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(DOCTOR, DENTIST, PHARMACIST, NURSE, ASSISTANT MEDICAL OFFICER)

EXTENDED EXECUTIVE SUMMARY

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PREFACE

The ability of a country to meet its health goals depends mainly on the knowledge, skills, motivation and deployment of the people responsible for organizing and delivering health services. Human resource for health (HRH) is vital in providing essential health interventions to the population. Limited capacity to produce health worker, failure to mitigate the migration of health workers, poor skill-mix and demographic imbalances will influence delivering quality and equitable health services to the nation. In HRH planning, there is a need for comprehensive, reliable and timely information on human resource for health, including numbers, demographic distribution, skills, services being provided and factors influencing recruitment and retention. Workforce planning has often been described as ensuring "the right people, with the right skills, in the right place, at the right time". An effective workforce planning is a challenge in healthcare due to a complex mix of staff and staff functions, the geographic area that is covered and the changing policies that influence the supply and requirements of care. Population size, gender, age and their health status are among fundamental factors influencing the requirement of HRH workforce.

With the existing workforce, Malaysia has achieved tremendous improvement in health status over the years, further gaining recognition from international health agencies. However, we are continuously striving to improve our benchmarks to be par with other developed countries. Despite that, new HRH graduates in Malaysia are experiencing delayed employment in their respective fields due to a few reasons. Besides the effect on health care services, delays in the hiring of the new graduates can lead to migration of the graduates to other countries, loss of skill and even loss of interest in the respective fields. Therefore, evidence on supply and requirement of HRH has become a necessity to guide policymakers to formulate solutions to overcome these emerging issues.

This report presents the results of a study using Needs-based approach to forecast the supply and requirements for the period 2016 - 2030 of five selected HRH categories namely doctors, dentists, pharmacists, nurses and Assistant Medical Officers (AMO) for Malaysia. Indeed, the study which was conducted from September 2014 to 2016 requires a systematic process to translate and illustrate the complexity of health care delivery in Malaysia into System Dynamics (SD) simulation modelling. In the study, the various scenario analysis was simulated to predict future HRH supply and requirement based on changes made on specific parameters.

The detailed report of the study is available and can be accessed through the Ministry of Health portal by request from the Planning Division. We aim that the findings of this report will facilitate and guide policymakers and relevant stakeholders to come out with appropriate policies. Through a clear policy direction, efficient management, sufficient resources including competent and skilled health workforce, it can be foreseen that the Malaysia population will continue to have a better health outcome. A healthier population will result in the improvement of the nation's productivity.

Lastly, we would like to congratulate the researchers and all participating stakeholders involved in this study. This study is a collaboration between Ministry of Health and academician from local universities namely Universiti Teknologi Malaysia (UTM), Universiti Teknikal Malaysia Melaka (UTEM) and Universiti Malaysia Pahang (UMP), with the involvement of other agencies in providing primary and secondary data. This study was made possible through a research grant funded by the Institute of Health System Research (IHSR), led and managed together with the Health Policy and Planning Section, Planning Division, MOH.

Planning Division
Ministry of Health Malaysia

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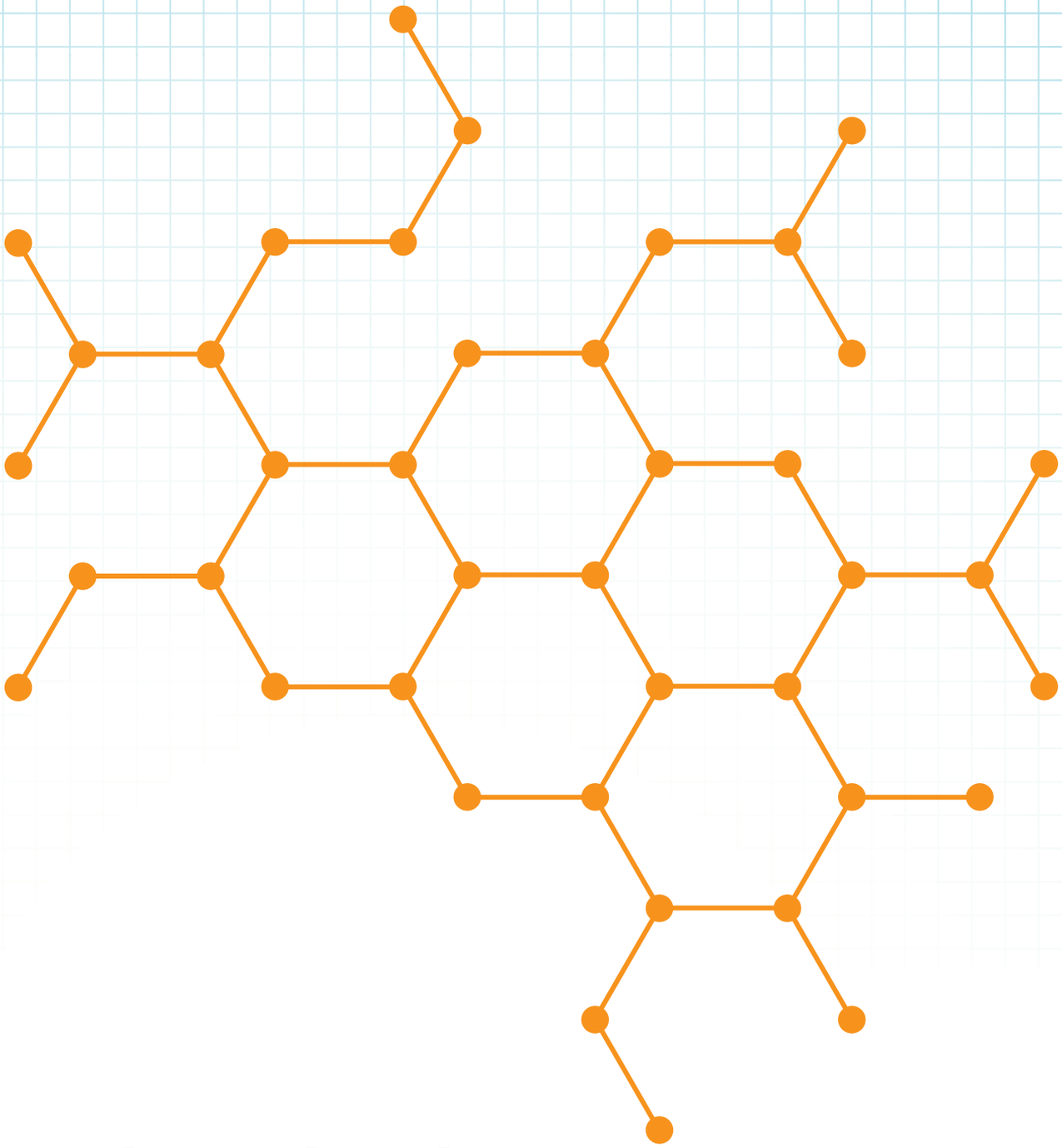
ACRONYMS AND ABBREVIATIONS

AMO	Assistant Medical Officer
APC	annual practising certificate
BID	brought-in-dead
BLESS	Business Licensing Electronic Support System
CT	Computed Tomography
CN	Community Nurse
C&P	Credentialing and privileging
DALY	Disability-Adjusted Life Year
DOSM	Department of Statistic Malaysia
DRG	Diagnosis Related Group
ED	Emergency Department
FTE	full-time equivalent
HD	Haemodialysis
HIMS	Health Information Management System
HIV	Human Immunodeficiency Virus
HRH	Human resource for health
ILKKM	Institut Latihan Kementerian Kesihatan Malaysia (Malaysia Ministry of Health Training Institute)
JM	Jururawat Masyarakat (refer to Community Nurse)
MDC	Malaysian Dental Council
MP	Malaysia Plan
MOH	Ministry of Health
MRI	Magnetic Resonance Imaging
MTR	Mid-Term Review
OECD	Organisation for Economic Co-operation and Development
OHP	Oral Health Programme
OPD	Outpatient Department
OSCC	One-Stop Crisis Centre
SOI	Severity of Illness
RN	Registered Nurse
RMSPE	root-mean-square percent error
WHO	World Health Organisation
MNB	Malaysian Nursing Board
NCD	Non-Communicable Disease
UHC	Universal Health Coverage



1 INTRODUCTION

SUPPLY AND NEEDS-BASED REQUIREMENT PROJECTIONS OF MALAYSIAN HUMAN RESOURCES FOR HEALTH USING SYSTEM DYNAMICS APPROACH 2016 – 2030

INTRODUCTION

Malaysia inherited a health system from the British upon independence in 1957 and the healthcare system had evolved from a simple single provider system to multiple providers. The Malaysia healthcare system is categorised as public and private sector providers interacting with one another. The Ministry of Health (MOH) Malaysia is the largest provider of public healthcare, alongside health care providers under the jurisdiction of the Ministry of Education (university healthcare facilities) and the Ministry of Defence (military healthcare facilities). Private health care providers, among others, include private hospitals, private clinics, private maternity homes, private nursing homes, private hospice and private haemodialysis centres.

The health care services in the public sector are highly subsidised by the government, while individual and some private health insurance or corporations are funding the private sector through fee-for-service. In the 11th Malaysia Plan, 2016-2020, Malaysia is continuously aiming to increase the accessibility of the people to the health care services while at the same time working towards improving the quality of services provided. The delivery of health service involves a team of health personnel comprising of a doctor, nurse, assistant medical officer, healthcare assistant, pharmacists, assistant pharmacist and others. The oral health care service team consists of dentist and dental therapist, who provide direct patient care.

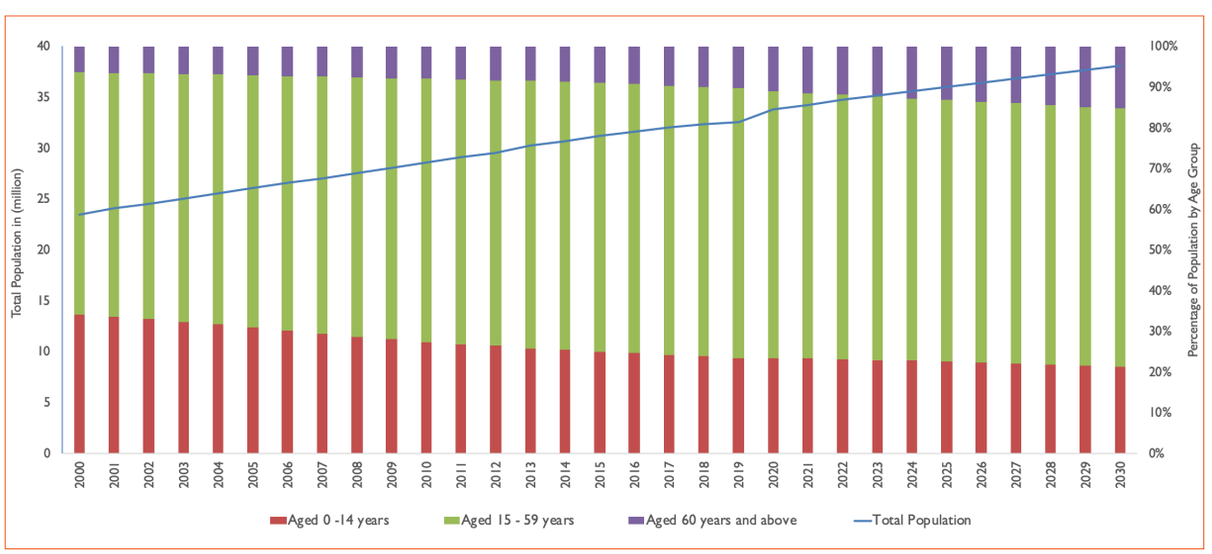
MOH offers a comprehensive range of health care services which includes health promotion, disease prevention, curative and rehabilitative care. Health care services are provided through facilities that include specialist and non-specialist hospitals and clinics. Another initiative in the delivery of health care is through the home-based care by a domiciliary team, where outreach services made possible by mobile teams and mobile clinics serving communities in rural areas, the urban poor, indigenous people and communities in the interior of Sarawak and Sabah. The non-operating dental personnel are the dental surgery assistant, dental technologist and health assistant.

1.1 Human Resource for Health Projections

This report presents the findings of a study entitled: "NEEDS-BASED MODELLING AND PROJECTION OF HEALTH HUMAN RESOURCES – NMRR-14-903-21795", which aimed at developing models to be used for the supply and requirement projections of selected Human Resources for Health (HRH) in Malaysia. The study conducted between September 2014 to August 2016, was part of the Ministry of Health's HRH workforce planning initiative towards establishing a comprehensive Malaysian HRH Master Plan. This study was specifically conducted to forecast the supply and requirement of doctors, dentists, pharmacists, nurses and assistants medical officers, for the country over the planning horizon up to 2030. Apart from that, this study intended to identify the effect of various future health population trends and scenarios on HRH supply and requirements by conducting the what-if and gap analysis.

