min/patient	81798	48
4	Drug protocol management	128	XL,L,M,S general and XL,L,M,S,XS specialist	1,549,947	25%	No. of admitted patients	387486.75	27.76 Min/patient	179277	106
5	Medical round participation	128	XL,L,M,S general and XL,L,M,S,XS specialist	9,049,759	25%	No. of Inpatients	2262439.75	17.43 Min/patient	657239	389

6	Drug therapy monitoring	128	XL,L,M,S general and XL,L,M,S,XS specialist	9,049,759	25%	No. of Inpatients	2262439.75	16.84 Min/patient	630089	373
7	Admission drug histories	128	XL,L,M,S general and XL,L,M,S,XS specialist	1,549,947	100%	No. of admitted patients	1549947	16.71 Min/patient	435018	257
8	Drug counseling	128	XL,L,M,S general and XL,L,M,S,XS specialist	1,549,947	100%	No. of admitted patients	1549947	18.35 Min/patient	474025	280
9	Inpatient Dispensing	241	XL,L,M,S,XS general and specialist	10,423,516	100%	No. of Inpatients	10423516	4.8 Min/patient	833881	493
10	Outpatient Dispensing	241	XL,L,M,S , XS general and specialist	6,357,312	100%	No. of Out-patients	6357312	4.8 Min/patient	508585	301
									Total	2466

Table 7 Illustration of how to calculate the demand of pharmacist for low level of use of services

Measurement in the Simulation model

Finally, the simulation gaps between the supply and demand of pharmacist workforce were measured. The figure 2 illustrates the simulation model to forecast the supply and demand of pharmacists in the public hospitals

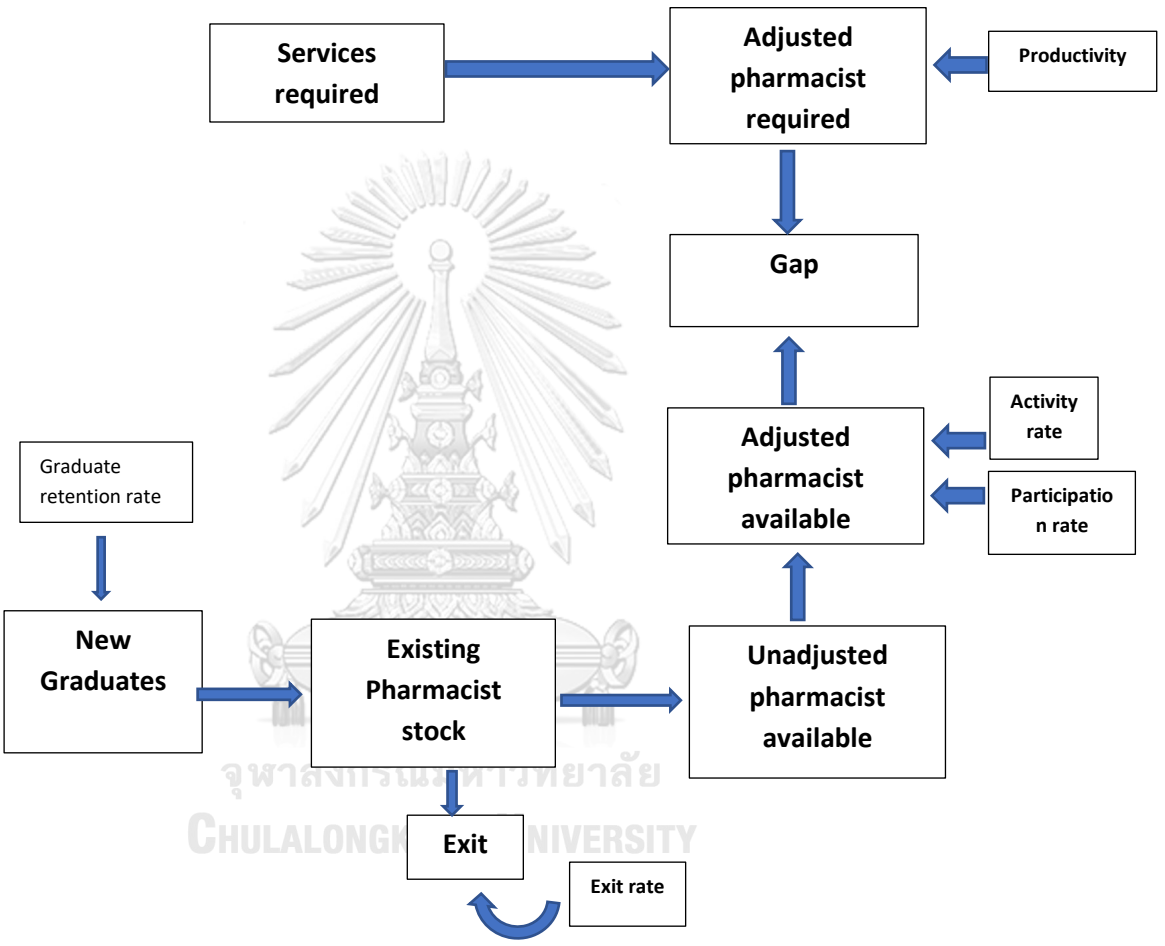

Figure 2 A simulation model for Pharmacists workforce in public hospital of Myanmar

Modules		Variables	Measurement approach	Baseline value	Assumption	Data sources for baseline
Supply	Inflow	Education	Number of graduates	229 new graduates per year	-Graduate number is increased up by 100%, 150% and 200%.	-UOP
		Compulsory Service	Compulsory service	-	2-year, 3-year	-
	Exiting workforce	Number of pharmacists	Headcount, FTE	270	Constant	-DOMS
	Out flow	Exit rate	Exit rate	5.15% per year (exit due to death, retirement and relocation)	-Exit rate is set at 50%, 75% and 85% after the policy for compulsory service is set up.	-DOMS
Demand		Clinical pharmacy services projected for the future	-Number of services -Time taken for each core clinical pharmacy services per year - Man hour to perform these services (hour/year)	-	-Level of utilization of clinical pharmacy services were set into; -Low level, -High level -Population growth rate is constant. -Level of health status of the population is constant.	-HSR, -U.S. survey, Thai study

Table 8 Source of baseline data and assumption in the simulation model

Note* UOP- Universities of Pharmacy, DOMS- Department of Medical service

HSR- The data for number of patients in 2016 is sourced from the hospital statistics report, Myanmar (2014-2016), U.S.survey- Data for time taken for each clinical service is taken from the survey "Evidence-based Core clinical pharmacy services in United States Hospitals in 20120: Services and Staffing". (Bond, Raehl, and Patry 2004)

CHAPTER-IV

RESULTS

The results were classified in two main portions according to the objectives of the study. The first part of the result was related to the current situational analysis of pharmacist workforce and the second part was about constructing a simulation model to improve the pharmacist workforce situations in the public hospitals.

1.Current situational analysis of pharmacist workforce

In the first part of the results, the results were described in three sub- portions about the numerical, distributional and skill shortage of the pharmacist workforce.

1.1. Numerical Shortage

The population number of Myanmar was 54.34 million in 2019. It was the projected number of populations based on 2014 census and sourced from the publications of Department of Population, Ministry of Labour, Immigration and Population. The graduated pharmacists from two universities of Pharmacy until to 2019 was 3965.

The finding of this study, table 9, showed that the density of pharmacist to 10,000 populations was 0.73 if 100% of the graduated pharmacists from two universities of Pharmacy until to 2019 were assumed to be actively practising pharmacists in the respective pharmaceutical sectors. The sensitivity analysis was done to assume the possible percentage and number of actively practising pharmacist workforce because the database for active workforce was available only for the public sectors and that of the private sector was limited in this study. For example, if 80% of the workforce was assumed to be active in the private and public pharmaceutical sectors, 3172 pharmacists were the total number of active pharmacist workforce and the density of pharmacist to 10,000 populations would be 0.58.

Scenario	No. of Pharmacist	Pharmacist/ 10,000 Population
100% pharmacy graduates are in pharmacist workforce	3,965	0.73
90% pharmacy graduates are in pharmacist workforce	3,569	0.66
80% pharmacy graduates are in pharmacist workforce	3,172	0.58
70% pharmacy graduates are in pharmacist workforce	2,776	0.51
60% pharmacy graduates are in pharmacist workforce	2,379	0.44

Table 9 Density of pharmacist per 10,000 populations

1.2. Distribution of Pharmacists

Distribution of pharmacists were described in three measures of WHO indicator.

1.2.1. Distribution of Pharmacists in the public and private sectors

This study found that the number of pharmacists who are working in the public sector was 605. Assuming that all pharmacy graduates until 2019 (3965 pharmacists) were to be actively practicing pharmacists in both private and public sectors (100% participation rate), the pharmacists in the public sector was 15.26% of the total workforce and the remaining 84.74% of the total workforce would be in the private sector.

The sensitivity analysis was performed for 80% participation rate and the result found that 19.8% of pharmacist would be in the public sector and 80.92% would be in the private sector.

1.2.2. Distribution of Pharmacists by geographic areas

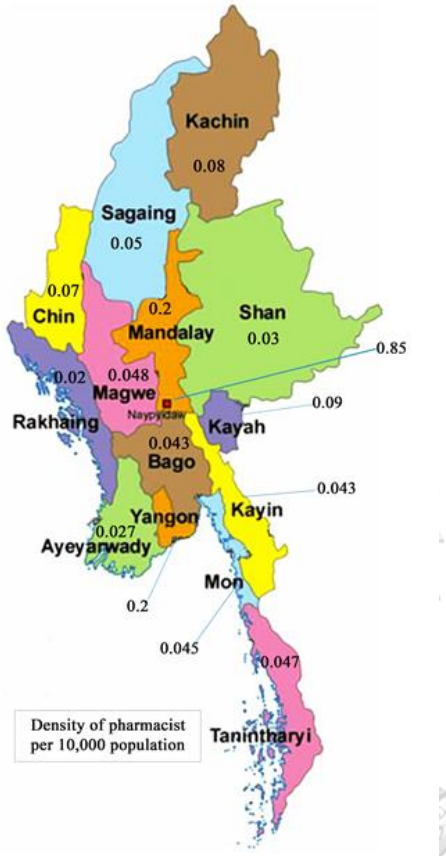

Figure 3 Distribution of pharmacists by geographical location

Figure 3 demonstrates the distribution of government workforce pharmacists by geographic location. The detailed analysis of the density of pharmacists per population in each area across 7 states, 7 regions and Nay Pyi Taw Union Territory showed that the highest density of pharmacists were employed in Nay Pyi Taw Union Territory (0.85 pharmacists per 10,000 population). This fining could result from the reason that Nay Pyi Taw is the capital city of Myanmar and most of the government offices are concentrated. The second highest numbers were in Mandalay Region (0.24 pharmacists per 10,000 population), and third highest numbers were in Yangon Region (0.21 pharmacists per 10,000 population). The lowest numbers of pharmacists were found in Rakhine State (0.02 pharmacists per 10,000 population).

1.2.3. Distribution of Pharmacists across settings in public sector

The distribution of pharmacists across settings in the public sectors was shown in the figure 4. The majority the pharmacists (48%) of the government pharmacist workforce were working in the government hospitals whereas, 27% of government pharmacist workforce was recruited in FDA. About 17% of the workforce constituted in the Universities of Pharmacy and 5% worked in the pharmaceutical industry. The density of pharmacists which was lower than 1% was found in the Department of Traditional Medicine, Department of Medical researches and Chemical's Examiner offices.