Effective workforce planning has often described as ensuring "the right people, with the right skills, in the right place, at the right time". This is a challenge in health care due to a complex mix of staff and staff functions, the geographic area that is covered and the changing policies that influence the supply and requirement of care. Population size, gender, age and their health status are among the important factors influencing the requirement of HRH workforce.

Figure 1: Malaysia Population Trends from 2000 to 2030 by Age Groups



Source: Department of Statistics Malaysia, 2018

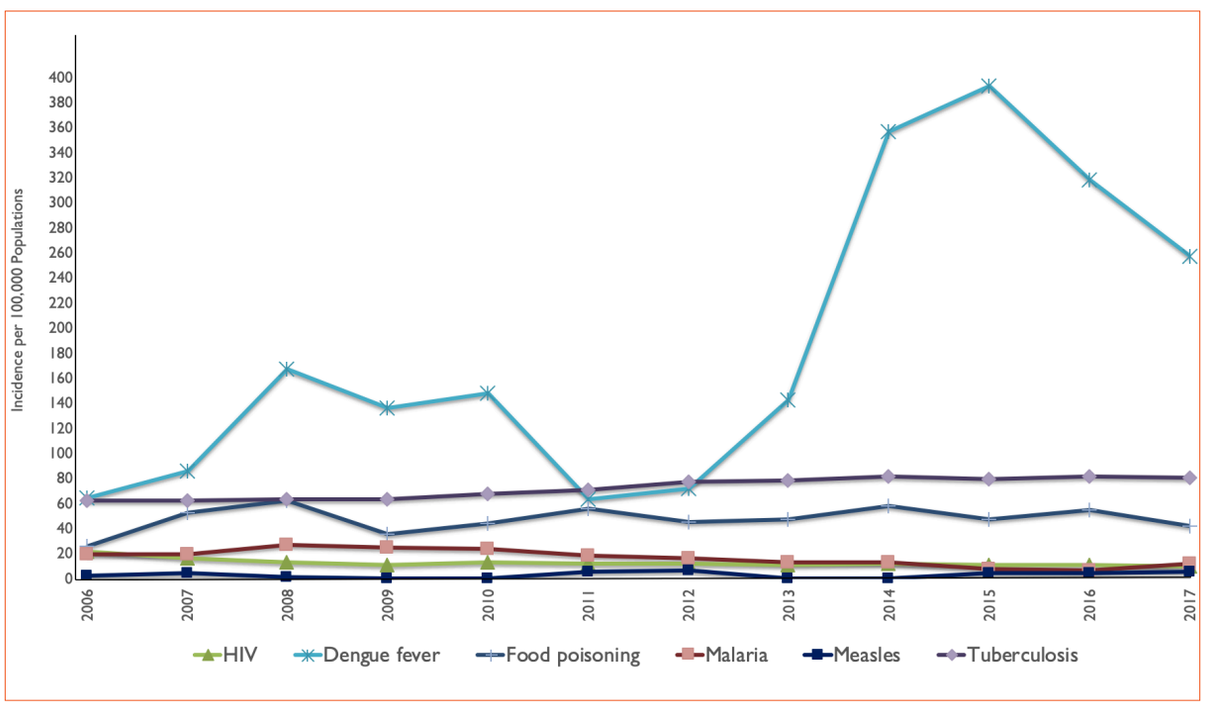
As shown in Figure 1, the population of Malaysia is projected to reach 38.07 million by 2030, and the ageing population, the population aged 60 and above, doubles up from 6% in 2000 to almost 15% in 2030. All other things equal, an older population will generally have more significant needs for care than a younger population. In addition to the population factor, the burden of diseases, incidence and prevalence of disease plays an important role. Malaysia faces a double burden of disease as seen in Malaysian Burden of Disease and Injury Study 2009 – 2014 (Institute of Public Health, 2017). Based on the NHMS study, the prevalence of diabetes, hypercholesterolemia, and obesity has increased over nine (9) years, as shown in Table 1. This health condition predisposes to ischaemic heart disease, which is the top cause of death in 2018 (Department of Statistics Malaysia, 2018). Figure 2 illustrates the trend in the incidence of selected infectious diseases from 2006 to 2017, which includes dengue fever, tuberculosis, food poisoning, HIV, malaria and measles.

Table 1: Trend of Selected Prevalence Health Conditions in Malaysia

PREVALENCE	2006	2011	2015
	Percentage (%)		
Diabetes (>18 yrs)	11.6	15.2	17.5
Hypertension (>18 yrs)	32.2	32.7	30.3
Hypercholesterolaemia	20.6	35.1	47.7
Obesity adult*	14.0	15.1	17.7
Smoking (adult) - current	21.5	23.1	22.8

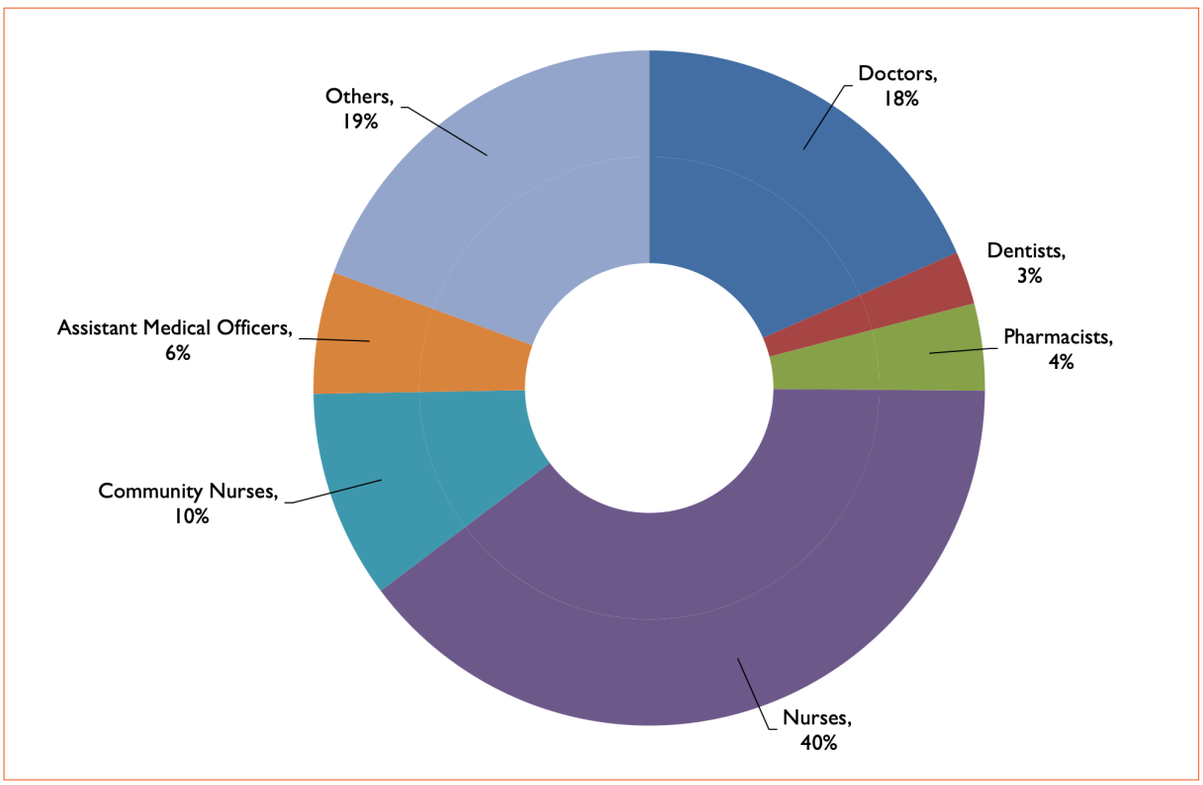
Source: Institute of Public Health, 2008; 2011; 2015

Figure 2: Trend in Incidence of Selected Communicable Diseases from 2006 – 2017



Source: Health Informatics Centre, 2007 - 2018

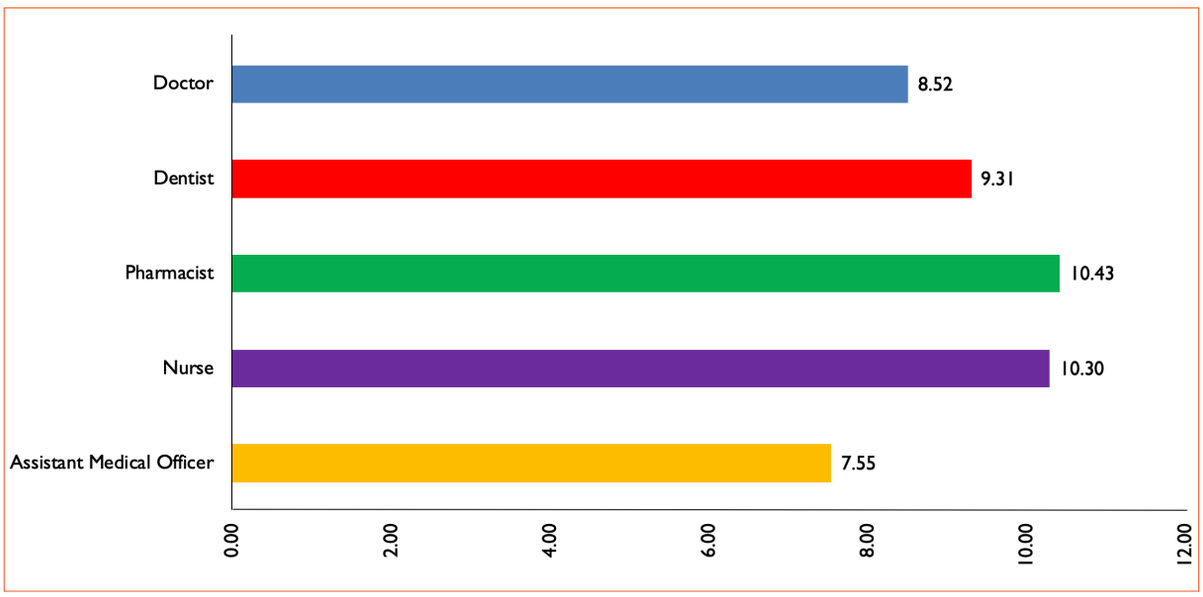
Figure 3: Distribution of Human Resources for Health in Malaysia by Profession, 2015



Source: Health Informatics Centre, 2016

Figure 3 illustrates the supply of HRH by professions in Malaysia for the year 2015. As seen above, the largest health workforces are nurses followed by doctors, assistant medical officers, pharmacist and dentist. Additionally, for every doctor in Malaysia, there are two (2) registered nurses (almost three (3) if community nurses are included). A significant number of allied health professionals are working together in the health workforce, where they make up about 19% of the total. However, in this study, the focus was mainly to the five (5) selected afore-mentioned health care professionals. Figure 4 demonstrates the five (5) health care professions' growth rate over the last 15 years from 2000 – 2015.

Figure 4: Average Annual Growth Rate of Five Selected Professions Over 15 Years in Malaysia, 2002 – 2017



Source: Health Informatics Centre, 2003 - 2017

Table 2: Basic Qualification and Study Duration of Selected Health Care Personnel

Healthcare Professionals	Type of qualification	Minimum years of study
Doctor	Bachelor's Degree	5
Dentist	Bachelor's Degree	5
Pharmacist	Bachelor's Degree	4
Nurse	Diploma	3
	Bachelor's Degree	4
Assistant Medical Officer	Diploma	3

1.2 Training, Role and Key Facts of Human Resource for Health

1.2.1 Doctor

Doctors, as defined in this study, are fully registered medical practitioners with the Malaysian Medical Council (MMC), i.e. medical officers and medical specialists. The career pathway of doctors begins with a minimum of five (5) years of undergraduate training, which is offered by the medical faculty in universities locally and abroad. In 2015, there are ten public universities and 20 private universities that offer medical courses in Malaysia. In Malaysia, medical graduates need to undergo a minimum of two (2) years clinical training period known as housemanship before obtaining the full registration with MMC. This clinical training period is to ensure their competency as medical practitioners.

Although there can be other ways to categorise doctor services, i.e. by discipline, speciality training, facility type, this study categorised doctors' services into direct and indirect patient care. Direct patient care is defined as health care services encompassing the entire spectrum of care provided directly to individuals or patients, ranging from preventive care, and primary to tertiary care. On the other hand, doctors engaged in indirect care are those involved in public health, administration, academic, research and regulatory. They do not provide patient care directly to individuals. Doctors working in the public sector usually work as a team of doctors and support staffs within a specific discipline. A team of doctors especially in government hospital setting may consist of a consultant, specialist, medical officer and house officer (HO). A patient requiring multidisciplinary care will have more than one team of doctors from various disciplines working together in providing medical care. In a department or facility without a specialist, medical officers handle cases with the back-up of a specialist through the referral system.