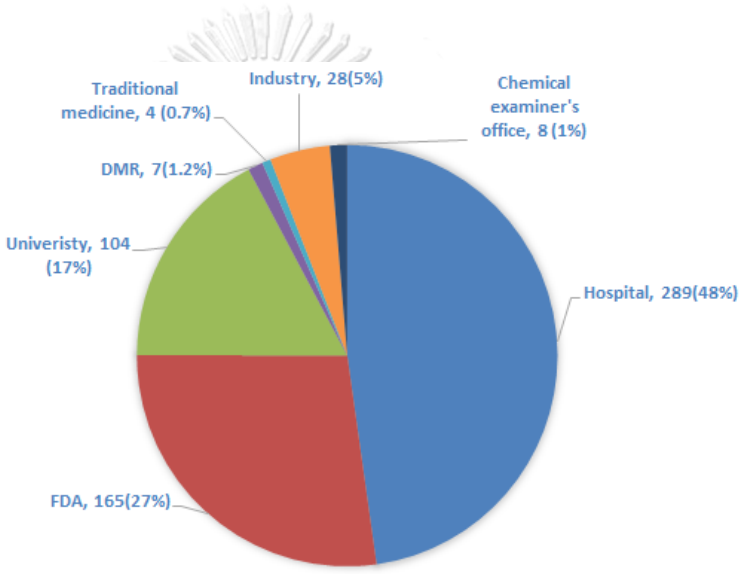

Figure 4 Distribution of Pharmacists across settings in public sectors

This study conducted the detailed analysis about the vacancy rate of pharmacists in each department according to the government workforce framework (Table 10). In the government hospitals, 67% of the pharmacist positions have already filled and 33% of the positions were still vacant. The number of pharmacists who work in Food and Drug Administration Department (FDA) were 165 (9 assistant directors, 17 officers and 139 pharmacists (deputy officers)). The government workforce framework for pharmacist (deputy officer position) was set the budgeted number of positions as 380. Among 380, 161 deputy officer positions (139 pharmacists and 22 industrial chemists) were recruited. 219 positions for deputy officers were still vacant in FDA and it was accounted as vacancy rate of 57.6%. Moreover, 104 positions of pharmacists were already filled and

there were 76 vacant positions and it was accounted as 41.3% vacant rates in two Universities of Pharmacy. In the department of Medical research (DMR), a total of 7 pharmacists (2 pharmacist officers (research officers) and 5 pharmacists (research assistants)) were working. In the department of Traditional Medicine, a total of 4 pharmacists (one assistant director, two pharmacist officers and one pharmacist (deputy officer))were recruited. In the Ministry of Industry, a total of 28 pharmacists were working and the Chemical Examiners' Office of Ministry of Home Affair recruited 8 pharmacists (3 assistant directors and 5 pharmacist officers).

Among seven departments, three departments (government hospitals, FDA and University of Pharmacy) had the workforce framework for pharmacist. Other departments recruited both pharmacists and other professions simultaneously for the available budgeted positions in the offices. The vacancies in these departments were belonged to all related professions and the data for the vacancy rate of pharmacists' position in these departments was not available.

Settings	# workforce frame	# filled position	Vacancy rate
Hospital	432	289	143 (33.1%)
Department of Food and Drug Administration	380[a]	165[b]	219(57.6%)[c]
University	184	108[d]	76 (41.3%)
Department of Medical Research	N/A	7	N/A
Department of Traditional Medicine	N/A	4	N/A
Pharmaceutical Industry	N/A	28	N/A
Chemical Examiner's office	N/A	8	N/A

Table 10 Distribution of pharmacists compared to government workforce framework (budgeted number, filled number and vacant number)

a. The work frame for pharmacist is 380 (without including officer position and assistant director position).

b. The no. of pharmacists (deputy officer) positions filled in FDA = 139, the no. of pharmacist officer = 17 and the no. of assistant director (pharmacist) = 9. The total no. of pharmacist for all positions filled is 165.

c. The job title of “pharmacist position (deputy officer)” recruits both pharmacists and industrial chemists and their filled numbers are 139 and 22. Total filled no. of pharmacist position (deputy officer) is 161. The percentage of filled pharmacist position (deputy officer) is 161/380= 57.6%.

d. The Total No. of positions filled is 104 and another four medical doctors are recruited in the budget position. Total number of positions filled is 108.

1.3. Current and future pharmacist roles and responsibilities

Semi-structured, face-to-face interview was conducted in seven study settings to access the existing roles and responsibilities of pharmacists and the potential role and responsibilities next five years. The detailed descriptions for each department were described below.

1.3.1. Hospital

100% of the pharmacist key informants reported that they perform the distribution function and store management function. 75% of the pharmacist answered that they performed the open tender process. These 75% of pharmacists were from the 200 to 2000 bedded general hospitals and from 100 to 1200 bedded specialist hospitals. Therefore, another 25% from under-200beded general hospitals and under-100 bedded specialist hospitals did not perform the open tender process. 53.6% of the pharmacist key informants reported that dispensing function was done in the out-patient department in the hospitals. Among 53.6%, 32.1% reported that dispensing function was performed by pharmacist. Another 21.4% reported that the dispensing function was performed by compounders. Pharmacists also responded that the number of drugs items was not fully dispensed to the patients who suffered the general disease. However, 100% full dispensing was achieved for the anti-TB drugs, HIV drugs which were supported by the NGO organizations. IPD dispensing function was delegated to the nurses in the wards.

The expectation on future role and responsibility was responded that all pharmacist key informants would like to perform OPD dispensing for all hospitals and IPD dispensing were also the same. They also responded that the clinical pharmacy services were expected to implement. One administrator key informant responded that electronic central and ward inventory linkage was also going to implement soon in the public hospitals.

1.3.2. Department of Food and Drug Administration

One administrator respondent responded that most of the pharmacists have been working in the drug control section, cosmetic and medical device control section and the laboratory section. A few of them also worked for food control section in the central office located in Nay Pyi Taw. Moreover, pharmacists were also recruited in the Regional and State level office, district office and offices located in the Trade Zone according to the organizational structure. The entry position to the FDA is pharmacist position (deputy officer).

Drug Control Section

The administer and pharmacist Key informants answered that pharmacists worked in this section mainly performed the pre-marketing and post-marketing control activities. The pre-market control activities consisted of drug registration for marketing approval, drug import recommendation, manufacturing licensing and control drug importation recommendation and so on. The post-market control activities consisted of the sampling of the marketed drugs and testing their quality by the quality control testing.

Cosmetic control Section

Both the administrator and pharmacist key informants reported that pharmacists mainly performed the pre-marketing and post-marketing control activities in this section. Pre-market control functions included cosmetic notification for imported and locally manufactured cosmetics and licensing for manufacturing for locally manufactured cosmetics. Moreover, Post-marketing surveillance (PMS) activities were also performed to assess the quality and safety of marketed products and it included the collection of cosmetic samples from the market and tests them in the laboratory.

Medical Devices control section

Both the administrator and pharmacist key informants responded that pharmacists mainly performed the pre-marketing and post-marketing control activities. Pre-market control functions included medical device import recommendation, medical device import notification, manufacturing licensing. Moreover, Post-marketing surveillance (PMS) activities were also performed to assess the

quality and safety of marketed products and it includes the collection of cosmetic samples from the market and tests them in the laboratory.

Food Control Section

The pharmacist key informant responded that one pharmacist mainly performed the pre-marketing control activities especially, import recommendation for functional food and dietary supplements.

Laboratory section

Both the administrator and pharmacist key informants responded that, pharmacists performed the documentation, sample receiving, testing, and reporting and data interpretation in the laboratory section. In the pharmaceutical chemistry laboratory, pharmacist tested the drugs based on 10 parameters for qualitative and quantitative analysis such as pH, loss on drying, Fourier-transform infrared spectroscopy (FTIR), Uniformity of dosage form, melting point, dissolution, water determination, High-performance liquid chromatography (HPLC), Ultraviolet visible spectroscopy (UV) and Titration. Pharmacist who worked in pharmaceutical microbiology lab responded that pharmacist performed the bioassay test to test the potency of antibiotics.

Pre-market control activities were mainly performed by the central office. Post- marketing activities were mainly performed by the state/regional office, district office and trade zone office. Consumer education with advocacies are mainly done by the decentralized office.

Future expectation on the function

The administrator key informant in cosmetic control department responded that they are going to be implement the electronic submission for cosmetic products notification. They will need the technical and manpower support of pharmacist workforce.

The administrator key informant in medical device control department responded that they would like to empower the medical device vigilance activity.

The pharmacist from laboratory section responded that they would like to promote the quality control testing of drugs from 10 parameters to more than 10 parameters.

Key informants from all departments responded that they would like to promote the post-market surveillance activity.

1.1.3. University of Pharmacy

100% of the pharmacist key informants responded that pharmacists who were working in the University of Pharmacy perform (1) academic activities, (2) research (academic and departmental research), (3) extra-curriculum activities such as motivation talk, knowledge sharing talk, sport, cultural festival, religious activity and Total Personal and Professional Development program (TPPD), (4) examiner such as assessment of answer paper sheet and in-charge the exam room. In the academic activities, both the lecture and practical works activities were included for not only in undergraduate level, but also in graduate level. In conducting the academic research by the Master and Ph.D degree students, they supervised the research. Moreover, the key informants also responded that they were also responsible as an in-charge for the clinical internship to the hospitals by the final year (4^{th} year student) under-graduate students. The key informants who were from the pharmaceutics department responded that they also arranged and supervised the field visit to the pharmaceutical industry for the 4^{th} year under-graduate students. The key informant who was in the administrator level such as the department head was also responsible for administrative jobs. They were the members of the administrative board for the financial issues, recruitment and removal of staff and solving problems. They were also members of academic board.

Future expectation on the function

Most of the respondents responded that they have willingness to promote in conducting the implementation researches in terms of numbers and quality.

One respondent responded that they have willingness to open new departments such as social and administrative pharmacy. They would like to promote clinical pharmacy curriculum for undergraduate students. One key participant responded they were now reviewing and updating the curriculum.

One respondent responded that the university has willingness to open drug information centre.

1.3.4. Department of Medical Research

An administrator respondent who worked in the Department of Medical research (DMR) (Pyin Oo Lwin Branch) responded that pharmacists were working in the pharmacology research division and biochemistry research division in DMR (Pyin Oo Lwin Branch).

In the pharmacology and biochemistry research division, 100% of pharmacists responded that pharmacists performed the isolation of active compounds and test the activities of these compounds such as anti-bacterial activity, anti-hyperglycaemic, anti-diarrhoea and anti-inflammatory and antioxidant activity. They assisted the students who conduct research in the department. They measured the impurities related ingredients in the milk and oil for food safety. They also measured the level of heavy metals. They also performed acute and sub-acute toxicity test by using animal experiments.

A pharmacist respondent who was a research officer in the vaccine quality control division in DMR (Yangon office) responded that the vaccine quality control division is under vaccine research Centre and it was much related to the hepatitis B vaccine plant under Ministry of Industry. At first, pharmacist working in this department participated in the production of hepatitis B vaccine. Later, pharmacist worked the quality control testing of raw materials and finished products of hepatitis B vaccine before release into the market. She also performed in-process quality control process and do testing samples of the stages of production process. The main testing procedure was Polymeric chain reaction (PCR), genetic sequencing and analysis of genetic sequencing using software.

Expectation on future functions

Most of the respondents responded that they have willingness to conduct the public health research and clinical research.

One administrator respondent responded that one pharmacist was currently needed to perform the pharmacokinetics and pharmacodynamics.

1.3.5. Department of Traditional medicine

The administrator respondent responded that one pharmacist was working in the quality control laboratory and three pharmacists are working in the enforcement section. Moreover, the administrator respondent responded that one pharmacist who worked in the laboratory section performed the quality control tests for the herbal medicines according to the WHO guidelines and physicochemical tests of active ingredients in the traditional medicine which apply for the drug registration. Moreover, the pharmacist also determined whether the traditional herbal medicines mixed with the foreign matters which contained other active ingredients.

The administrator key informant responded that the pharmacists working in the enforcement section assessed whether the traditional medicines contain the permissible limit of pharmaceutical catalysts, preservatives and excipients according to the ASEAN guidelines when the traditional medicines applied the new drug registration in the department. The administrator key informant also responded that pharmacists participated as trainers in the GMP training to the manufacturers of traditional medicines. They also participated as a member of committee which bought the production machines for the government traditional medicines manufacturing plants. They also took part in the committee to update the new Traditional medicine law.

100% of the pharmacist respondents who worked in the drug enforcement section responded that they took part in the regulatory process such as licensing of the manufacturing, advertising of the traditional medicines and registration of traditional medicine for marketing authorization. They also performed the approval process of raw material recommendation. In these processes, they performed document assessment and participate as a committee member in the Traditional Medicine advisory committee. They provided GMP training to the Traditional medicine manufacturing plants. One pharmacist from enforcement section responded that she was taking part as a member of committee which bought the production machines for the government traditional medicines manufacturing plants.

Expectation on future functions

The administrator also gave her opinion about the importance of pharmacist in the traditional medicine department, "The department was updating Traditional medicine law. Active Traditional medicine law has enacted in 1996 and it controlled the traditional medicines which are manufactured locally and it does not cover to control the traditional medicines which are imported from foreign countries. When a new law is enacted to control both locally manufactured and imported traditional medicines, traditional medicines which will contain excipients, preservatives as the modern medicines, are needed to assess with more manpower including pharmacists. Because pharmacists are efficient workforce who has technical knowledge related with the production and quality control of modern medicines. This technical knowledge can apply in the regulatory process. Moreover, the department of traditional medicines has two production plants to manufacture the traditional medicines to be used in the public traditional medicine clinics and hospitals. These plants are now upgrading and the workforce of pharmacist are needed in the production section and quality control section of the plants. Currently, there is no pharmacist in the industries. In the accreditation of QC lab in the department and in the developing of Myanmar Herbal pharmacopeia, more pharmacist workforce would be needed."

1.3.6. Chemical Examiners' office

A pharmacist respondent who worked in Chemical Examiners' office responded that pharmacists were now working in the narcotic laboratory, forensic toxicology laboratory, forensic stain laboratory and general analytical laboratory. She also responded the detailed function of pharmacists in each section of the office. Pharmacists who worked in the narcotic laboratory analysed the narcotic drugs, psychotropic substances and their precursors. They also examined the urine and blood samples for the presence of narcotic drugs and psychotropic substances. Pharmacists who worked in the forensic toxicology laboratory examined the urine, blood, gastric juice, biopsy tissues and visceral organs for the presence of toxic substances. They examined blood for the presence of alcohol. They examined the remaining exhibits from criminal cases for the presence of toxic substances. Pharmacists who worked in the forensic stain laboratory examine smeared glass slides, urethral swab and vaginal swab for the presence of spermatozoa and seminal

fluid. Pharmacists who worked in general analytical laboratory analyse the samples from crime scene. They identify counterfeit products. They also measured the quality of alcohol and presence of methanol. The position of pharmacist who worked in this office started with the officer position. She responded that there are three assistant directors and five pharmacist officers in the Chemical Examiner's office.

Expectation on future function

They would like to promote the quantitative testing method to test narcotic drugs. This would help in tracing the tracks of the production site of narcotic drugs.

1.3.7. Pharmaceutical Industries

QA department

Pharmacist respondent working in the QA department responded that they performed the self-inspection, calibration and validation, drug registration and manufacturing licensing process, in-house training and documentation. For the self-inspection process, pharmacist performed the inspection to all production departments about compliance with GMP. They also prepared and reviewed the checklist for inspection of production departments. They inspected and checked the starting raw material and packaging material in warehouses. For calibration and validation function, they validated the various stages of manufacturing processes and utilities. They reviewed all Document qualification, Installation qualification, Operation qualification, and Production qualification protocols. They investigated the cause of batch deviation. For drug registration and manufacturing licensing process, they managed and reviewed the documents that are required for submission of Drug dossier to FDA drug regulatory process. They provided the GMP training program for the staffs. For documentation, they reviewed and approved the quality related documents (SOPs, stability protocols, specification, manufacturing and packaging instructions, site master files, validation activities, master batch records, etc.).

Production Department

Pharmacist respondents who work in the production departments responded that they participated in all production stages and assured current GMP requirements. They also monitored

and controlled the manufacturing environment and plant hygiene. They checked the maintenance of the production department, premises, equipment and machines. They prepared report and kept the batch records of products.

Quality Control Department

Pharmacists who work in the quality control department responded that they performed the following functions;

1. Analysis of raw material (API, excipients, components, water) in process material, finished product, stability samples

2. Preparation and standardization of reagent

3. Instrument validation and verification

4. Method validation

5. Sampling

6. Checking and approving the test result before release and

7. Batch analysis

Research and Development

Pharmacists performed the researches for formulation development. There is a separate department conducting research. Pharmacists working in QA, QC and production department also perform the researches.

Technological development department

Pharmacist key informant responded that pharmacist performed purchasing of pharmaceutical raw materials and excipients by open tender process.

Expectation on future function

They are performing Research and Development to be able to produce new generic drugs with new active ingredient or new dosage forms. They would like to test bioequivalence for all generic drugs.

2. Simulation model

This study estimated the projection on the supply and demand of the pharmacist based on the relevant data. The results were explained in three parts: (1) Projection on supply, (2) Projection on demand, and (3) projection on the gap between the supply and demand by using the simulation model.

2.1. Projected Supply of the pharmacists

The various scenarios for the projected supply of the pharmacists were generated by fluctuating the values of different factors such as compulsory service, exit rate and graduation rate. Without the policy intervention, the baseline supply would be increased by 15 FTE pharmacists per each year until to get to 478 FTE pharmacist in 2034. The figures for the projected supply of the pharmacists are also described in the tables 15 to 26. (APPENDIX III).

2.2. Projected Demand for the pharmacists

If the government supposed to have core clinical pharmacy services in the government hospitals in the upcoming years, 2466 FTE pharmacists would be required (for low level of utilization of service) and 3,334 FTE pharmacists would be required to deliver these services (for high level of utilization of service) in the public hospitals. The results of the projected demand for the pharmacist were figured in the Table 27, (APPENDIX III).

2.3. Projection on the gap between the supply and demand using the simulation model

There were 36 scenarios (ranged from S1 to S 36) resulting from the simulating on the factors on the supply and demand of the workforce. (Table -11) The simulated gaps for each scenario for 15-year periods were demonstrated in the figures below. (Figure 5,6,7, and 8)

Scenarios	Compulsory services	Level of services (Demand)	Graduation rate	Exit rate
S 1	2year	Low level of utilization of service	100%	50%
S 2				75%
S 3				85%
S 4			150%	50%
S 5				75%
S 6				85%
S 7			200%	50%
S 8				75%
S 9				85%
S 10	3year	Low level of utilization of service	100%	50%
S 11				75%
S 12				85%
S 13			150%	50%
S 14				75%
S 15				85%
S 16			200%	50%
S 17				75%
S 18				85%
S 19	2year	high level of utilization of service	100%	50%
S 20				75%
S 21				85%
S 22			150%	50%
S 23				75%
S 24				85%
S 25			200%	50%
S 26				75%
S 27				85%
S 28	3year	high level of utilization of service	100%	50%
S 29				75%
S 30				85%
S 31			150%	50%
S 32				75%
S 33				85%
S 34			200%	50%
S 35				75%
S 36				85%

Table 11 Different 36 scenarios of policy interventions

In the figure 5, the various input values on the factors of the supply and demand of the pharmacist workforce in the simulation model were 2-year compulsory services, different exit rate (50%,75%, 85%), different graduation rates (100%, 150%, 200%) and low level of utilization of clinical pharmacy services. The sensitivity analysis showed that there were only three scenarios that touched the line where the supply meets demand. They are S4, S7 and S8. This was the meaning that the shortage of pharmacist would be solved or the enough workforce of pharmacist would be achieved to provide the clinical pharmacy services after 7years in S7 scenario, after 11 years in S4 scenario and after 13 years in S8 scenario.

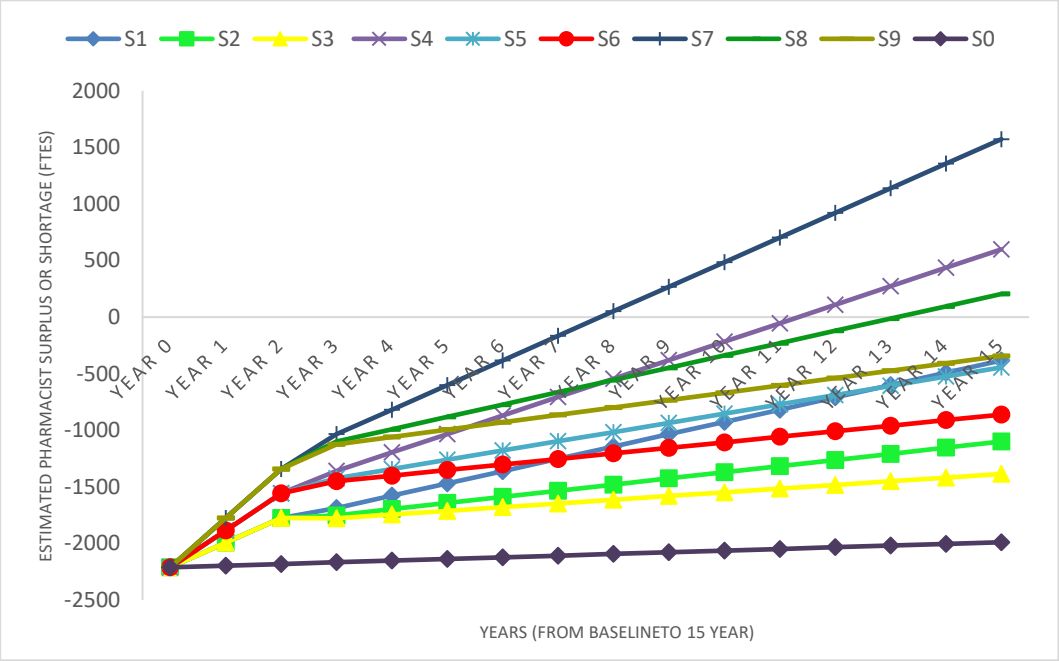

Figure 5 Different scenarios combined with 2-year compulsory services, different exit rate (50%,75%, 85%), different graduation rates (100%, 150%, 200%) and low level of utilization of clinical pharmacy services.

In the figure 6, the various input values on the factors of the supply and demand of the pharmacist workforce in the simulation model were 3-year compulsory services, different exit rate (50%,75%, 85%), different graduation rates (100%, 150%, 200%) and low level of utilization of clinical pharmacy services. The sensitivity analysis showed that there were four scenarios that touched the line where the supply meets the demand. They are S13, S16, S17 and S18. It means that the shortage of pharmacist would be solved or the enough workforce of pharmacist would be achieved to provide the clinical pharmacy services after 6 years in S16 scenario, after 10 years in S13 and S17 scenarios and after 14 years in S18 scenario.