Over the past ten years, Malaysia has seen a marked increase in the number of doctors which resulted in improvement in doctor to population ratio. Concurrently, plenty of news on issues related to new medical graduates awaiting housemanship training, which is often interpreted as a lack of employment opportunity in Malaysia, is reported in mainstream news and social media. Meanwhile, new public and private health facilities continue to flourish while existing healthcare facilities offer new services, which need doctors. These mismatched scenarios cause misperception among the clients as they continue to experience long waiting time for medical care while healthcare managers are facing challenges to work within their means, with inadequate supplies of doctors, to maintain the safety and quality of medical care services. Hence this study was conducted to shed some light on the future status of doctor supply concerning the needs and demand for their services. The results on projections of supply and requirement for doctors were based on initial data of the doctor population as of 2015 summarized in Table 3.

Table 3: Key Facts on Doctors in Malaysia, 2015

Total number of doctors in Malaysia	46,491
• Total number of doctors in the Ministry of Health	33,545
• Total number of doctors in other govern-ment agency	n.a.
• Total number of doctors in the private sector	12,946
Doctor to population ratio	1: 656

Source: Ministry of Health, 2016

Doctors received full registration	4,543
Doctors received provisional registration	5,146
Doctors received Annual Practising Certificate (APC)	37,029
• The proportion of public and private practice based on APC issued	65% public, 35% private
• Male to female ratio	50% male, 50% female
• Median age	44.7 years
Total number of local undergraduate medical schools	30
• The proportion of public and private medical schools	33% public, 67% private

Source: Malaysian Medical Council, n.d.

1.2.2 Dentist

With the introduction of compulsory service in June 2001, there was an upward trend of dental practitioners in the public sector from 2008 until 2017. In 2015, it was noted that there were more dentist in the public sector (66.5%) compared to the private sector (33.5%) and more female dentists (65%) than male dentists (35%). Overall, in 2015, there were 6,384 practising dentists in the country serving in both the public and the private sector. Generally, dentists are involved in the provision of oral health care services; however, a smaller proportion engaged in administrative, academic, research and regulatory task. In 2015, there were 13 dental degree programmes in the country, six (6) public dental school and seven (7) private dental school respectively.

This study focuses on the projection of dentists aimed to ensure that the number of dentists corresponds to the change in the population's oral health needs in the years to come. This study investigates the nature of oral health care services and factors influencing the supply and requirement of dentists. The results on projections of supply and requirement for dentists were based on initial data of the dentist population as of 2015 summarized in Table 4.

Table 4: Key Facts on Dentists in Malaysia, 2015

Total number of dentists in Malaysia	6,384
• Total number of dentists in MOH	3,488
• Total number of doctors in other govern-ment agency	533
• Total number of dentists in private sector	2,363
Dentist to population ratio	1: 4,775

Source: Health Facts, MOH 2016

Dentist received full registration	980
Dentist received Annual Practicing Certificate (APC)	6,384
• The proportion of public and private practice based on APC issued	62.7% public, 37.3% private
• Male to female ratio	35% male, 65% female
• Median age	39.5 years
Total number of local undergraduate dental schools	17
• The proportion of public and private dental schools	46% public, 54% private

Source: MDC Annual Report 2016

1.2.3 Pharmacist

The Malaysian pharmaceutical services delivered by both public and private pharmaceutical providers where the roles of pharmacists are to ensure quality, safety and efficacy of medicines to fulfil, urge, and foster rational use of medication among members of the public. Pharmaceutical care services are achievable by contributing to the preparation, supply, control of medicine and providing information to those who prescribe or use pharmaceutical products. The spectrum of health care needs is broad, as patients' medications use involves self-care, acute care and chronic care.

Majority of pharmacy practice involves directly with patient care in hospitals, health clinics and community pharmacies. Pharmacists involved in the in-direct patient care are pharmacy management, enforcement, regulatory, pharmaceutical industries, academia and research, which plays a significant role in the healthcare system in the country. Malaysia has comprehensive pharmacy services in the public sector, which co-exist with the private healthcare system. The Ministry of Health forms the largest provider of public healthcare, alongside other health care providers under the jurisdiction of the Ministry of Education (i.e. the university hospitals) and Ministry of Defence (military hospitals). Private health care providers, among others include community pharmacy, private hospital pharmacy and pharmaceutical industry.

In order to be a registered pharmacist in Malaysia, a pharmacy graduate shall be registered with the Pharmacy Board of Malaysia (PBM) which is an established body formed under the Registration of Pharmacists Act (ROPA) 1951. The constitution of the board is from public and private sectors pharmacist and is presided by Director General of Health. Under this act, registered pharmacists are individuals who are rovisionally registered pharmacist under section 6 or a fully registered pharmacist under section 6B (ROPA) 1951.

The pharmacist population has improved markedly from 2008 until 2016 with an average increment of 6% over 8 years, where the pharmacist to population ratio of 2008 is 1:4,137 and while in 2017 is 1:2,773. In 2015, the total number of pharmacists in Malaysia was 10,511 with a pharmacist to population ratio of 1:2,900. According to the data from PBM, 901 pharmacists received their full registration and 1,486 received their provisional registration in 2015. Based on the registration issued, 30% of them are male and 70% are female. In 2015, there are 19 pharmacy schools in Malaysia offering pharmacy degree programme consisting of five (5) and (14) public and private pharmacy schools respectively. Currently, 20 fully recognized pharmacy schools have been established to offer pharmacy degree programme.

The application processes of Annual Certificate (AC) were done manually prior to June 2014. Due to technical issues encountered by the PBM, the data of AC was not available for the year 2015. The 2015 data comprises of pharmacists in both public and private sectors. In the earlier part of implementing BLESS, due to several technical issues with the system, PBM has exempted pharmacists in the public sector from applying AC for 2015 and 2016 until all the issues have been resolved. Thus, this explains the reduced total number of registered pharmacists for the year 2015 and 2016 as compared to the year 2014. Therefore, this might be the explanation of the actual number of AC are not publicly available for the year 2015 and 2016. Table 5 illustrates the key facts on pharmacist in Malaysia 2015.

Table 5: Key Facts on Pharmacist in Malaysia, 2015

Total number of pharmacist in Malaysia	10,511
• Total number of pharmacist in Ministry of Health (MOH)	6,423
• Total number of doctors in other govern-ment agency (Non-MOH)	185
• Total number of pharmacist in private sector	3,903
Dentist to population ratio	1 : 2,900
Fully Registered Pharmacist (FRP)	901
Provisional Registration Pharmacist (PRP)	1486
• The proportion of public and private practice based on AC issued	63% public, 37% private
• Male to female ratio	30% male, 70% female
• Median Ratio	Not available
Total number of local undergraduate pharmacy schools	19
• The proportion of public and private pharmacy schools	23.3% public, 73.7% private

Source: Pharmacy Board Malaysia

1.2.4 Nurse

In Malaysia, the nursing profession continuously evolving in line with the technological advancement in medicine, industrial revolution and to meet the Need and Demand of the population.

The number of nurses has increased tremendously over the past ten years and makes a significant improvement in nurse to population ratio. In the year 2007, nurse to population ratio was 1: 942 has improved to 1: 305 in 2015. The public-private ratio in 2015 was about 2 to 1 with 69,590 of nurse work in the public sector as compared to 30,335 in the private sector.

To be a registered nurse, the graduates have to undergo a training course in recognized training premises, which fulfil the requirements stipulated by the Malaysian Nursing Board. Both public and private nursing colleges and universities offer training services. Currently, there are 76 public and private institutions offering diploma and degree in nursing programmes. MOH is the main provider for nurse training courses in Malaysia. According to data from Malaysian Nursing Board (MNB), a total number of 149,160 nurses received their registration in 2015; with 99,752 nurses renewed their annual practising certificate (APC) and 5,852 nurses are newly registered. Based on the APC issued, 95.74% of them are female and the median age of the nurses was in the age range 25-34 years old. Table 6 shows the key facts on nurses in Malaysia in 2015.

Table 6: Key Facts on Nurse in Malaysia, 2015

Total number of nurses in Malaysia	99,925
• Total number of nurses in the Ministry of Health	64,016
• Total number of nurses in other government agency	5,574
• Total number of nurses in private sector	30,335
Nurses to population ratio	1: 305

Source: Ministry of Health, 2016

Total number of registered Nurses	149,160
Nurses received Annual Practising Certificate (APC)	105,604
• New registration	5,852
• Renew APC	99,752
• Proportion of public and private practice based on APC issued	70% public, 30% private
• Male to female ratio	4% male, 96% female
• Median age	25-34 years
• Percentage nurses aged < 25 years old	0.4%
• Percentage of nurses aged 25-34 years old	54.3%
• Percentage of nurses aged 35-44 years old	25.5%
• Percentage of nurses aged 45-54 years old	11.5%
• Percentage of nurses aged 55-64 years old	6.6%
• Percentage of nurses aged ≥ 65 years old	1%

Source: Malaysian Nursing Board

Total number of local nursing colleges/ institutions	76
• Proportion of public and private nursing colleges/ institutions	41% public, 59% private

Source: Nursing Division

1.2.5 Assistant Medical Officer (AMO)

Assistant Medical Officer (AMO) profession have existed in Malaysia for almost two centuries ago. Initially known as 'apothecaries', introduced by the British administration in Penang in 1823, their initial function was to sell and dispense medications. During the Colonial period, they were known as 'Sub Assistant Surgeons' and eventually were called 'Dressars' by the Malay Community back then. The term 'dressar' originated from the English word 'Dresser' which refers to assistant surgeons who dressed patients' wounds. These 'Dressars' served in remote areas and lived in quarters within the hospital or clinic's compound to make it easier for patients to seek help at night or during emergencies. In 1963, they were known as 'Pembantu Rumah Sakit' (Infirmary Assistant). Seven years later, it was changed to 'Pembantu Hospital' (Hospital Assistant) and subsequently to 'Medical Assistants' in 1985. Currently, and since 2007, they are called 'Penolong Pegawai Perubatan' (Assistant Medical Officers).

The profession with similar scope of practices to Assistant Medical Officers (AMO) is Physician Assistants (PAs) in the United States. PAs are mainly placed in primary health care settings, Emergency Departments and subspecialty areas in hospitals. Similar profession to the AMOs in Malaysia is also found in other countries with variations of the role with comparable scopes of practice.

An AMO works in hospitals and community clinics and is responsible for providing health services comprising of promotion, prevention, curative and rehabilitative under the supervision of Medical Officer. The role of the AMO is divided into primary and secondary roles as follows:

a. Primary Role

i. To screen (triage) all the patients
ii. To check, diagnose and provide treatment for uncomplicated cases
iii. To counsel and provide health education to the patient and the surrounding/local community

An AMO also provides initial first aid & treatment in any emergency condition in the following areas:

- Health clinics
- Community clinic
- National Service camps
- Sport schools
- Estate clinics
- Immigration (health screening)
- Higher learning institutions
- Community Health Services
- Health camps and
- Oil rigs

b. Secondary Role

The AMO provides services in specialized and sub-specialized areas under the medical programs related to public health. The areas are:

i. Wellness programs
ii. Communicable diseases programs (TIBI, H1N1, HIV)
iii. Non-Communicable diseases programs (Diabetics, hypertension, asthma, cardiovascular)
iv. Specialized services in a medical program such as Emergency, Medical, Surgical, Orthopaedic, Cardiology, Cardiothoracic, Haemodialysis, Respiratory, Ophthalmology, Ear, Nose & Throat (ENT), Dermatology, Obstetrics & Gynaecology, Urology, Paediatrics, Anaesthesiology, Forensic, Psychiatric and organ transplant and others.
v. Sub-specialized services in Neurophysiology, plastic surgery, micro hand surgery, spinal surgery and nuclear medicine.
vi. Professional training, in-service training
vii. Research and quality assurance
viii. Enforcement and monitoring practitioners

The results on projections of supply and requirement for AMO were particularly based on initial data of AMO population as of 2015 summarized in Table 7