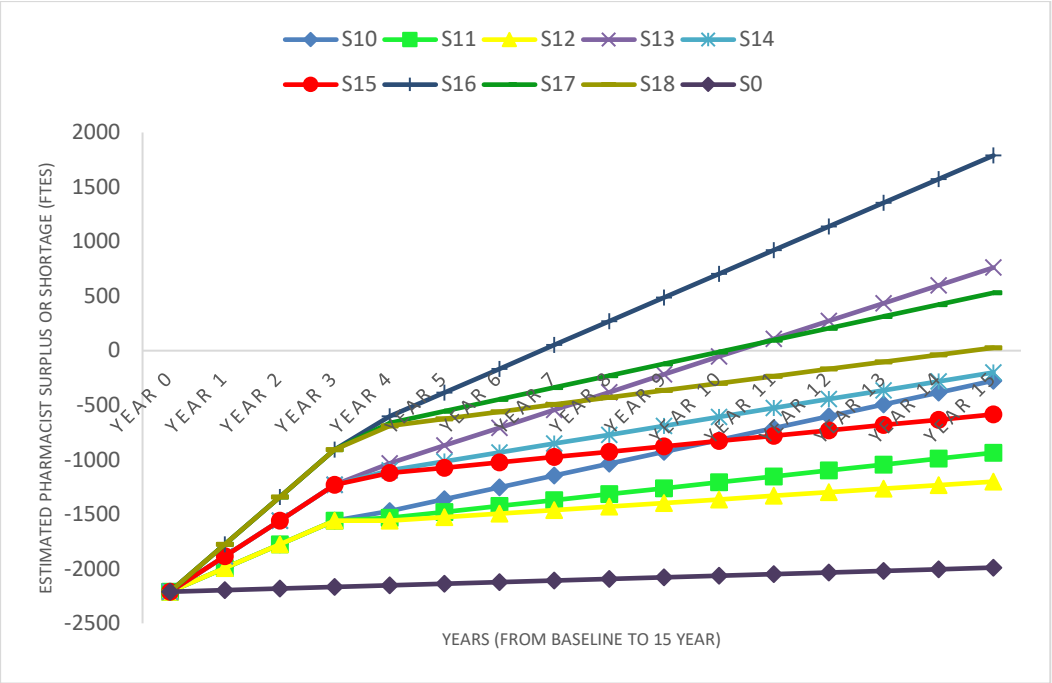

Figure 6 Different scenarios combined with 3-year compulsory services, different exit rate (50%,75%, 85%), different graduation rates (100%, 150%, 200%) and low level of utilization of clinical pharmacy services

In the figure 7, the various input values on the factors of the supply and demand of the pharmacist workforce in the simulation model were 2-year compulsory services, different exit rate (50%,75%, 85%), different graduation rates (100%, 150%, 200%) and high level of utilization of clinical pharmacy services. The sensitivity analysis showed that there was only one scenario that touched the line where the supply meets the demand. It is S25. It means that the shortage of pharmacist would be solved or the enough workforce of pharmacist would be achieved to provide the clinical pharmacy services after 11years in S25 scenario.

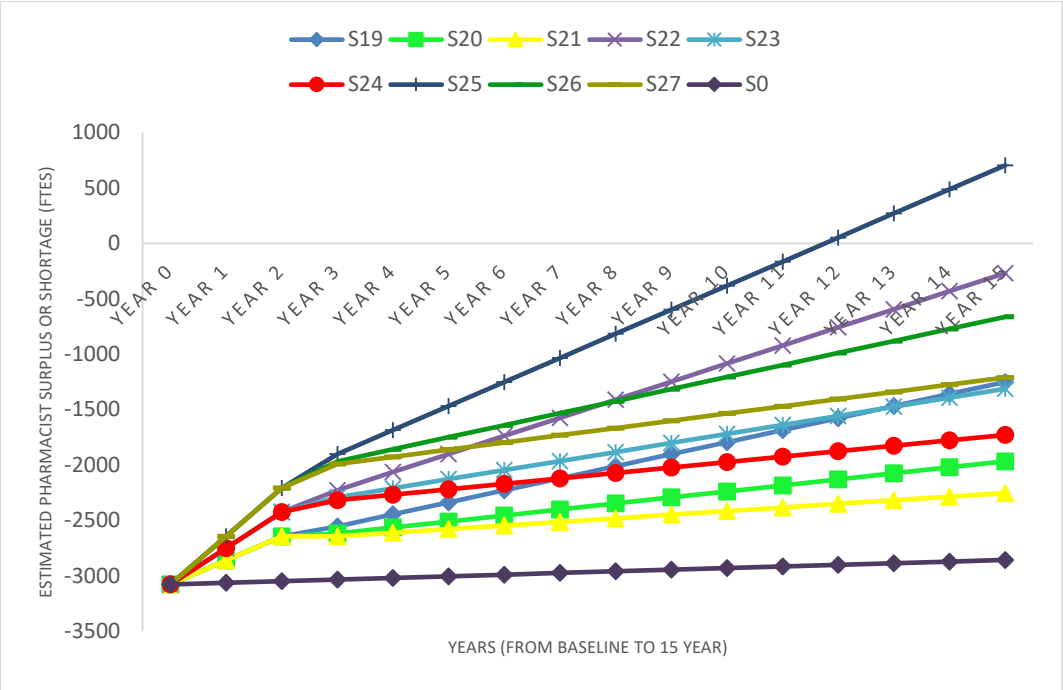

Figure 7 Different scenarios combined with 3-year compulsory services, different exit rate (50%,75%, 85%), different graduation rates (100%, 150%, 200%) and high level of utilization of clinical pharmacy services.

In the figure 8, the various input values on the factors of the supply and demand of the pharmacist workforce in the simulation model were 3-year compulsory services, different exit rate (50%,75%, 85%), different graduation rates (100%, 150%, 200%) and high level of utilization of clinical pharmacy services. The sensitivity analysis showed that there was only one scenario that touched the line where the supply meets the demand. It is S 34. It means that the shortage of pharmacist would be solved or the enough workforce of pharmacist would be achieved to provide the clinical pharmacy services after 10 years in S34 scenario.

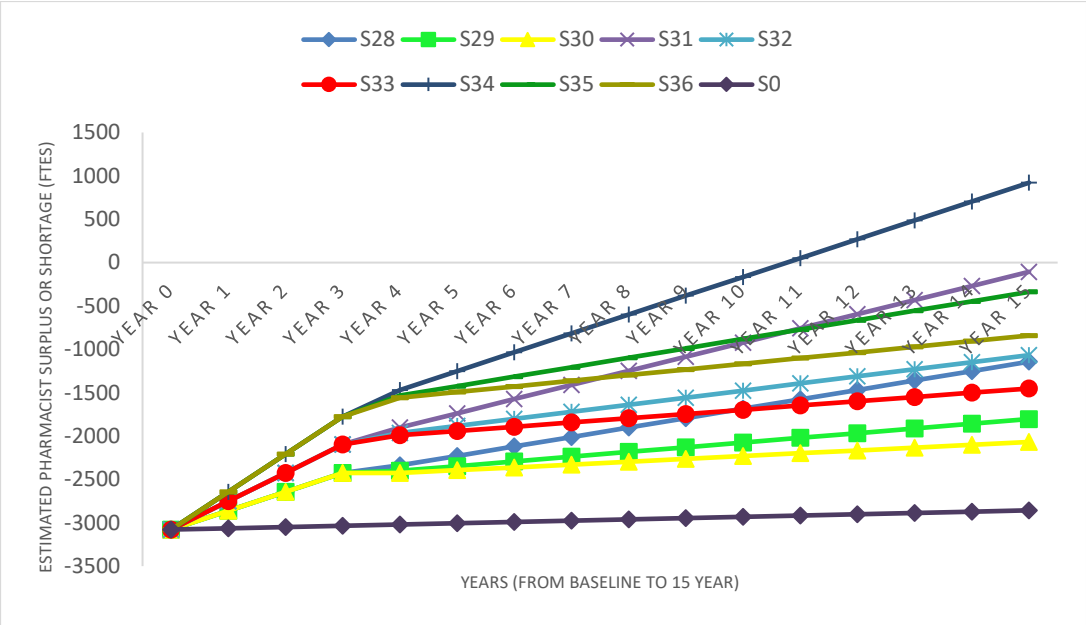

Figure 8 Different scenarios combined with 3-year compulsory services, different exit rate (50%,75%, 85%), different graduation rates (100%, 150%, 200%) and high level of utilization of clinical pharmacy services.

There were nine scenarios which touched the line where the supply meets demand within 15-year periods (S4, S7, S8, S13, S16, S17, S18, S25 and S34). Figure 9 illustrates the nine scenarios and table 12 explains the detailed information about these scenarios. These nine scenarios could ensure to have the enough pharmacist workforce within 15-year period to deliver the clinical pharmacy services in public hospital.

Among the nine scenarios, S7 and S16 touched the line where the supply and demand for pharmacist meet after 6 years and 8 years from baseline year. The simulation model found the policy interventions such as 200% graduation rate, 2-year and 3-year compulsory service, 50% exit rate after compulsory service, and low level of utilization of service to be effective in hitting the supply and demand in a shorter time requirement.

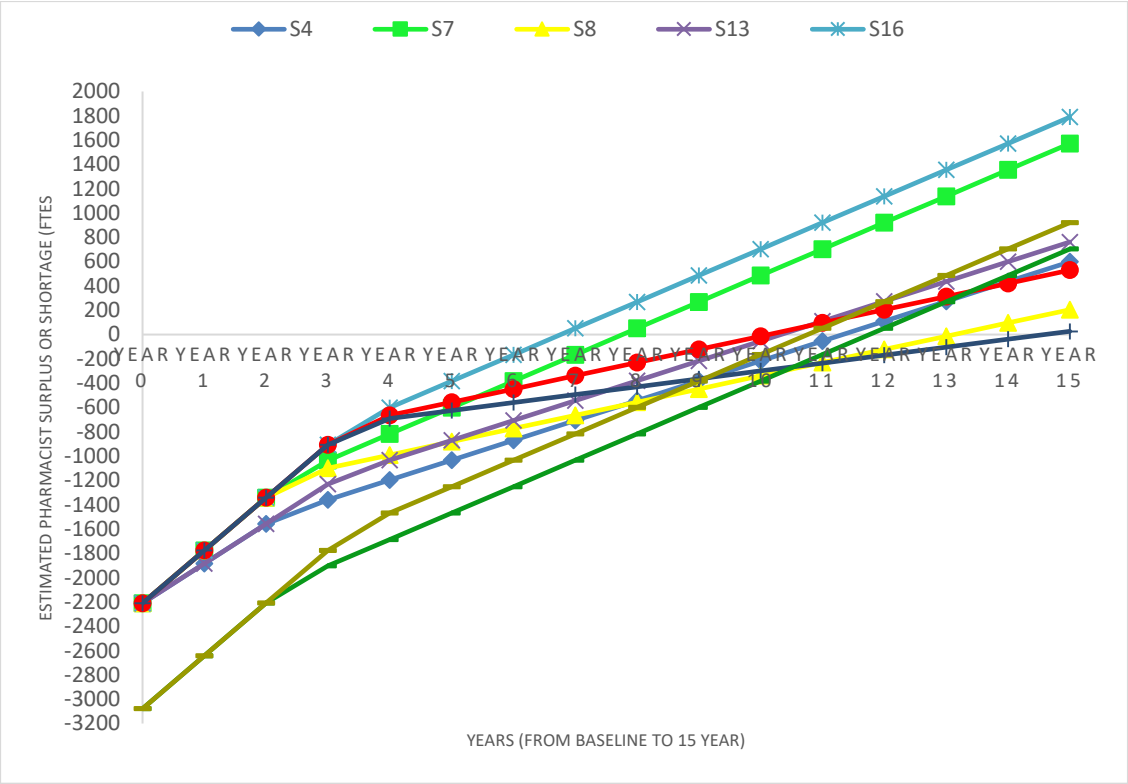

Figure 9 The selected nine scenarios

Scenarios	Compulsory services	Level of services (Demand)	Graduation rate	Exit rate	Time when Supply meets demand
S 4	2-year	Low level of service	150%	50%	between year 11 and 12
S 7			200%	50%	between year 7 and 8
S 8			200%	75%	between year 13 and 14
S 13	3-year	Low level of service	150%	50%	between year 10 and 11
S 16			200%	50%	between year 6 and 7
S 17			200%	75%	between year 10 and 11
S 18			200%	85%	between year 14 and 15
S 25	2-year	High level of service	200%	50%	between year 11 and 12
S 34	3-year	High level of service	200%	50%	between year 10 and 11

Table 12 Detailed information about nine scenarios

CHAPTER- V

DISCUSSION AND CONCLUSION

This chapter included the discussion, conclusion and limitation of the study. This chapter ended with the recommendation.

5.1. Discussion

The results were discussed in two parts according to two objectives of this study.

5.1.1. Discussion on Current situational analysis of pharmacy workforce

This study was the first study to analyse the pharmacist workforce situation, especially in the public sector of Myanmar although it had a limitation to access the pharmacist workforce data in the private sector. The results of this study confirmed that pharmacist shortage was severe in Myanmar. Numerical shortage was an origin leading to be a root cause of other sorts of shortage, such as distribution and skill shortage. The root causes should be accessed to tackle the workforce shortage crisis.

Numerical shortage was caused by many possible factors in Myanmar. Insufficient pharmacy graduates were found to be the root cause of numerical shortage problem. There are two pharmacy Universities which produced about 200 pharmacists annually in Myanmar. There is also no private Pharmacy Institutions in Myanmar until 2019. Compared to the neighboured ASEAN countries, the numbers of graduates per year in Cambodia, and Vietnam were 280 and 4300 from 3 and 26 Universities of pharmacy respectively. [5, 105] The numbers of pharmacist graduates should be increased to meet WHO recommended ratio. Increasing the number of faculties or enlarging the size of current faculties would be needed to produce more graduates. However, the universities and training schools under MOHS have challenges such as academic staff inadequacy, high attrition and turnover rate.[61] The root causes of these challenges should be analyzed and solved firstly before the infrastructure build in.

Unequal distribution of pharmacy in public and private sectors was observed in the country. There are many possible causal factors. Firstly, low salary has high impact on all health workers to

work in public sectors of Myanmar.[106] Secondly, there is no incentive for health workers in the public sector besides salary although non-monetary incentive is also a factor to motivate and retain the health workforce.[107] Thirdly, pharmacists have a delayed or lack of opportunity to get a higher position. For example, the entry point of pharmacists in Ministry of Health and Sports (MOHS) is the deputy officer although only one department such as Chemical Examiner's office in the Ministry of Foreign Affairs recruited pharmacists in the officer position at first. After 5years of services, pharmacists with deputy officer position can have a chance to take entrance exam in order to promote to officer positions in government hospitals and FDA. Sometimes, some department has more delayed promotion opportunity than this system so that the road map to have a good career pathway was not clearly seen. Fourthly, staff housing is inadequate in the public sectors.[107] As a result, pharmacy professions became less popular among the new students. Moreover, the graduates joined to the favorable working environments with better paid jobs in the private sector. The situation would even worse if there is no plan for human resource management.

Lack of information about the current pharmacist workforce situation was found to be another cause of pharmacist shortage. Even though pharmacist shortage alerted the government, they would not notice the extent and complication of the problem exactly without complete information. This would lead to the lack or insufficient matching between the supply of the graduates from Universities and the demand for workforce in the working place. Policy maker should consider to perform regular monitoring and strategic human resource planning for pharmacist workforce.

The government health expenditure is also tight and the infrastructures are not complete to fulfill the needs of health system. Budget insufficiency causes limitation to support the HRH development in terms of production of more skillful workforces and training of existing workforce. Therefore, it is also another possible factor in considering working in public sectors by new graduates.

The research findings proved that the government pharmacy workforce was geographically unequally distributed across seven states, seven regions and Nay Pyi Taw Union Territory. Although hardship allowances such as double salary have been provided to recruit and retain health workers

in hard-to-reach areas, little impact has been found resulting in many vacant positions which cannot filled and failing to provide necessary health care services in those areas.[106] An effective human resources management strategy such as a regularly-rotated duty assigned system in hard-to-reach areas is highly recommended together with other strategies such as creating a safe, secure and good working environment, other non-financial incentives of professional development to generate more local health workers and to recruit them in that areas.

Skill shortage was observed in many settings, but was significant in public hospitals. Scope of responsibility of hospital pharmacist in Myanmar was very limited. FIP basal statements on the future of hospital pharmacy include six main areas of hospital pharmacist activities; (1) procurement, (2) influences on prescribing, (3) preparation and delivery of drugs, (4) administration, (5) monitoring of medicine practice, and (6) Human Resources and training.[108] However, this study found that most hospital pharmacists performed mainly the procurement and medical store management in almost all hospitals. Very few hospitals performed the out-patient dispensing function by pharmacists delegating the dispensing functions to compounders (pharmacist assistants) and nurses in most hospitals. Many informants reported that hospital pharmacist should initiate clinical work, however multiple factors including limited budget, lack of standard job definition, lack of sufficient knowledge and training might limit them to initiate tasks other than procurement.

Insufficient training resulted from the short internship period in the pharmacy education. The undergraduate pharmacy education is 4 year curriculum and the clinical internship is one and half month in the fourth year of B.Pharm program. Short internship training of the students may limit to produce the skillful clinical workforce. One study in Finland revealed that internship provides many benefits such as knowing well about the linkage between academic course works and pharmaceutical in-practice life during studies and improved self-recognition through the response from the instructors and colleges during the internships.[109] Pharmacy internship course can integrate the theoretical knowledge into the everyday practice.[110] The importance of pharmacy

internships is very significant in undergraduate pharmacy education all over the world.[109] The schedule of internship is 6-month to 12-month period after 4-5 years of study internationally. Therefore, the stakeholders should consider updating the curriculum of the undergraduate pharmacy education to have a suitable internship period. As of 2018, the graduate program (Master degree) in clinical pharmacy was initiated in the two Universities of Pharmacy in Myanmar and about eight to twelve students per each batch were accepted to enrol in this program. It was expected that the first batch of Master of Clinical Pharmacy program will generate the clinical pharmacist graduates to practice in the health system in the coming year, 2021.

5.1.2. Discussion on Simulation model

The simulation model provided many policy intervention scenarios to have an adequate pharmacist workforce. The simulation results proved that increasing inflow into the supply of the workforce by three ways (i) increasing the number of graduates, (ii) compulsory services policy intervention and (iii) decreasing the exit rate, have improved the pharmacist workforce requirements significantly compared to the baseline scenario without any policy intervention.

This study found that double graduation rate was observed to be the most effective among 100% and 150% graduation rates scenarios. To produce the number of graduates to be doubled, government would need to open new faculties or extend the size of the existing faculties. This finding of would be in accordance with Japan system. The Japan government tried to optimize the balance between supply and demand of medical doctors by increasing the numbers of doctors. They opened new 40 medical schools to increase the number of medical doctors per 100,000 population from 115 (in 1970) to 157 (in 1986). [111] Moreover, a set of skill along with the double number of graduates would be needed to practice as the clinical pharmacists in the health system and therefore the curriculum needed to update to have enough training and experiences in the field with adequate internship period. To do so, the government would need to invest the expenditure for infrastructures

including the academic staffs, the buildings, the training facilities including the required machines and equipment.

Sometimes, double seats had little impact on the shortage problem, for example in the pharmacist shortage in South East Regional Health Authorities which was the public health care system of Jamaica. This is because the participation rate was only 5% to 10% in the public sector by the pharmacist graduates of the Utech's pharmacy education.[96] In contrast with these results, the participation rate in the public sector was assumed to be 100% with the compulsory service policy in this study.

The compulsory service is an effective policy intervention to have sufficient workforce. There were evidences that this policy issues have improved the health workforce situations including numerical and distributional shortage in the underserved areas of some countries including Indonesia and Japan.[82, 83] In the simulation model, the compulsory services for 2-year and 3-year were assumed. The difference between the simulation gaps resulted from the compulsory services for 2-year and 3-year were not too apart that both were effective to fill the pharmacist workforce requirement compared to the baseline scenario (no policy intervention).

After complementary services have been completed, the human resources for health may tend to leave the public sectors. For example, in Kenya, 34% of doctors who completed their serving in public sectors intended to leave South Africa and another 13% planned to relocate to private sector.[81] The simulation model assumed the different exit rates after 2-year and 3-year compulsory services. The results informed that the higher the exit rates, the more simulation gaps would be in the workforce and the more pharmacists would be required. The 50% exit rate rather than 75% and 85% would be better to have the sufficient pharmacist workforce in a shorter period. To achieve low exit rate, the retention and retaining strategies will serve as long term solutions for HRH shortage problem and they consist of a set of incentives financially and non-financially. A recent study in Switzerland (2006) has confirmed that sufficient pay was a factor that retain doctors and nurses in the public

sector by increasing salaries by 60%. Salary and salary supplements have been reported as the important motivation factors for health workers.[14] As non-monetary incentive, opportunity for training, further education, tuition fee reimbursement, favorable working conditions have ascertained the health workers to be retained in the health sectors. Sometimes, the vacation holidays and flexible working hours served as non-monetary benefit in some hospitals of United States. [69] The opposite was the heavy workload and long working hours which forced to resign the health workers.[68] Job satisfaction was in turn, influenced by the above retention and retaining factors and it was an important motivation factor to keep the workforce's productivity.

The findings reported that the workforce demand to provide the high level of use of service would need more pharmacists compared to the low level of service. Therefore, this study recommended that these new policy interventions are introduced to provide the low level of service at first because the workforce supply would not meet the high demand at the beginning step of the situations.

The combined effects of policy interventions achieved the required pharmacist workforce. Among the policy interventions, one policy invention (S16) with double graduation rate, 3-year compulsory service, 50% exit rate and low level of use of service ensured to fill the required pharmacist workforce as early as 6 year and 7 year. Government should try to propose this policy intervention to deliver the clinical pharmacy services in the public hospitals if they would like to implement these services in a shorter time.

On the other hands, the policy option with the shortest time (S16) would not be said to be the best policy depended on the affordable budget amount. S16 touched the line after 6 years and it would need the highest budget requirement within 6-years compared to other scenarios. If the government have budget constraints to choose it, they can choose another policy option among nine scenarios that could also have enough pharmacist workforce requirements within 15-year period. For example, in S 4, the government would need to spend the lesser budget amount but it may take longer time (for 11 years) to fulfill the workforce because it was the less costly policy scenario which

has a combined policies of 2 year compulsory services, 150% graduation rate, 50% exit rate and the low level of use of service.