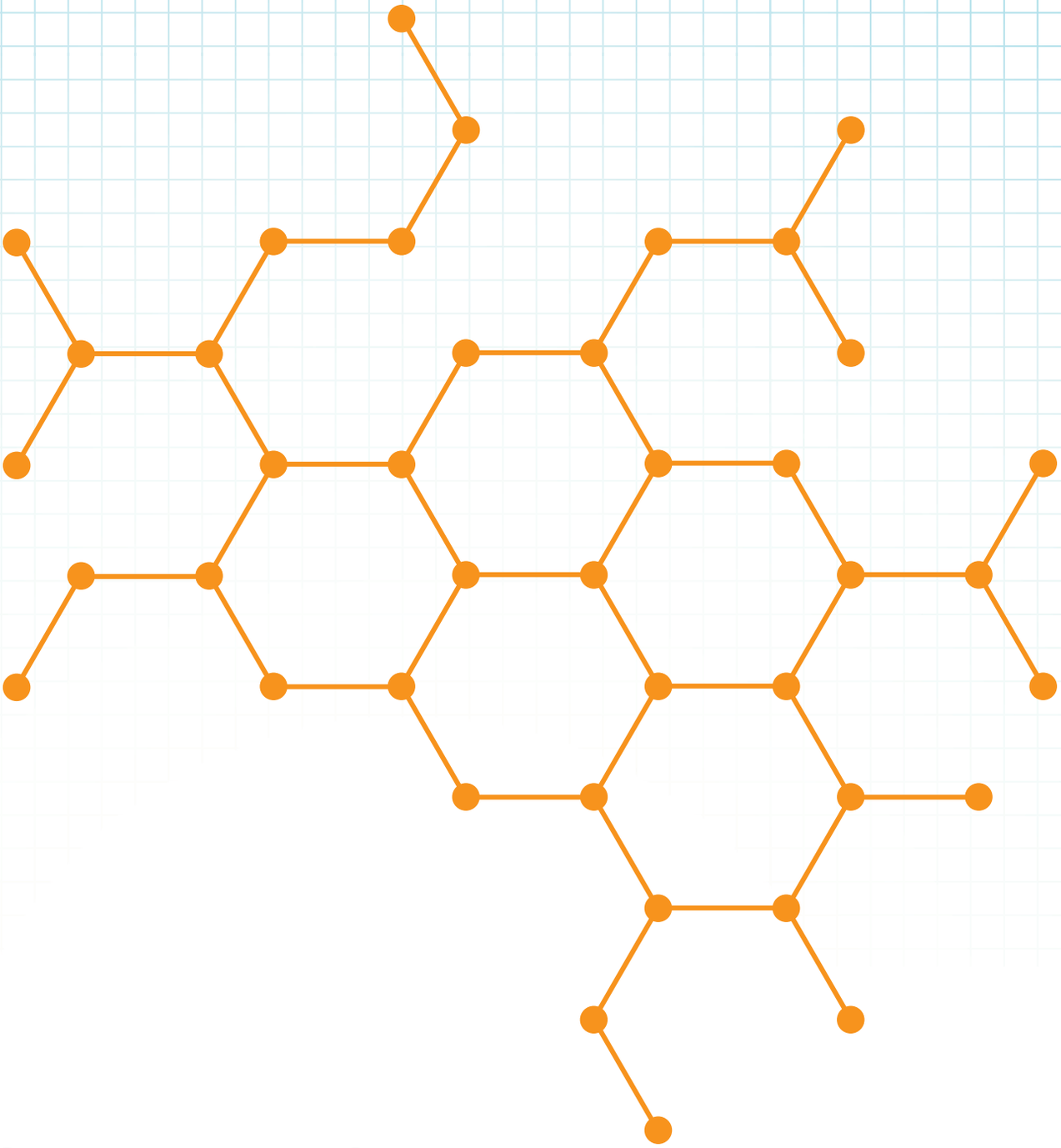
Table 7: Key facts on Assistant Medical Officers (AMOs) in Malaysia, 2015

Total number of AMO in Malaysia	14,724
• Total number of AMO in Ministry of Health	12,198
• Total number of AMOs in other government agency	896
• Total number of AMO in private sector	1,630
AMO to population ratio	1:2070

Source: Ministry of Health, 2016

Actual New Registered AMOs	1,702
Annual Renewal Certificates	12,141
Actual Total Registered AMOs	18,647
Male to female ratio	90% male, 10% female

Source: Medical Assistant Board



2

MODELLING AND PROJECTION METHODOLOGY

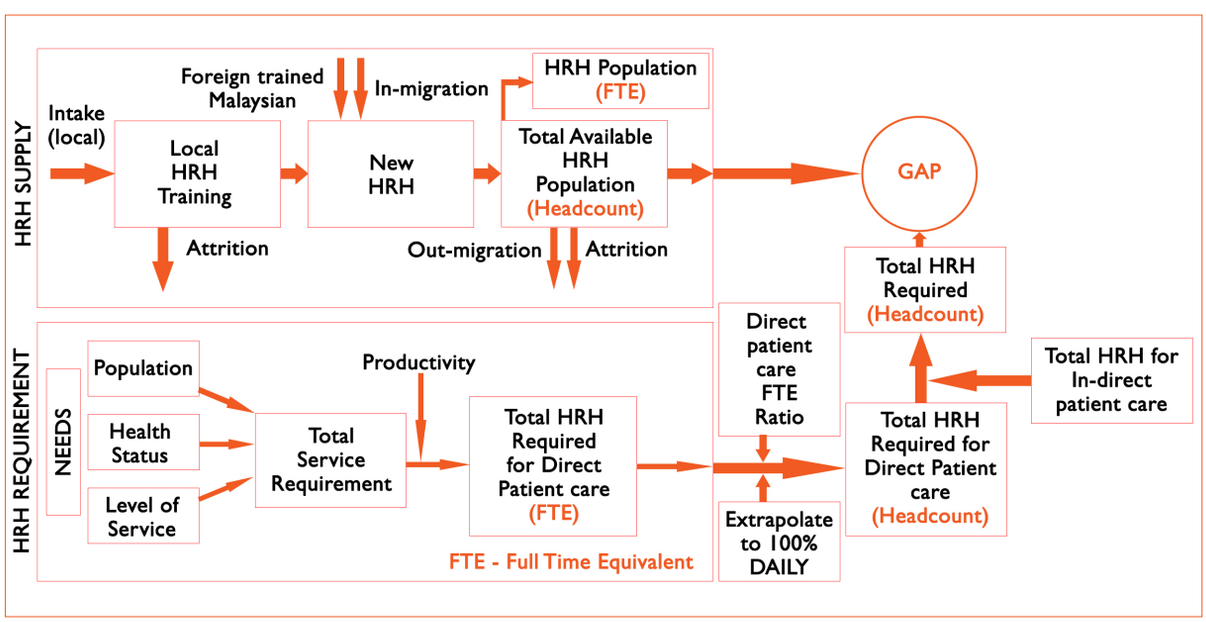
SUPPLY AND NEEDS-BASED REQUIREMENT PROJECTIONS OF HUMAN RESOURCE FOR HEALTH IN MALAYSIA USING SYSTEM DYNAMICS APPROACH 2016 – 2030

MODELLING AND PROJECTION METHODOLOGY

A major task in an informed and evidence-based HRH workforce planning is to model and project analytically the future supply and requirements of HRH, and to choose the right interventions that minimize the imbalance. It is a challenging task since it involves many factors and uncertainties which may include the demography, epidemiology and population health status, composition and distribution of the health workforce, workforce training issues, migration of health workers, public expectations, level of economic development, and culture.

In this study, the HRH workforce forecasting was carried out based on the framework adapted from Birch et al. (2007) and Tomblin-Murphy et al. (2009) as shown in Figure 5. There are three main modelling components in the framework: the HRH Supply, HRH Requirement and the Gap models.

Figure 5: Integrated modelling framework of HRH Supply and Requirement Projections



Adapted from Birch et al., 2007; Tomblin-Murphy et al., 2009

The HRH requirements model, on the other side, was constructed based on the Need-based approach which, as described by WHO (2010), is one of the most widely used requirements projection models. This approach explores likely changes in not only population demography but also population needs for health services, based on changes in patterns of disease, disabilities and injuries and the numbers and kinds of services required to respond to these outcomes. It estimates HRH requirements based on the population growth, health status, level of services, and productivity of health personnel (Birch et al., 2009; Murphy et al., 2001). It has also been applied in Canada ((Birch et al, 2007; Tomblin-Murphy et al, 2008; Birch et al, 2009), United Kingdom (CfWI, 2012, 2013a, 2013b, 2014b, 2014c), and Europe (Ono et al., 2013).

It is noted that there are many other common approaches used for requirements projections, as reviewed among others by Dreesch et al. (2005) and Birch et al. (2007), which include namely:

(i) The workforce-to-population ratio-based approach: This is a simple projection of future numbers of required health workers based on proposed thresholds for workforce density (e.g. 25 doctors per 10,000 population or 1:400 ratio). This approach is least demanding in terms of data but does little to explicitly address other key variables, aside from population growth, that can be expected to affect the type and scale of future health services provision and the associated workforce. This approach is based on the assumption that there is homogeneity at the levels of the numerator (all doctors are equally productive and will remain so) and of the denominator (all populations have similar needs, which will remain constant). Such assumptions are certainly risky.

(ii) The service demands (utilization) based approach: This approach draws on observed health services utilization rates for different population groups, applies these rates to the future population profile to determine the scope and nature of expected demands for services, and converts these into required health personnel by applying established productivity standards or norms. With the demand-based approach, the future requirements are estimated based on the current utilization level of provided services and future demographic projection. The advantage of this approach is it allows the projection of requirements to implement based on little to no changes in the utilization rate and population growth. However, the approach fails to recognise that more patients do not know that they need the health care service or did not seek health care service when they need it in reality. This approach includes only those patients who present themselves in the hospital.

(iii) The service targets (facility) based approach: This is an alternative approach that specifies targets for the production (and presumed utilization) of various types of health services and the institutions providing them based on a set of assumptions, and determines how they must evolve in number, size and staffing per productivity norms. This approach converts these targets into human resources required by the mean of staffing, facilities and the productivity standard. This approach assumes that the standard of each service is achievable and practicable through the projection time scale. The limitation, however, is that the resources produce minimal results in the population needs and potentially causes the unrealistic assumptions for the needs.

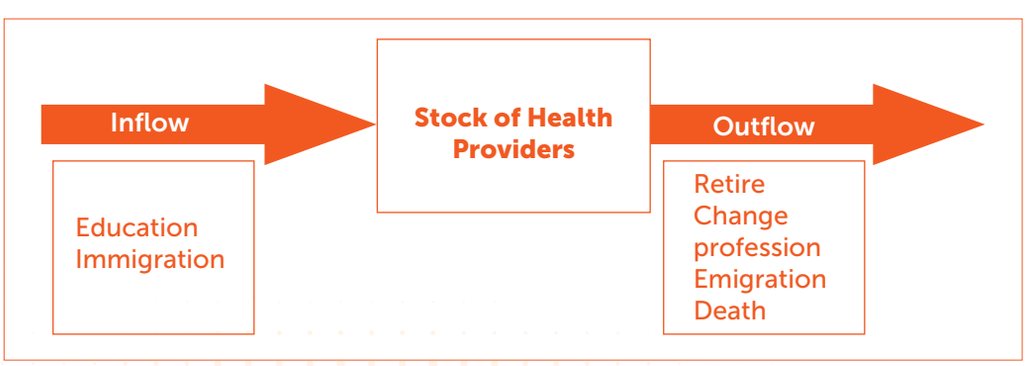
However, based on the comprehensiveness of the underlying factors that are taken into account in estimating HRH requirements, and the belief that one of the objectives of a health system must be to address the health care needs of its population, the needs-based approach was judged the most appropriate approach to be used. This study is the first study that used a needs-based approach in projecting HRH workforce supply and requirements in the Malaysian context. This study also is the first study that used System Dynamics (SD) simulation modelling approach, instead of using MS Excel tool, to develop and integrate the supply and the needs-based requirements projection models. SD is known to be a dynamic and flexible method, widely used for modelling complex problems. It has been used in many workforce planning studies in Canada and the United Kingdom (Birch, 2007; CfWI, 2013b, 2013c, 2014b).

The following sections provide, in a more detail, the modelling methods and processes carried in this HRH workforce modelling and projection study.

2.1 The HRH Workforce Supply Modelling: The In-and-Out Flows Approach

The supply or availability of HRH is conceptually simpler to estimate and project. The supply projection model is devoted to identifying how many HRH are or will be available to deliver health services to the population. It requires careful calculation of the numbers of new entrants into the health workforce, the capacity to produce more or fewer health workers in the future and recruit them into the health services industry, and the loss rates through retirement, emigration, death or pre-retirement leaving. This way of supply calculation may be called formally, as the In-and-Out Flows approach as illustrated in Figure 6. The inflows may include the graduated workforces from local and overseas universities, and in-migrations workforce and the outflows are workforces who leave the system due to complete retirement, change in profession, emigration or death.

Figure 6: The In-and-Out Flows approach for HRH workforce supply projection



With the In-and-Out Flows approach, the total available supply of HRH at time t, M^t, is determined by adding the inflows of HRH at time t, In^t, and subtracting the outflows of HRH at time t, O^t, to the total available supply of HRH in the previous time period, Mt^{-1}, or

$$Mt = Mt\text{-}1 + Int - Ot$$

Here, M^t represents the total headcounts of available HRH workforce at time t.