. After the sufficient workforce achieve, the clinical pharmacy services could be provided with high level switched from low level; which means that almost all patients could access to the services in the next coming years. This would also be a way that prevent the workforce not to be surplus. It was demonstrated in the Figure 10 and a detailed explanation was described in the 5.1.2.1. A strategic human resource planning would be needed to propose this intensive plan by the policy makers.

Overall, the policy makers need to consider the budget requirements to implement the new policy which would be suitable for the situation. A detailed estimation of budget was described in 5.1.2.2.

5.1.2.1. Defending not to be the surplus after the supply meets the demand of the workforce

After the model chose the best scenario (S16) from the assumptions, it simulated this best scenario not to be the surplus of the pharmacist in the workforce. The model increased the level of service to be higher service utilization rate after first meeting with supply and demand.(Figure 10) The result found that the simulated gap went down to 30% shortage in next year of increasing the demand by raising the level of service (year 7) and meeting the demand after the late 4-year again (year 10).

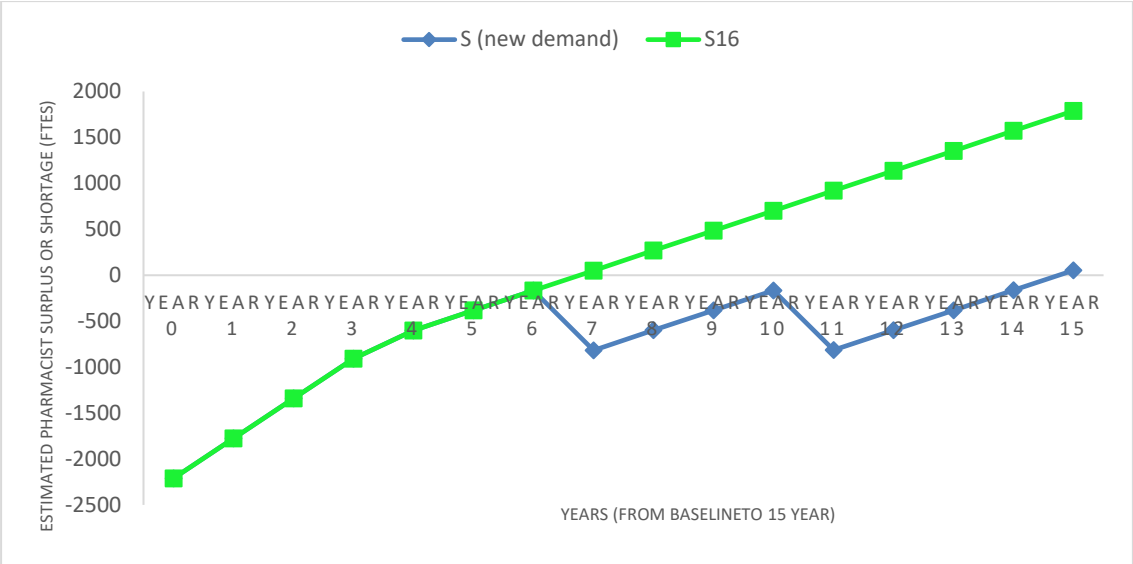

Figure 10 The defense not to be surplus of the workforce

5.1.2.2. Estimation of Budget requirements for each policy scenario

When these new policies were introduced into the real situations of the public hospitals of Myanmar, the possible budget requirement would be needed to prepare by government.

The possible budget requirement would arise from;

(1) The salary of the new incoming pharmacist workforce,

(2) The budget needed to support the pharmacy university to produce the double graduation,

(3) The budget needed to support the incentive to the pharmacists in order to have the low exit rate

The salary of the new incoming pharmacist workforce was estimated based on the demand; 2466 FTE pharmacists would be required (for low level of utilization of service) and 3,334 FTE pharmacists would be required to deliver these services (for high level of utilization of service) in the public hospitals. For the salary of a total of 2466 FTE pharmacists, the minimum budget amount, 357,715 U.S $ would be needed. For the salary of 3334 FTE pharmacists, the minimum budget amount, 483,430 U.S $ would be needed. The budget requirement of each scenario per each year

was estimated in the table 13 where the bold purple color words shows the minimum budget amount and the time taken (number of year) to fulfill the required demand of pharmacist. Moreover, in figures 11 and 12, the minimum budget requirement to fulfill the enough workforce was illustrated with a line and each scenario cut the line at different time point to show that they needed the minimum budget within a short time or longer time within 15-year period.

Year	S4	S7	S8	S13	S16	S17	S18	S25	S34
Year 0	37120	37120	37120	37120	37120	37120	37120	37120	37120
Year 1	84431	100110	100110	84431	100110	100110	100110	100110	100110
Year 2	131742	163100	163100	131742	163100	163100	163100	163100	163100
Year 3	160487	207523	198239	179054	226090	226090	226090	207523	226090
Year 4	184142	239018	213987	207798	270513	261229	257516	239018	270513
Year 5	207798	270513	229734	231453	302008	276977	266964	270513	302008
Year 6	231453	302008	245482	255109	333503	292724	276413	302008	333503
Year 7	255109	333503	261229	278765	**364997**	308472	285861	333503	364997
Year 8	278765	**364997**	276977	302420	396492	324219	295310	364997	396492
Year 9	302420	396492	292724	326076	427987	339967	304758	396492	427987
Year 10	326076	427987	308472	349731	459482	355714	314207	427987	459482
Year 11	349731	459482	324219	**373387**	490977	**371462**	323655	459482	**490977**
Year 12	**373387**	490977	339967	397043	522472	387209	333104	**490977**	522472
Year 13	397043	522472	355714	420698	553967	402956	342552	522472	553967
Year 14	420698	553967	**371462**	444354	585462	418704	352001	553967	585462
Year 15	444354	585462	387209	468009	616957	434451	**361449**	585462	616957

Table 13 Estimation of total budget requirement of each scenario per each year

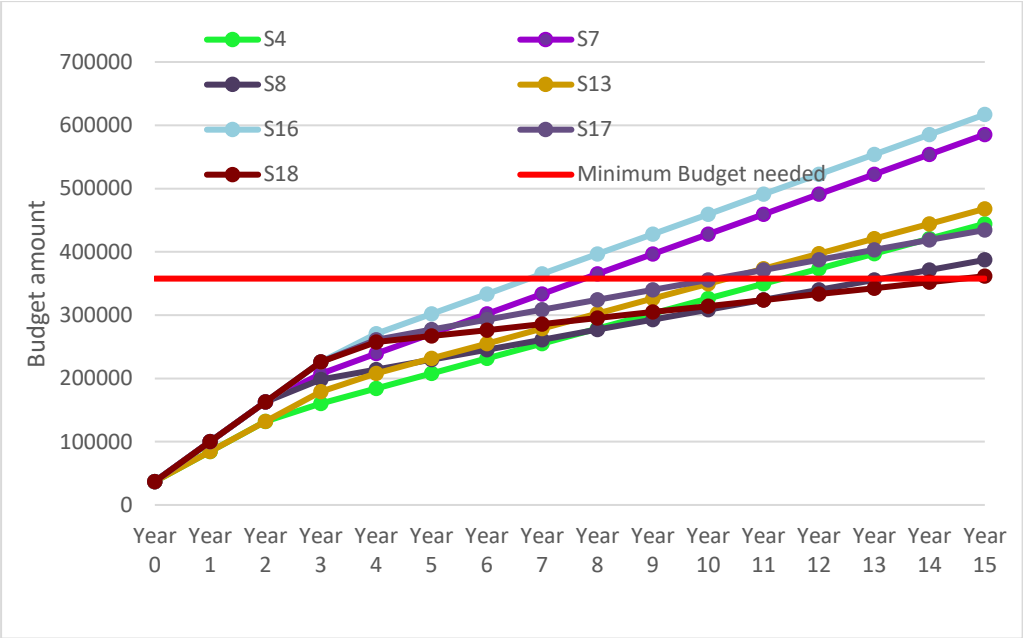

Figure 11 Illustration of budget requirement of each scenario within 15-year period (S4, S7, S8, S13, S16, S17, S18)

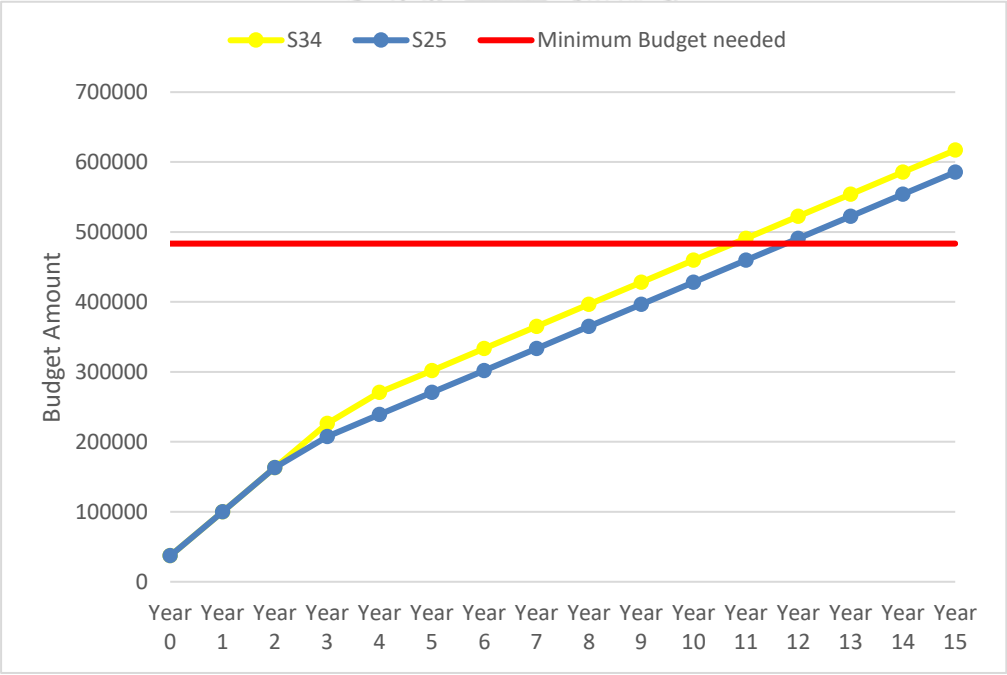

Figure 12 Illustration of budget requirement of each scenario within 15-year period (S25, S34)

5.2. Conclusion

This study the numerical, distribution and skill pharmacist shortage were identified. There was a strong need for human resource planning to increase the number of pharmacist graduates into the system especially in the public sectors. Further modelling study was required to propose strategic policy to solve the problem.

This study provided a snapshot of HRH situation of pharmacists in Myanmar especially, in the public sectors in 2019. The numerical shortage was in evidence because the density of pharmacist per 10,000 population was well below the WHO recommended ratio. There were still vacant positions to be filled in the jobs. Pharmacists were unevenly geographically distributed across the country. The pharmacists were mal-distributed among public and private sectors in Myanmar.

The skill shortage was seen in the public hospitals. The current functions of hospital pharmacist were very limited and the clinical pharmacy services called “Pharmaceutical Care” were still needed to develop. Therefore, this study developed a simulation model to predict the pharmacist workforce requirement to deliver the required clinical pharmacy services.

The results of simulation model suggested the best policy option among the policy intervention scenarios by sensitivity analysis. It was the policy intervention including the combined policies; the double graduation rate (200%), 3-year compulsory service, 50% exit rate and low-level clinical pharmacy service. If the government implement this policy intervention, they should consider the budgets needed such as the monthly salaries and the investment in the pharmacy institutions and non-monetary incentive to improve recruitment, retention and retaining strategies. The government could also choose another less costly policy intervention per each year among nine scenarios depended on the adjusted budget.

5.3. Limitations

This study has a limitation that it could not access to the pharmacist workforce data in the private sector. Moreover, the workforce requirement to perform the pharmacists’ current functions of procurement and store management was not estimated in the simulation model.

The study used the non-probability sampling method to select key informants in the interview. The workforce framework in hospital and FDA could not reflect the real situation and it may cause some under-estimation to calculate the vacancy rate of the pharmacists in public hospitals. Furthermore, many assumptions were used in the study.

In the simulation model, the demand for the HRH workforce is affected by a number of factors such as (1) the level of utilization of service, (2) the prevalence and incidence rate of disease and (3) the growing number of the population. The limitation of this study was that the most updated data cannot used to input into the model because the number of patients in 2016 was used to calculate the number of services based on the data of the hospital statistics, 2016. Another limitation was that the growing population rate and the health status of growing population were not taken into account in the model of this study. Furthermore, the new clinical pharmacy services were proposed to deliver in the future and therefore, the past levels of use of service for these services were unknown and it were then adjusted as assumptions as two different levels of use of service.

5.4. Recommendations

The policy interventions proposed by nine scenarios of this study should be analyzed and the best policy appropriate to the Myanmar condition should be chosen and implemented by governments. Before selecting and introducing the best appropriate policy, the regulatory impact assessment should be done because it provides the detailed appraisal of the possible effects of the new policy whether the new policy could possibly touch the objectives of the health system. Moreover, government needed to prepare the possible budget requirements for the selected policy intervention.

APPENDIX I

Setting	No. of setting interviewed	No. of pharmacist interviewed	No. of administrator* interviewed	Administrator
Hospitals[1]				Medical superintendent
Specialist hospital				
XL (700-1200 bed)	2/3	2	-	
L (500-550 bed)	3/10	3	1	
M (200-300 bed)	4/8	4	2	
S (100- 150 bed)	3/7	3	2	
XS (50 bed)	0/4	0	0	
General hospital				
XL (800-2000 bed)	3/4	3	3	
L (500 bed)	2/13	2	-	
M (200- 300 bed)	4/33	4	1	
S (100- 150 bed)	4/42	4	-	
XS (50 bed)	3/115	3	-	
FDA[1]				Director, Deputy Director
Central office Drug control section Food control section Cosmetic control section Medical device control section Pharmaceutical chemistry laboratory Microbiology laboratory	1/1	8	4	
FDA (Yangon Branch)	1/2	4	1	
Region/State FDA (Shan State)	1/14	1	-	
District FDA (Nyaung Oo district)	1/15	1	-	
Trade Zone FDA(Muse')	1/5	1	-	
University[1]				Rector

University of Pharmacy (Yangon)	1/1	6	1	
University of pharmacy (Mandalay)	1/1	6	1	
Department of Medical Research (DMR)[1]				Director
DMR (Yangon)	1/1	1		
DMR (Pyin Oo Lwin)	1/1	6	1	
Department of Traditional Medicine[1]	1/1	3	1	Director
Pharmaceutical Industry (BPI)[2]			1	General Manager
R&D	2/2	0	-	
QA	2/2	3	-	
QC	2/2	2	-	
Production	2/2	8	-	
Procurement (Technological Development Department)	1/1	1	-	
Pharmaceutical research department	1/1	1	-	
Chemical examiner's office[3]	1/3	1	-	-

Table 14 Characteristics of study sites and key informants

APPENDIX II

Semi-structure questionnaire

1. Which work setting do you work in?

2. What are the specific job title, functions and responsibility of pharmacist in the work?

4. Is there any function that delegate to other health workers?

5. How do you think that what kind of services related to pharmacy will be provided in the future in the work setting?

APPENDIX III

Projected Supply of pharmacists

Year	Year	Projected supply with Exit rate (50%) after 2yr	Projected supply with Exit rate (75%) after 2yr	Projected supply with Exit rate (85%) after 2yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	473.3015	473.3015	473.3015	270.865042
2021	Year 2	690.508	690.508	690.508	285.635084
2022	Year 3	779.667	715.64325	690.03375	300.405126
2023	Year 4	888.27025	769.944875	722.614725	315.175168
2024	Year 5	996.8735	824.2465	755.1957	329.94521
2025	Year 6	1105.47675	878.548125	787.776675	344.715252
2026	Year 7	1214.08	932.84975	820.35765	359.485294
2027	Year 8	1322.68325	987.151375	852.938625	374.255336
2028	Year 9	1431.2865	1041.453	885.5196	389.025378
2029	Year 10	1539.88975	1095.754625	918.100575	403.79542
2030	Year 11	1648.493	1150.05625	950.68155	418.565462
2031	Year 12	1757.09625	1204.357875	983.262525	433.335504
2032	Year 13	1865.6995	1258.6595	1015.8435	448.105546
2033	Year 14	1974.30275	1312.961125	1048.424475	462.875588
2034	Year 15	2082.906	1367.26275	1081.00545	477.64563

Table 15 100% graduates with 2year-Compulsory service with different exit rates comparing with baseline scenario (low level of utilization of service)

Year	Year	Projected supply with Exit rate (50%) after 2yr	Projected supply with Exit rate (75%) after 2yr	Projected supply with Exit rate (85%) after 2yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	582.379	582.379	582.379	270.865042
2021	Year 2	908.663	908.663	908.663	285.635084
2022	Year 3	1106.8995	1042.87575	1017.2663	300.405126
2023	Year 4	1270.0415	1124.44675	1066.2089	315.175168
2024	Year 5	1433.1835	1206.01775	1115.1515	329.94521
2025	Year 6	1596.3255	1287.58875	1164.0941	344.715252
2026	Year 7	1759.4675	1369.15975	1213.0367	359.485294
2027	Year 8	1922.6095	1450.73075	1261.9793	374.255336
2028	Year 9	2085.7515	1532.30175	1310.9219	389.025378
2029	Year 10	2248.8935	1613.87275	1359.8645	403.79542
2030	Year 11	2412.0355	1695.44375	1408.8071	418.565462
2031	Year 12	2575.1775	1777.01475	1457.7497	433.335504
2032	Year 13	2738.3195	1858.58575	1506.6923	448.105546
2033	Year 14	2901.4615	1940.15675	1555.6349	462.875588
2034	Year 15	3064.6035	2021.72775	1604.5775	477.64563

Table 16 150% graduates with 2year-Compulsory service with different exit rates comparing with baseline scenario (low level of utilization of service)

Year	Year	Projected supply with Exit rate (50%) after 2yr	Projected supply with Exit rate (75%) after 2yr	Projected supply with Exit rate (85%) after 2yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	690.508	690.508	690.508	270.865042
2021	Year 2	1124.921	1124.921	1124.921	285.635084
2022	Year 3	1431.2865	1367.26275	1341.65325	300.405126
2023	Year 4	1648.493	1475.866	1406.8152	315.175168
2024	Year 5	1865.6995	1584.46925	1471.97715	329.94521
2025	Year 6	2082.906	1693.0725	1537.1391	344.715252
2026	Year 7	2300.1125	1801.67575	1602.30105	359.485294
2027	Year 8	2517.319	1910.279	1667.463	374.255336
2028	Year 9	2734.5255	2018.88225	1732.62495	389.025378
2029	Year 10	2951.732	2127.4855	1797.7869	403.79542
2030	Year 11	3168.9385	2236.08875	1862.94885	418.565462
2031	Year 12	3386.145	2344.692	1928.1108	433.335504
2032	Year 13	3603.3515	2453.29525	1993.27275	448.105546
2033	Year 14	3820.558	2561.8985	2058.4347	462.875588
2034	Year 15	4037.7645	2670.50175	2123.59665	477.64563

Table 17 200% graduates with 2year-Compulsory service with different exit rates comparing with baseline scenario (low level of utilization of service)

Year	Year	Projected supply with Exit rate (50%) after 3yr	Projected supply with Exit rate (75%) after 3yr	Projected supply with Exit rate (85%) after 3yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	473.3015	473.3015	473.3015	270.865042
2021	Year 2	690.508	690.508	690.508	285.635084
2022	Year 3	907.7145	907.7145	907.7145	300.405126
2023	Year 4	996.8735	932.84975	907.24025	315.175168
2024	Year 5	1105.47675	987.151375	939.821225	329.94521
2025	Year 6	1214.08	1041.453	972.4022	344.715252
2026	Year 7	1322.68325	1095.754625	1004.983175	359.485294
2027	Year 8	1431.2865	1150.05625	1037.56415	374.255336
2028	Year 9	1539.88975	1204.357875	1070.145125	389.025378
2029	Year 10	1648.493	1258.6595	1102.7261	403.79542
2030	Year 11	1757.09625	1312.961125	1135.307075	418.565462
2031	Year 12	1865.6995	1367.26275	1167.88805	433.335504
2032	Year 13	1974.30275	1421.564375	1200.469025	448.105546
2033	Year 14	2082.906	1475.866	1233.05	462.875588
2034	Year 15	2191.50925	1530.167625	1265.630975	477.64563

Table 18 100% graduates with 3year-Compulsory service with different exit rates comparing with baseline scenario (low level of utilization of service)

Year	Year	Projected supply with Exit rate (50%) after 3yr	Projected supply with Exit rate (75%) after 3yr	Projected supply with Exit rate (85%) after 3yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	582.379	582.379	582.379	270.865042
2021	Year 2	908.663	908.663	908.663	285.635084
2022	Year 3	1234.947	1234.947	1234.947	300.405126
2023	Year 4	1433.1835	1369.15975	1343.5503	315.175168
2024	Year 5	1596.3255	1450.73075	1392.4929	329.94521
2025	Year 6	1759.4675	1532.30175	1441.4355	344.715252
2026	Year 7	1922.6095	1613.87275	1490.3781	359.485294
2027	Year 8	2085.7515	1695.44375	1539.3207	374.255336
2028	Year 9	2248.8935	1777.01475	1588.2633	389.025378
2029	Year 10	2412.0355	1858.58575	1637.2059	403.79542
2030	Year 11	2575.1775	1940.15675	1686.1485	418.565462
2031	Year 12	2738.3195	2021.72775	1735.0911	433.335504
2032	Year 13	2901.4615	2103.29875	1784.0337	448.105546
2033	Year 14	3064.6035	2184.86975	1832.9763	462.875588
2034	Year 15	3227.7455	2266.44075	1881.9189	477.64563

Table 19 150% graduates with 3 year-Compulsory service with different exit rates comparing with baseline scenario (low level of utilization of service)

Year	Year	Projected supply with Exit rate (50%) after 3yr	Projected supply with Exit rate (75%) after 3yr	Projected supply with Exit rate (85%) after 3yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	690.508	690.508	690.508	270.865042
2021	Year 2	1124.921	1124.921	1124.921	285.635084
2022	Year 3	1559.334	1559.334	1559.334	300.405126
2023	Year 4	1865.6995	1801.67575	1776.06625	315.175168
2024	Year 5	2082.906	1910.279	1841.2282	329.94521
2025	Year 6	2300.1125	2018.88225	1906.39015	344.715252
2026	Year 7	2517.319	2127.4855	1971.5521	359.485294
2027	Year 8	2734.5255	2236.08875	2036.71405	374.255336
2028	Year 9	2951.732	2344.692	2101.876	389.025378
2029	Year 10	3168.9385	2453.29525	2167.03795	403.79542
2030	Year 11	3386.145	2561.8985	2232.1999	418.565462
2031	Year 12	3603.3515	2670.50175	2297.36185	433.335504
2032	Year 13	3820.558	2779.105	2362.5238	448.105546
2033	Year 14	4037.7645	2887.70825	2427.68575	462.875588
2034	Year 15	4254.971	2996.3115	2492.8477	477.64563