2.2 HRH Requirement Modelling: The Needs-based Approach

With the needs-based approach, the requirement of HRH is estimated based on population, health care needs and have considered the following four main factors:

a) Demography (P_{ij}):

The P_{ij} represents the demographic elements of the whole population that captures the population size P by age group i and gender j.

b) Epidemiology (H_{ij}/P_{ij}):

The expression H_{ij}/P_{ij} introduces the levels and distribution of health care needs in the population explicitly as a determinant of HRH requirements into the projection framework. Here, H_{ij} represents the average level of needs of individuals in age group i and gender j.

c) Level of service (Q_{ij}/H_{ij}):

The expression Q_{ij}/H_{ij} represents the level of service determinant of HRH requirements where Q_{ij} is the level of healthcare services provided for each need of the population in age group i and gender j.

d) Productivity (N_{ij}/Q_{ij}):

The expression N_{ij}/Q_{ij} represents the inverse of the average level of productivity of HRH serving population group P_{ij}. It can be interpreted as the number of HRH required, N_{ij}, to serve the health service needs, Q_{ij}, of the population group, P_{ij}.

Suppose,

N^{rt}	:	Total HRH Requirements at time t
P_{ij}^t	:	Demography (Population size) at time t
$\left(\frac{H_{ij}}{P_{ij}}\right)^t$	:	Epidemiology status of population at time t
$\left(\frac{Q_{ij}}{H_{ij}}\right)^t$	:	Level of service provided by HRH at time t
$\left(\frac{N_{ij}}{Q_{ij}}\right)^t$	:	Productivity of HRH at time t
i	:	Age group
j	:	Gender

The total HRH requirement at time t, N^{rt} is given by,

$$N^{rt} = \sum_{ij} N_{ij}^{rt} = \sum_{ij} \left[\left(\frac{N_{ij}}{Q_{ij}} \right)^{t} \times \left(\frac{Q_{ij}}{H_{ij}} \right)^{t} \times \left(\frac{H_{ij}}{P_{ij}} \right)^{t} \times P_{ij}^{t} \right]$$

Here, N^{rt} is in the unit of Full Time Equivalent (FTE), and must be converted into headcount for gap analysis and planning purposes.

2.2.1 Need-based Approach

With the needs-based approach, the requirement of HRH is estimated based on population, health care needs and have considered the following four main factors:

2.2.2 Service Demand Approach

The service demand approach in this study applied the similar factors and models as in the needs-based approach. However, instead of provider's perspective in the epidemiology and level of service components, the utilisation data of healthcare services as well as service coverage for diseases / conditions were used as the input data. This approach allows the estimation of the HRH requirement based on the community's perspective of health care service needs.

2.3 Supply and Requirement Gap Analysis

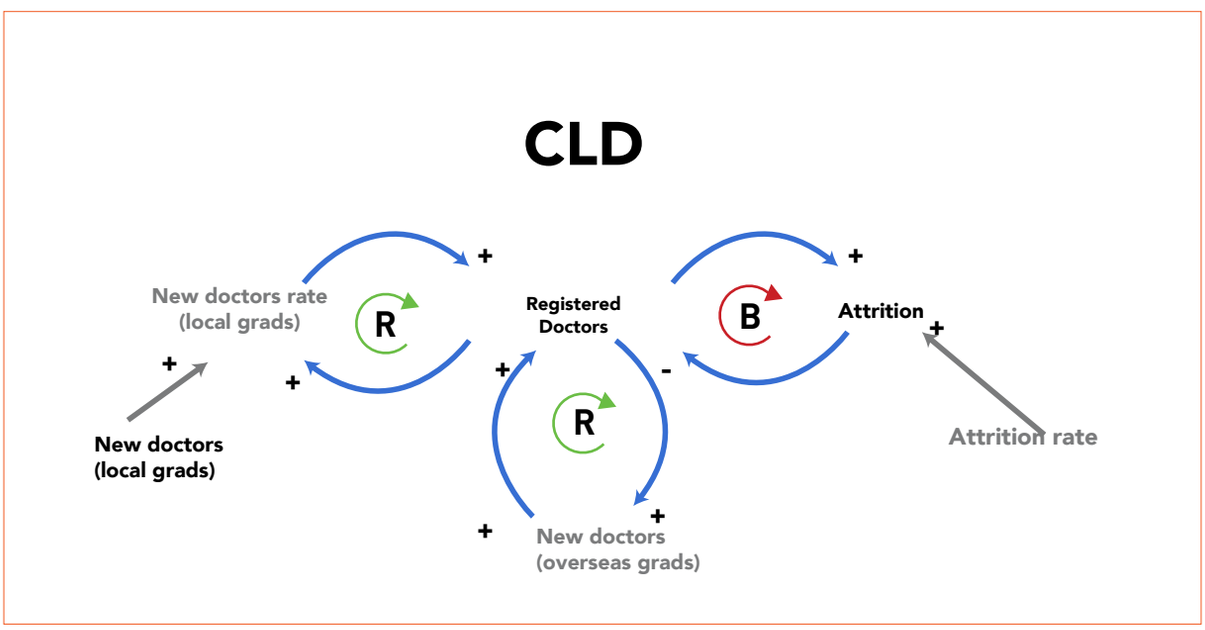
By integrating the supply and requirement models, it is then possible to conduct a gap analysis. Gap analysis is simply a comparison between the output from the supply model to output from the requirement model, which is the number of HRH supply and HRH requirement. The outputs are in full-time equivalent (FTE) and headcount unit. The difference of HRH supply to HRH requirement over 15 years from 2016 to 2030 is calculated and plotted to look at the trend and pattern of supply and requirement. In the event of substantial undersupply or oversupply, possible intervention can be simulated through scenario analysis. These analyses involve understanding the parameters in each model, the impact of gaps between HRH workforce supply and requirements, and find practical strategies and changes in policies to minimise the imbalance.

2.4 Application of System Dynamics Approach in HRH Workforce Modelling

Healthcare system is complex and interdependent, making the projections of HRH supply and requirements complex and difficult. It was, therefore, decided to use the System Dynamics (SD) approach for developing the HRH supply and needs-based requirement projection models. SD is a collaborative simulation modelling approach that has been used for many years to support significant planning decisions in the healthcare systems worldwide (Birch, 2007; CfWI, 2013b, 2013c, 2014b). It enables complex HRH workforce supply and requirement to be better understood and their behaviour over time to be quantified and projected using computer simulation. With SD, not only that complex processes are able to be represented and integrated with the complex datasets, its ability to represent a system graphically, stakeholders can readily be involved in the modelling and validation processes. This study used Vensim software as a tool to build the SD-based HRH projection models.

Fundamentally, SD deals with stocks and flows, internal feedback loops, and time delays to represent the structure of the system that affects system behaviour that changes dynamically over time. Stocks and flows are used to describe the units flowing through the system with flows affecting the stock levels. A "stock" is a quantity that either grows or depletes over time, a "flow" is a connector that drives the increase or decrease of a stock. In summary, three key concepts in system dynamics approach System Thinking, Feedback Loop, and Stock and Flow. Two key SD diagramming tools are used to assist in translating system structure into the model structure, the Causal Loop Diagram (CLD) and Stock and Flow Diagram (SFD), as illustrated Figure 7 in and Figure 8 .

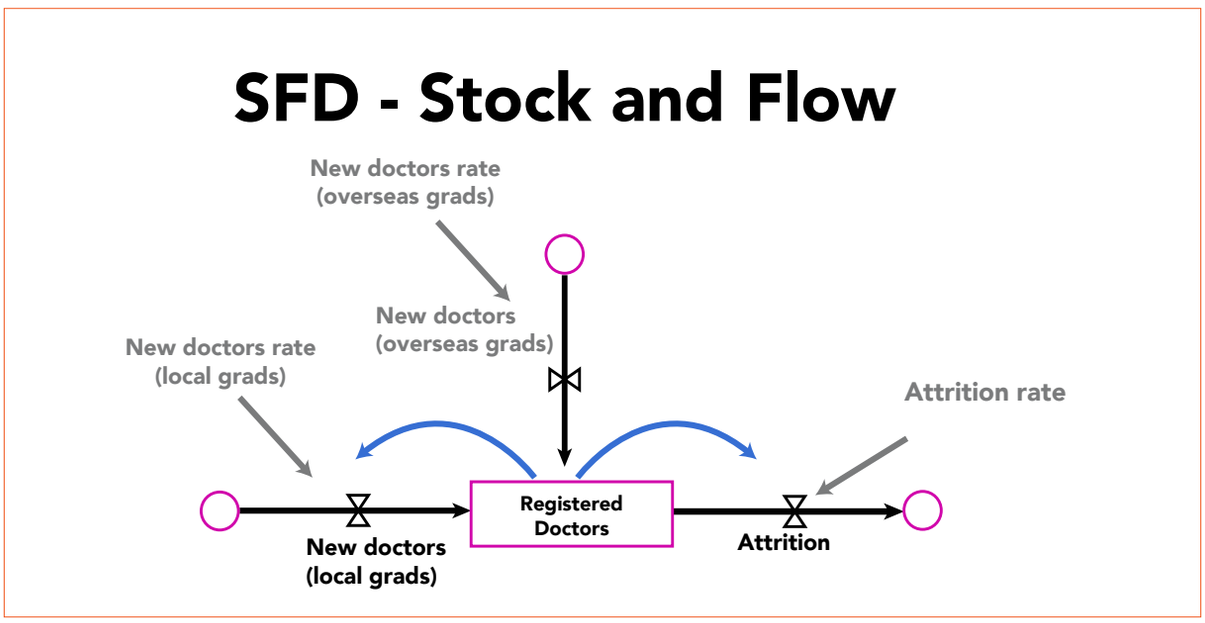
Figure 7: The Causal Loop Diagram for Basic Registered Doctor Supply



The CLD in Figure 7 illustrates a simple doctor supply system. The increase in the number of medical graduates (both from local and overseas) increases the number of registered doctors available. The increase in the number of attritions, on the other hand, decreases the number of registered doctors.

While the advantage of CLD is the simplicity of its diagrammatic conventions for representing and communicating the major circular causality mechanism, this simplicity is a limitation because it does not distinguish between the different types of variables such as stocks, flows and information. SD then uses SFD as the basis for building simulation models for quantitative analyses.

Figure 8: The Stock and Flow Diagram for doctor supply.



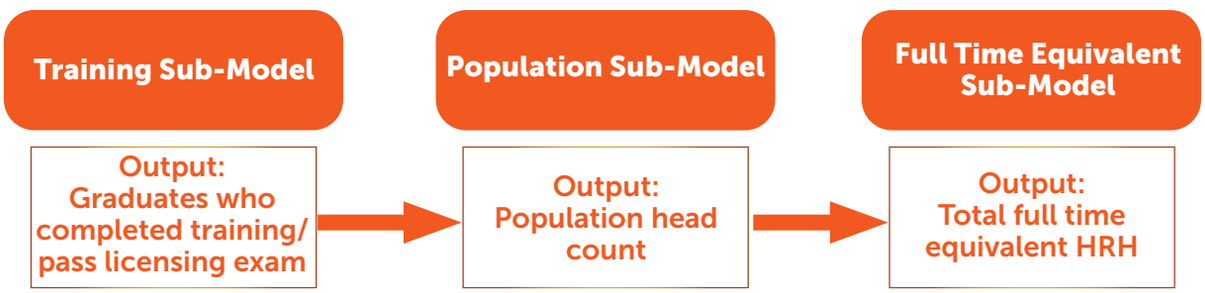
The SFD in Figure 8, can be created directly using Vensim software, one of the SD software tools available in the market. In SFD (as well as in Vensim) the box represents the stock (level), the double arrows (the arrow with valve/regulator symbol) represent the flows (resource or material). Single arrows represent information links (or information flows). The cloud-like symbols to the left of the New Doctors flow and the right of the Attrition flow are the source and the sink, respectively. The source and the sink mark the boundary of the system.

In this project, various Programs and Divisions from the Ministry of Health including Planning Division, Institute Health System Research, and experts in SD modelling from public universities, were together developing the system dynamic models based on the modelling framework given in Figure 5. The models were to be used to provide the supply and requirement projections of five selected professions, namely Doctors, Dentists, Pharmacists, Nurses, and Assistant Medical Officers.