Table 20 200% graduates with 3 year-Compulsory service with different exit rates comparing with baseline scenario (low level of utilization of service)

Year	Year	Projected supply with Exit rate (50%) after 2yr	Projected supply with Exit rate (75%) after 2yr	Projected supply with Exit rate (85%) after 2yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	473.3015	473.3015	473.3015	270.865042
2021	Year 2	690.508	690.508	690.508	285.635084
2022	Year 3	779.667	715.64325	690.03375	300.405126
2023	Year 4	888.27025	769.944875	722.614725	315.175168
2024	Year 5	996.8735	824.2465	755.1957	329.94521
2025	Year 6	1105.47675	878.548125	787.776675	344.715252
2026	Year 7	1214.08	932.84975	820.35765	359.485294
2027	Year 8	1322.68325	987.151375	852.938625	374.255336
2028	Year 9	1431.2865	1041.453	885.5196	389.025378
2029	Year 10	1539.88975	1095.754625	918.100575	403.79542
2030	Year 11	1648.493	1150.05625	950.68155	418.565462
2031	Year 12	1757.09625	1204.357875	983.262525	433.335504
2032	Year 13	1865.6995	1258.6595	1015.8435	448.105546
2033	Year 14	1974.30275	1312.961125	1048.424475	462.875588
2034	Year 15	2082.906	1367.26275	1081.00545	477.64563

Table 21 100% graduates with 2 year-Compulsory service with different exit rates comparing with baseline scenario (High level of utilization of service)

Year	Year	Projected supply with Exit rate (50%) after 2yr	Projected supply with Exit rate (75%) after 2yr	Projected supply with Exit rate (85%) after 2yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	582.379	582.379	582.379	270.865042
2021	Year 2	908.663	908.663	908.663	285.635084
2022	Year 3	1106.8995	1042.87575	1017.2663	300.405126
2023	Year 4	1270.0415	1124.44675	1066.2089	315.175168
2024	Year 5	1433.1835	1206.01775	1115.1515	329.94521
2025	Year 6	1596.3255	1287.58875	1164.0941	344.715252
2026	Year 7	1759.4675	1369.15975	1213.0367	359.485294
2027	Year 8	1922.6095	1450.73075	1261.9793	374.255336
2028	Year 9	2085.7515	1532.30175	1310.9219	389.025378
2029	Year 10	2248.8935	1613.87275	1359.8645	403.79542
2030	Year 11	2412.0355	1695.44375	1408.8071	418.565462
2031	Year 12	2575.1775	1777.01475	1457.7497	433.335504
2032	Year 13	2738.3195	1858.58575	1506.6923	448.105546
2033	Year 14	2901.4615	1940.15675	1555.6349	462.875588
2034	Year 15	3064.6035	2021.72775	1604.5775	477.64563

Table 22 150% graduates with 2 year-Compulsory service with different exit rates comparing with baseline scenario (High level of utilization of service)

Year	Year	Projected supply with Exit rate (50%) after 2yr	Projected supply with Exit rate (75%) after 2yr	Projected supply with Exit rate (85%) after 2yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	690.508	690.508	690.508	270.865042
2021	Year 2	1124.921	1124.921	1124.921	285.635084
2022	Year 3	1431.2865	1367.26275	1341.65325	300.405126
2023	Year 4	1648.493	1475.866	1406.8152	315.175168
2024	Year 5	1865.6995	1584.46925	1471.97715	329.94521
2025	Year 6	2082.906	1693.0725	1537.1391	344.715252
2026	Year 7	2300.1125	1801.67575	1602.30105	359.485294
2027	Year 8	2517.319	1910.279	1667.463	374.255336
2028	Year 9	2734.5255	2018.88225	1732.62495	389.025378
2029	Year 10	2951.732	2127.4855	1797.7869	403.79542
2030	Year 11	3168.9385	2236.08875	1862.94885	418.565462
2031	Year 12	3386.145	2344.692	1928.1108	433.335504
2032	Year 13	3603.3515	2453.29525	1993.27275	448.105546
2033	Year 14	3820.558	2561.8985	2058.4347	462.875588
2034	Year 15	4037.7645	2670.50175	2123.59665	477.64563

Table 23 200% graduates with 2 year-Compulsory service with different exit rates comparing with baseline scenario (High level of utilization of service)

Year	Year	Projected supply with Exit rate (50%) after 3yr	Projected supply with Exit rate (75%) after 3yr	Projected supply with Exit rate (85%) after 3yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	473.3015	473.3015	473.3015	270.865042
2021	Year 2	690.508	690.508	690.508	285.635084
2022	Year 3	907.7145	907.7145	907.7145	300.405126
2023	Year 4	996.8735	932.84975	907.24025	315.175168
2024	Year 5	1105.47675	987.151375	939.821225	329.94521
2025	Year 6	1214.08	1041.453	972.4022	344.715252
2026	Year 7	1322.68325	1095.754625	1004.983175	359.485294
2027	Year 8	1431.2865	1150.05625	1037.56415	374.255336
2028	Year 9	1539.88975	1204.357875	1070.145125	389.025378
2029	Year 10	1648.493	1258.6595	1102.7261	403.79542
2030	Year 11	1757.09625	1312.961125	1135.307075	418.565462
2031	Year 12	1865.6995	1367.26275	1167.88805	433.335504
2032	Year 13	1974.30275	1421.564375	1200.469025	448.105546
2033	Year 14	2082.906	1475.866	1233.05	462.875588
2034	Year 15	2191.50925	1530.167625	1265.630975	477.64563

Table 24 100% graduates with 3 year-Compulsory service with different exit rates comparing with baseline scenario (High level of utilization of service)

Year	Year	Projected supply with Exit rate (50%) after 3yr	Projected supply with Exit rate (75%) after 3yr	Projected supply with Exit rate (85%) after 3yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	582.379	582.379	582.379	270.865042
2021	Year 2	908.663	908.663	908.663	285.635084
2022	Year 3	1234.947	1234.947	1234.947	300.405126
2023	Year 4	1433.1835	1369.15975	1343.5503	315.175168
2024	Year 5	1596.3255	1450.73075	1392.4929	329.94521
2025	Year 6	1759.4675	1532.30175	1441.4355	344.715252
2026	Year 7	1922.6095	1613.87275	1490.3781	359.485294
2027	Year 8	2085.7515	1695.44375	1539.3207	374.255336
2028	Year 9	2248.8935	1777.01475	1588.2633	389.025378
2029	Year 10	2412.0355	1858.58575	1637.2059	403.79542
2030	Year 11	2575.1775	1940.15675	1686.1485	418.565462
2031	Year 12	2738.3195	2021.72775	1735.0911	433.335504
2032	Year 13	2901.4615	2103.29875	1784.0337	448.105546
2033	Year 14	3064.6035	2184.86975	1832.9763	462.875588
2034	Year 15	3227.7455	2266.44075	1881.9189	477.64563

Table 25 150% graduates with 3 year-Compulsory service with different exit rates comparing with baseline scenario (High level of utilization of service)

Year	Year	Projected supply with Exit rate (50%) after 3yr	Projected supply with Exit rate (75%) after 3yr	Projected supply with Exit rate (85%) after 3yr	Projected supply (no policy intervention)
2019	Year 0	256.095	256.095	256.095	256.095
2020	Year 1	690.508	690.508	690.508	270.865042
2021	Year 2	1124.921	1124.921	1124.921	285.635084
2022	Year 3	1559.334	1559.334	1559.334	300.405126
2023	Year 4	1865.6995	1801.67575	1776.06625	315.175168
2024	Year 5	2082.906	1910.279	1841.2282	329.94521
2025	Year 6	2300.1125	2018.88225	1906.39015	344.715252
2026	Year 7	2517.319	2127.4855	1971.5521	359.485294
2027	Year 8	2734.5255	2236.08875	2036.71405	374.255336
2028	Year 9	2951.732	2344.692	2101.876	389.025378
2029	Year 10	3168.9385	2453.29525	2167.03795	403.79542
2030	Year 11	3386.145	2561.8985	2232.1999	418.565462
2031	Year 12	3603.3515	2670.50175	2297.36185	433.335504
2032	Year 13	3820.558	2779.105	2362.5238	448.105546
2033	Year 14	4037.7645	2887.70825	2427.68575	462.875588
2034	Year 15	4254.971	2996.3115	2492.8477	477.64563

Table 26 200% graduates with 3 year-Compulsory service with different exit rates comparing with baseline scenario (High level of utilization of service)

No.	Name of services	Hospitals		Number of services		No. of service used by patients(E)	Patients	Mean time	Man hour		FTEs	
		Number of hospital	Type of hospitals	Demand I*	Demand II*		Number of patients		Demand I*	Demand II*	Demand I*	Demand II*
1	Drug Information services	128	XL,L,M,S general and XL,L,M,S,XS specialist	–	–	0.00%	Inpatients	17.71 hr/week	117877.76	117877.76	70	70
2	Drug use evaluation	128	XL,L,M,S general and XL,L,M,S,XS specialist	–	–	0.00%	Inpatients	37.57 hr/week	250065.92	250065.92	148	148
3	ADR management	128	XL,L,M,S general and XL,L,M,S,XS specialist	234041.997	234041.99	15.10%	No. of Admitted patients	20.97 min/patient	81797.67795	81797.67795	48	48
4	Drug protocol management	128	XL,L,M,S general and XL,L,M,S,XS specialist	387486.75	774973.5	25%, 50%	No of admitted patients	27.76 min/patient	179277.203	358554.406	106	212
5	Medical round participation	128	XL,L,M,S general and XL,L,M,S,XS specialist	2262439.75	4524879.5	25%,50%	No. of inpatients	17.43 min/patient	657238.7474	1314477.495	389	778
6	Drug therapy monitoring	128	XL,L,M,S general and XL,L,M,S,XS specialist	2262439.75	4524879.5	25%,50%	No. of inpatient	16.84 min/patiet	630089.4704	1260178.941	373	746
7	Admission drug histories	128	XL,L,M,S general and XL,L,M,S,XS	1549947	1549947	100.00%	No of admitted	16.71 min/patient	435018.458	435018.458	257	257

			specialist				patients					
8	Drug counseling	128	XL,L,M,S general and XL,L,M,S,XS specialist	1549947	1549947	100.00%	No of admitted patients	18.35 min/patient	474025.4575	474025.4575	280	280
9	Inpatient Dispensing	241	XL,L,M,S, XS general and specialist	10423516	10423516	100.00%	No. of Inpatients	4.8 min/patient	833881.28	833881.28	493	493
10	Outpatient Dispensing	241	XL,L,M,S , XS general and specialist	6357312	6357312	100.00%	No. of Out-patients	4.8 min/patient	508584.96	508584.96	301	301
											2,466FTEs	3,334FTEs

Table 27 Projected Demand for pharmacists

Demand I* = Level of service I (25% for Drug protocol management, Medical round participation, Drug therapy monitoring and 100% for Admission drug histories, Drug counselling, Inpatient dispensing, Outpatient dispensing, 15.1% for ADR management)

Demand II* = Level of service II (50% for Drug protocol management, Medical round participation, Drug therapy monitoring and 100% for Admission drug histories, Drug counselling, Inpatient dispensing, Outpatient dispensing, 15.1% for ADR management)

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