2.4.1 The Supply Model

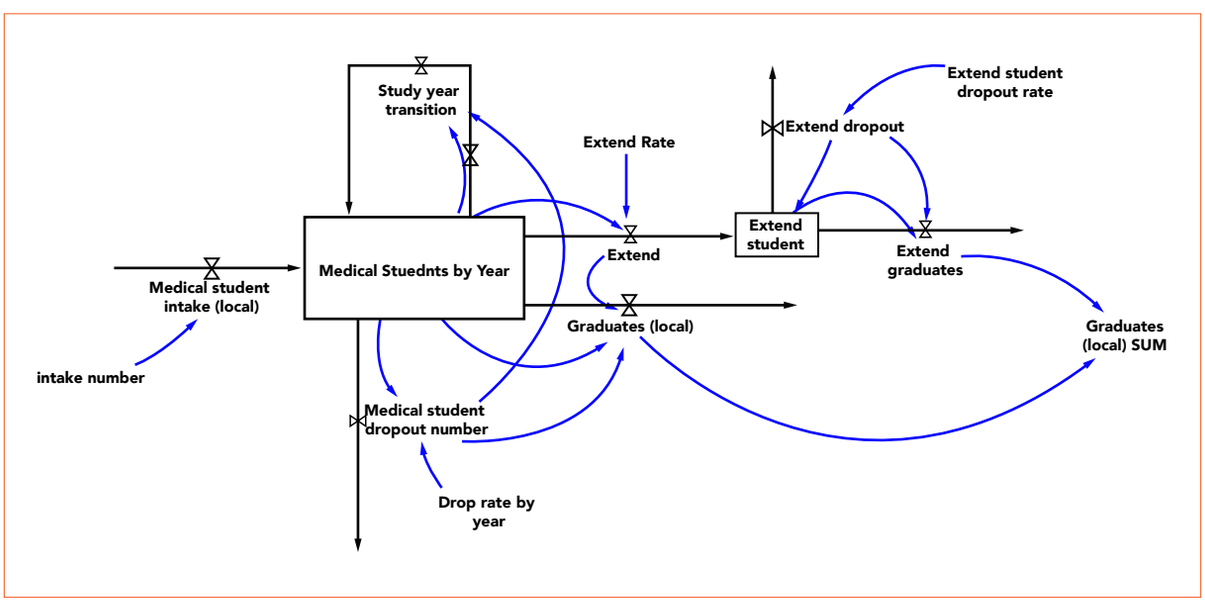
The system dynamics approach has been applied to develop the supply model. The supply models for all the five selected professions have a common model structure. It consists of three (3) sub-models; Training, Population and FTE as illustrated in Figure 9.

Figure 9: HRH Training Sub - Model



The following Figure 10, Figure 11, Figure 12 and Figure 13 show the SD-based training, population and FTE sub-models of the Doctor Supply Model developed in this study to project the supply of doctors.

Figure 10: Doctor Supply Model (Training Sub-Model)



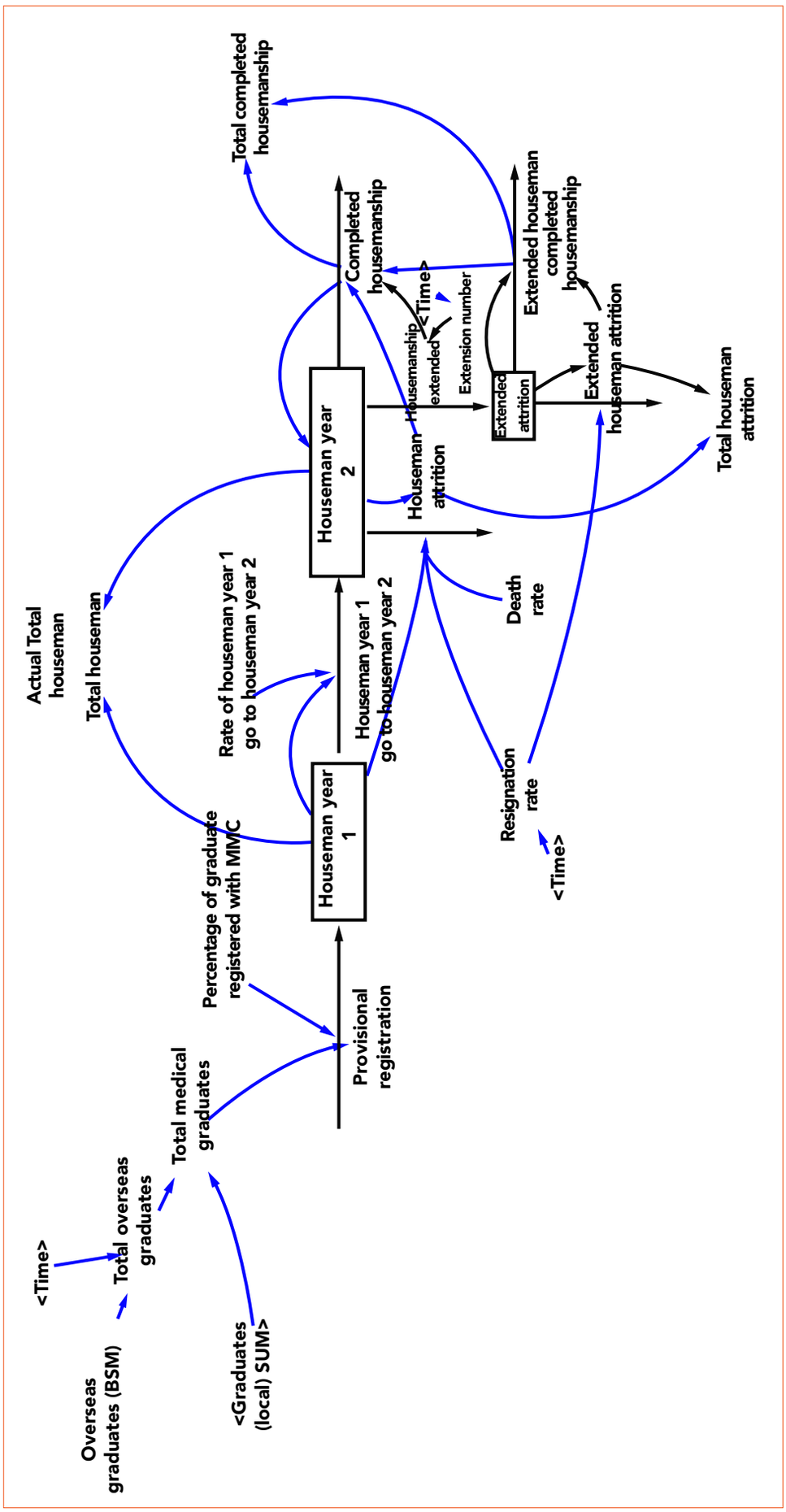


Figure 11: Doctor Supply Model (Training Sub-Model-Housemanship) - continued

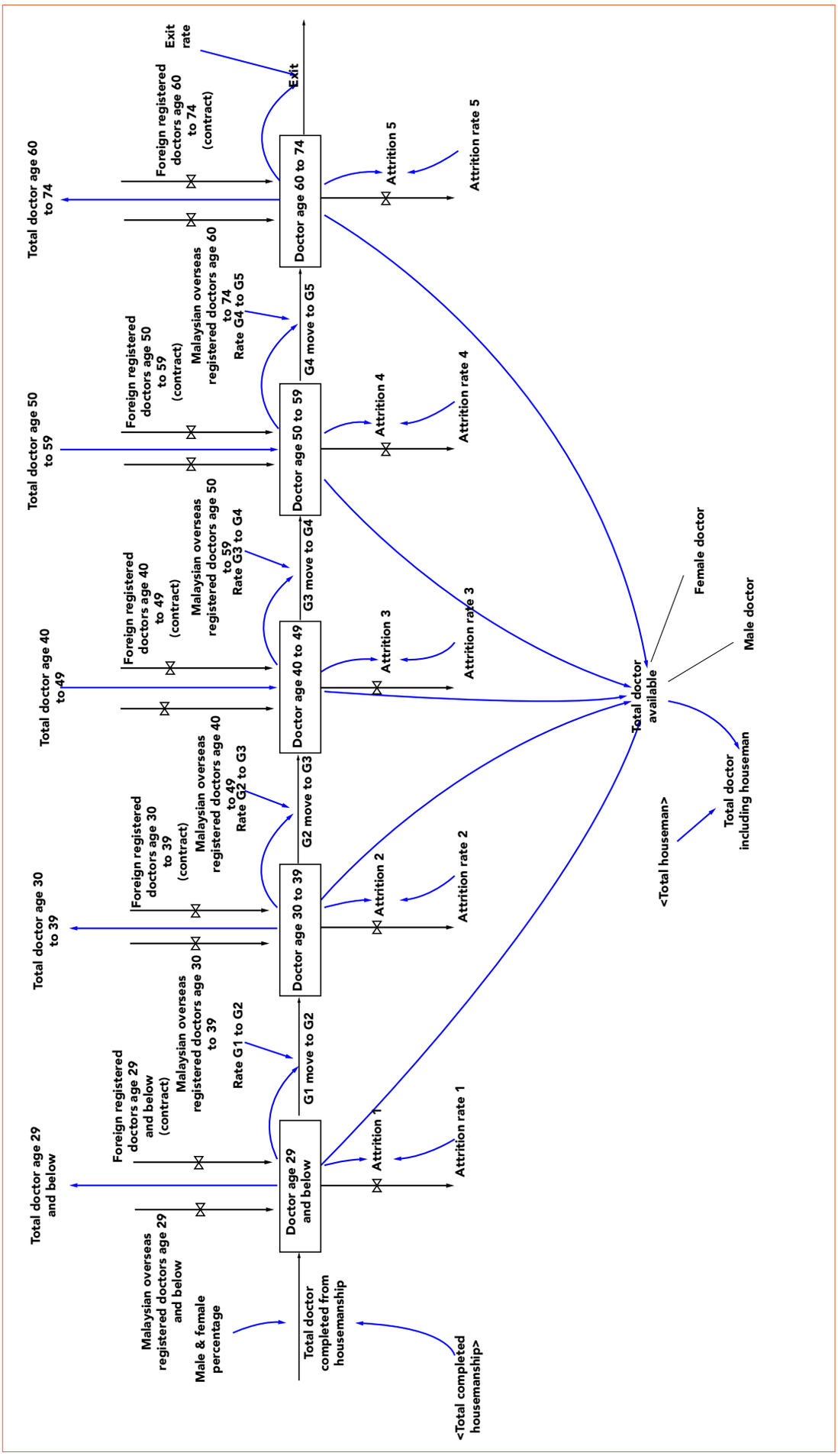


Figure 12: Doctor Supply Model (Population Sub-Model)

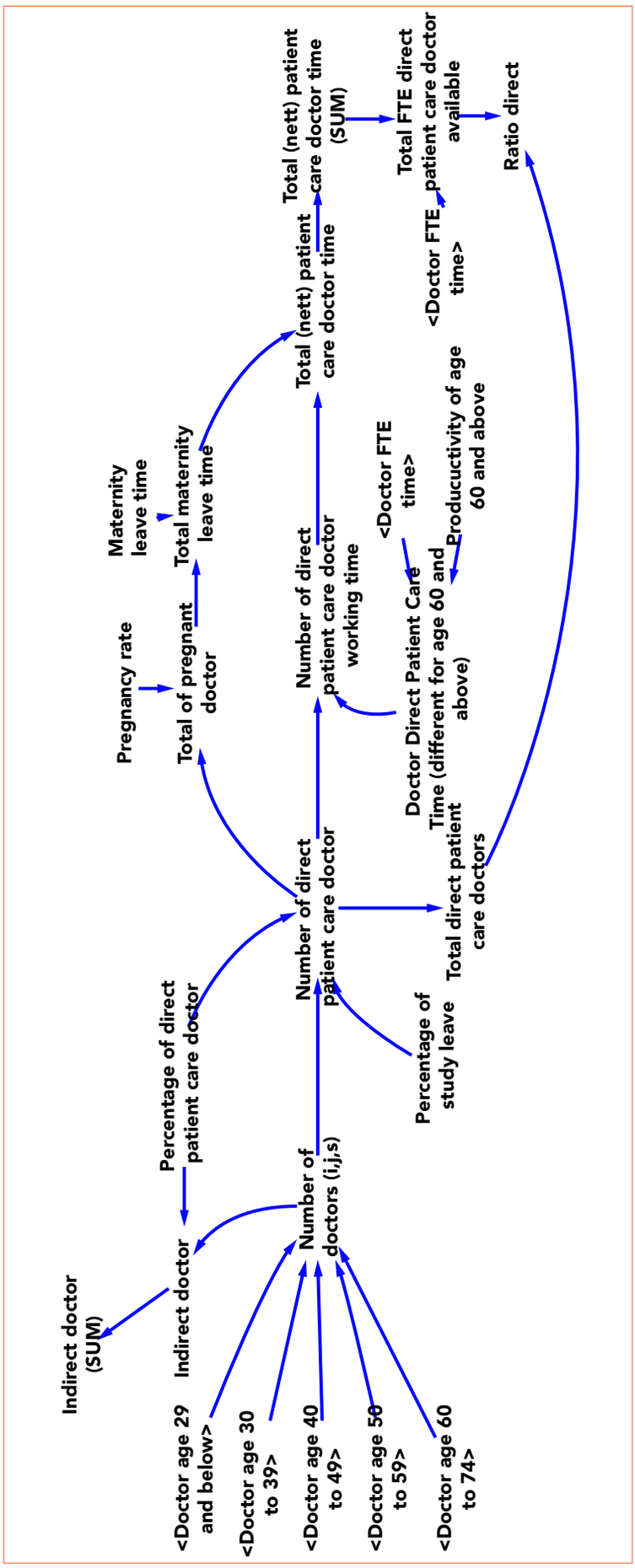


Figure 13: Doctor Supply Model (FTE Sub-Model)

2.4.2 The Requirement Model

The Needs-based requirement model for each selected health profession was also developed using the system dynamics approach. The requirement model was used to determine the number of HRH workforce required to attain the population health care needs (as opposed to health care demand/utilisation). The needs are derived from the factors included in the Needs-based approach and defined from the perspective of health care providers. In this study, however, the term health care 'demand' was used in what-if scenario analysis to refer to the 'adjusted need' which is defined as the health care needs adjusted to follow closely the current health care utilisation.

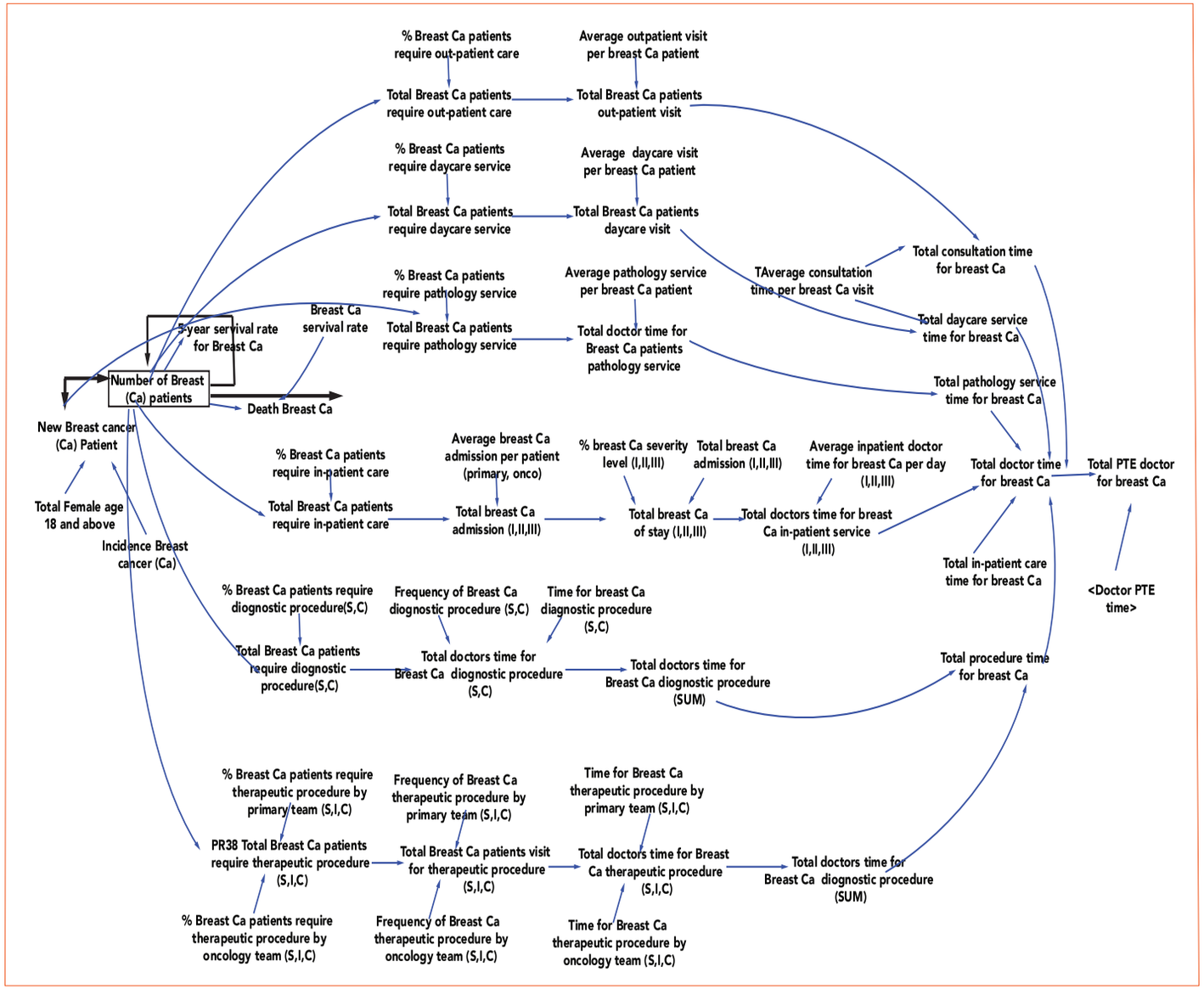
The requirement models for all professions were structured based on three (3) categories of Malaysian common health care provider's services which were the preventive care, disease-based care, and other health care services. Each of these categories were further broken down into relevant sub-categories, each to correspond to the requirement sub-models, as detailed in Table 8, Table 9, Table 10, Table 11 and Table 12 for Doctor, Dentist, Pharmacist, Nurse and AMO, respectively. Note that the requirement models for Pharmacist, Nurse and AMO are heavily based on output from the Doctor's requirement model. The sub-models listed in table 4c, 4d and 4e are additional and specific to Pharmacist, Nurse and AMO. Figures 10a, 10b and 10c are samples of SD-based requirement model for Doctor, Dentist, Pharmacist, Nurse and AMO, respectively.

Table 8: Requirement Model (Sub-Models) for Doctor

REQUIREMENT MODEL (Doctors)		
Service Category	**Sub-Model**	
1. Preventive Care	1. Antenatal care 2. Delivery 3. Child health 4. School health 5. Women's health 6. Family planning	7. Men's health 8. Quit smoking 9. Special purpose medical check-up 10. Adolescent screening 11. Elderly screening
2. Disease-based care	1. Breast cancer 2. Mouth & oropharynx cancer 3. Oesophageal cancer 4. Stomach cancer 5. Colon & rectum cancer 6. Liver cancer 7. Pancreas cancer 8. Trachea, bronchus & lung cancer 9. Cervical cancer 10. Ovarian cancer 11. Prostate cancer 12. Bladder cancer 13. Brain & other central nervous system cancer 14. Lymphoma 15. Leukaemia 16. Tuberculosis 17. Syphilis 18. Chlamydia 19. Gonorrhoea 20. HIV 21. Diarrhoeal diseases 22. Diphtheria 23. Pertussis	24. Tetanus 25. Polio 26. Measles 27. Meningitis & Encephalitis 28. Hepatitis A 29. Hepatitis B 30. Hepatitis C 31. Other hepatitis 32. Malaria 33. Dengue 34. Lower respiratory infection (LRI) 35. Upper respiratory infection (URI) 36. Otitis media 37. Maternal haemorrhage 38. Maternal sepsis 39. Hypertensive disorder of pregnancy 40. Obstructed labour 41. Abortion 42. Low birth weight 43. Birth trauma & asphyxia 44. Neonatal infection 45. Protein energy malnutrition 46. Nutritional anaemia

REQUIREMENT MODEL (Doctors)		
Service Category	**Sub-Model**	
2. Disease-based care	47. Benign neoplasm 48. Diabetes mellitus (DM) 49. Endocrine, nutritional, blood & immune disorder 50. Unipolar depressive disorder 51. Bipolar affective disorder 52. Schizophrenia 53. Alcohol use disorder 54. Drug induce disorder 55. Anxiety disorder 56. Alzheimer's disease & other dementias 57. Parkinson's disease 58. Epilepsy 59. Glaucoma 60. Cataract 61. Hearing loss 62. Rheumatic heart disease 63. Hypertensive heart disease 64. Ischaemic heart disease 65. Cerebrovascular disease 66. Pericarditis, endocarditis & myocarditis 67. Chronic obstructive pulmonary disease 68. Asthma 69. Peptic ulcer disease	70. Appendicitis 71. Liver cirrhosis 72. Nephritis 73. Benign prostatic hypertrophy 74. Skin & subcutaneous disease 75. Rheumatoid arthritis 76. Osteoarthritis 77. Back pain 78. Spina bifida 79. Congenital heart anomalies 80. Cleft palate & lip 81. Down's syndrome 82. Other chromosomal abnormalities 83. Road traffic injuries 84. Poisoning 85. Falls 86. Fires, heat & hot substances 87. Drowning 88. Self-inflected injuries 89. Interpersonal violence / homicide 90. Hypertension 91. Hypercholesterolemia
3. Other medical care services	1. Forensic medicine 2. Emergency medical care	3. Health tourism 4. Domiciliary care

Figure 14: Doctor Requirement Model (Breast Cancer Sub-Model)



As can be seen in Table 8, population health care needs for rehabilitation medicine, palliative and geriatric care were not included in this study. Figure 14 shows the requirement sub-model for breast cancer. From this model, the required number of doctors (in FTE unit) for cancer disease care services can be projected.

Table 9: Requirement Model (Sub-Models) for Dentist

REQUIREMENT MODEL (Dentist)	
Service Category	**Sub-Model**
1. Preventive Care	1. Preventive Care
2. Disease-based care	1. Carries 2. Periodontal 3. Malocclusion 4. Trauma 5. Oral Cancer 6. Congenital

The following Figure 15 shows a sample of the system dynamics-based models that have been developed and used in this study to project the requirement for dentist.

Figure 15: Dentist Requirement Model for Carries

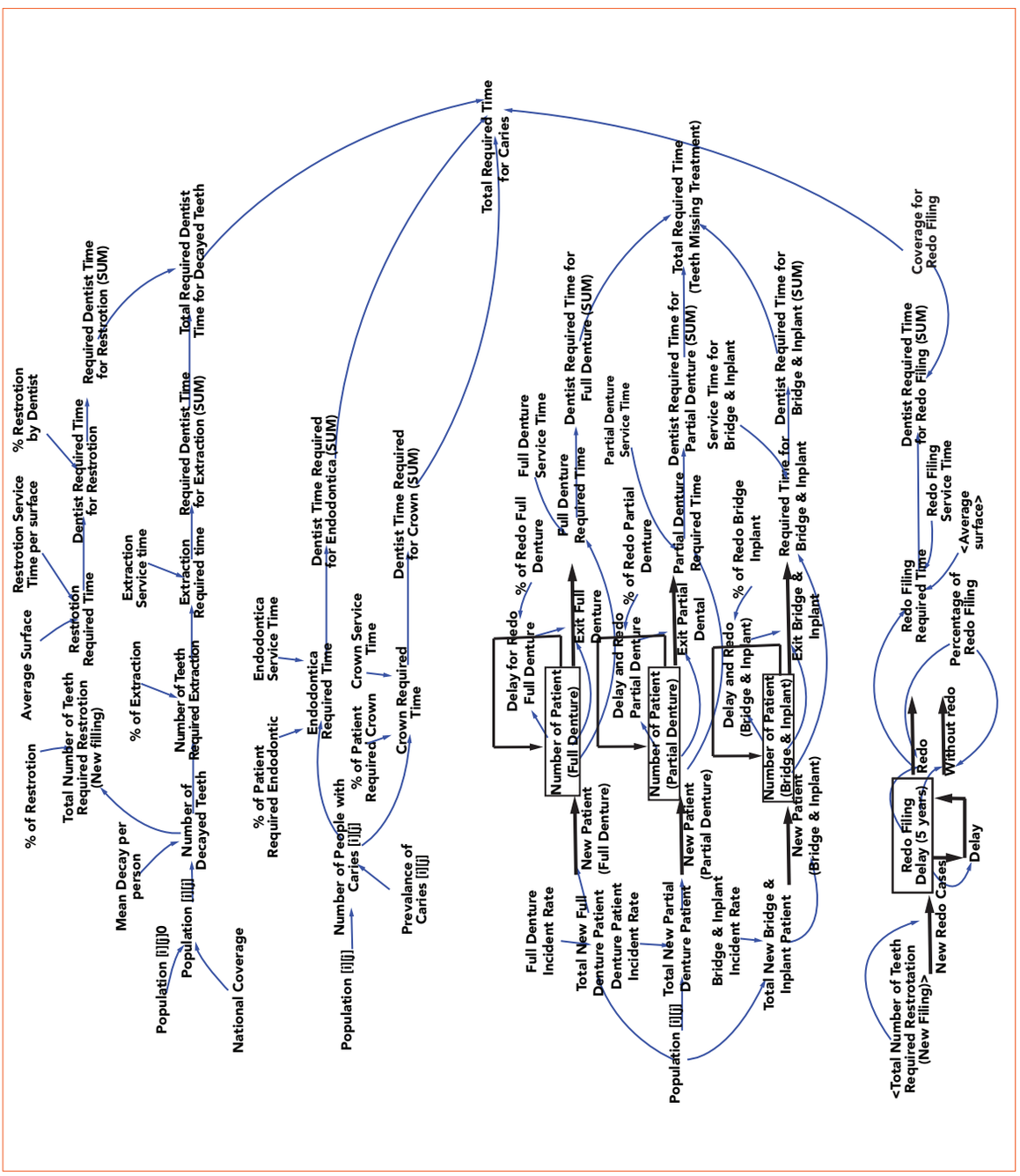


Table 10: Requirement Model (Sub-Models) for Pharmacist

REQUIREMENT MODEL (Pharmacist)
Sub-Model
1. Outpatient (Counselling, HMR, Methadone) 2. Medication Therapeutic Adherence Clinic (MTAC) 3. Inpatient Dispensing 4. Ward Pharmacist 5. Therapeutic Drug Monitoring (TDM) 6. Total Parenteral Nutrition (TPN) 7. Cytotoxic Drug Reconstitution CDR 8. Nuclear Pharmacy

The following Figure 16 shows a sample of the system dynamics-based models that have been developed and used in this study to project the requirement for pharmacists.

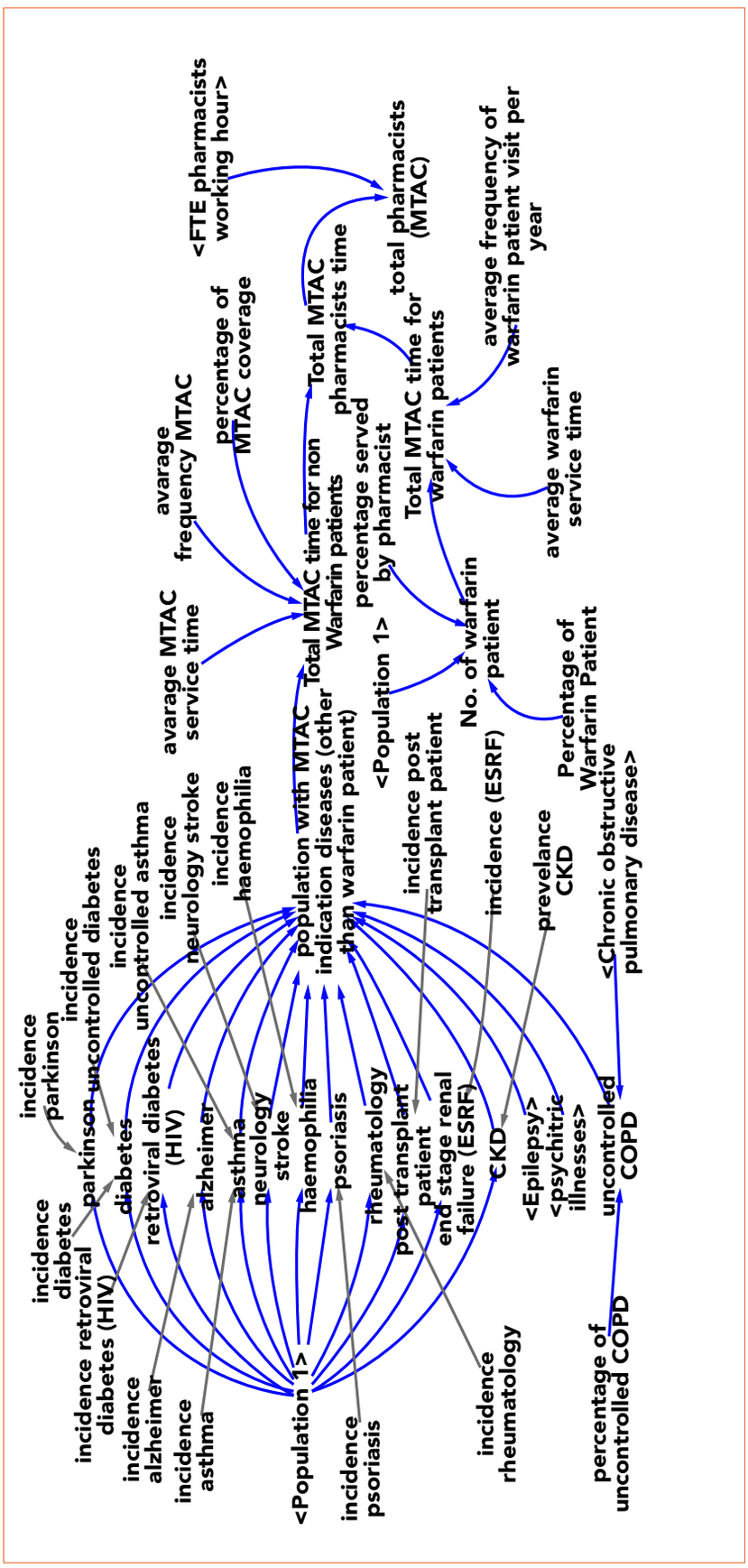


Figure 16: Pharmacist Requirement Model (Medication Therapeutic Adherence Clinic)

Table 11: Requirement Model (Sub-Models) for Nurse

REQUIREMENT MODEL (Nurse)	
Service Category	**Sub-Model**
1. Preventive care	1. Antenatal care 2. Delivery 3. Child health 4. School health 5. Women's health 6. Family planning 7. Post-natal care 8. Men's health 9. Special purpose medical check-up 10. Adolescent health 11. Domiciliary Care
2. Disease-based care	1. Inpatient 2. Outpatient 3. Procedure 4. Day care
3. Other medical care services	1. Emergency Services 2. Haemodialysis

The following Figure 17 shows a sample of the system dynamics-based models that have been developed and used in this study to project the requirement for nurses.

Figure 17: Nurse Requirement Model (Child Health)

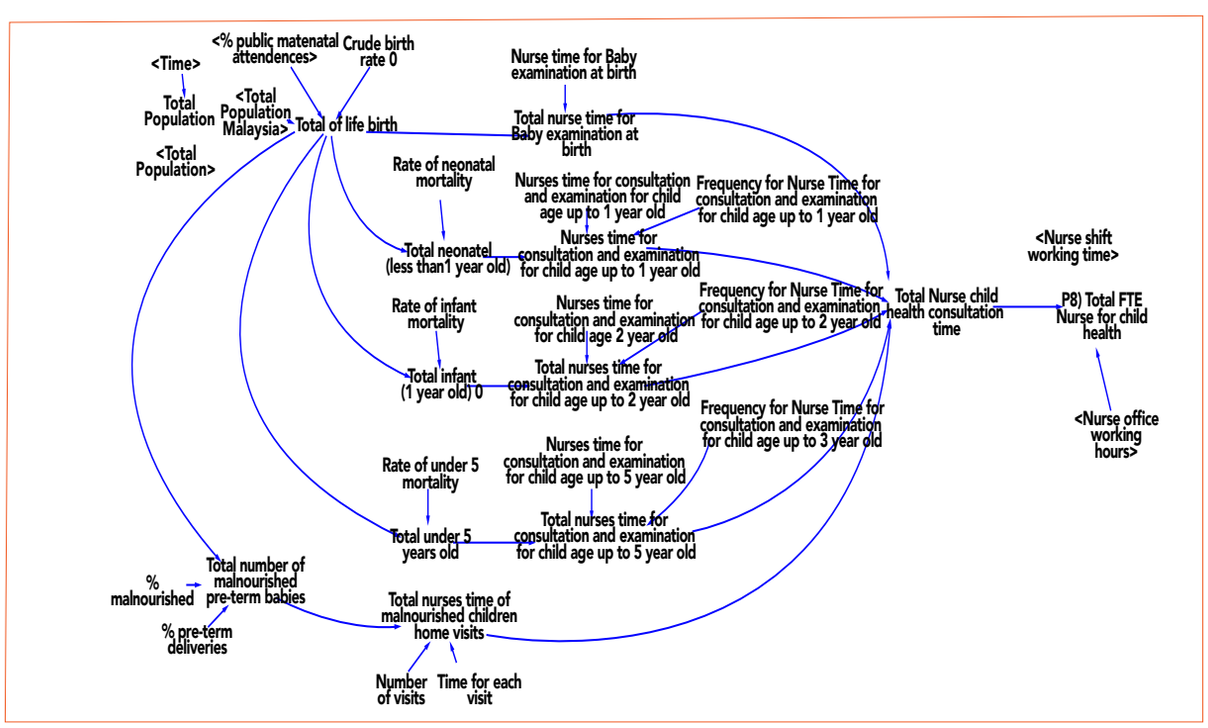
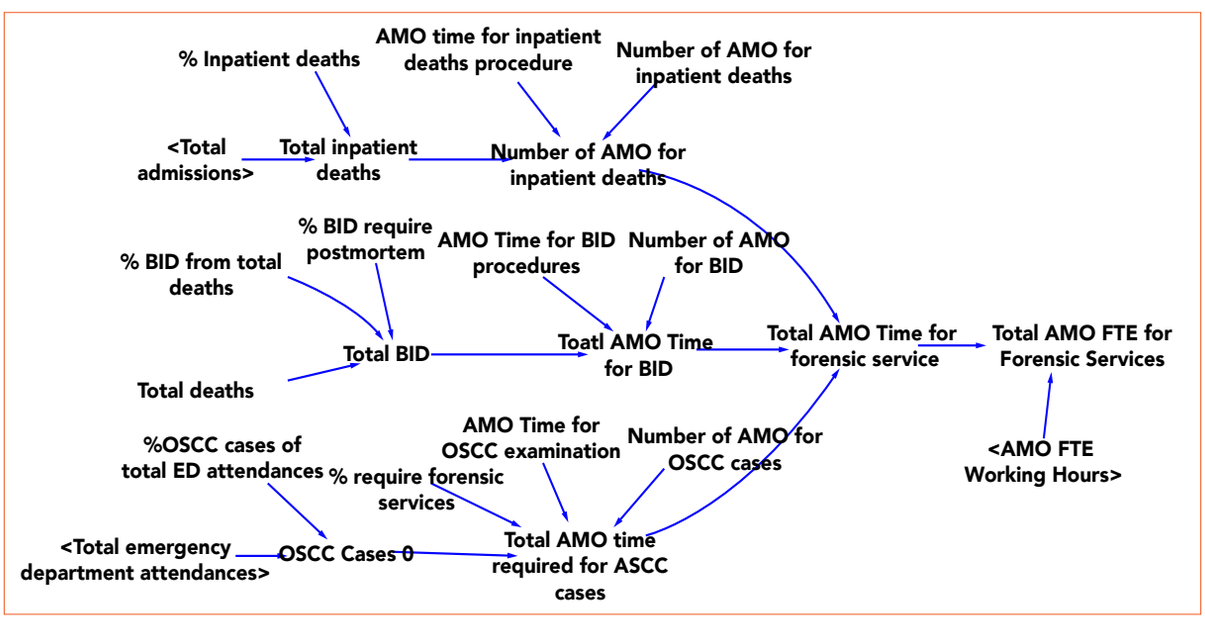


Table 12: Requirement Model (Sub-Models) for AMO

REQUIREMENT MODEL (AMO)	
Service Category	**Sub-Model**
1. Preventive care	1. School health 2. Child health 3. Men's health 4. Quit smoking 5. Special purpose medical check-up 6. Domiciliary care 7. Adolescent screening 8. Elderly screening
2. Disease Based Care	1. Outpatient 2. Procedure 3. Intensive Care Unit (ICU)
3. Others Medical Care	1. Forensic Services 2. Pre-Hospital Care 3. Psychiatry Services 4. Emergency Services 5. Haemodialysis

The following Figure 18 shows a sample of the system dynamics-based models that have been developed and used in this study to project the requirement for AMOs.

Figure 18: AMO Requirement Model (Forensic Medicine)



2.5 Data used in HRH Projection Modelling

Data to project supply and requirement of doctors, dentists, pharmacists, nurses and AMOs in this study were obtained from various combinations of primary and secondary sources. The study considered various data from multiple sources. Following are the broad list of data and data sources that were obtained and considered to be used in the study;

a) Training Sub-Model: Data on training including the number of student intakes, enrolment, drop-out, number of graduates by training institutions were obtained from Ministry of Education (Higher Education), medical faculty in local universities, MOH Training Management Division, education sponsorships agencies, councils / boards and MOH Human Resource Division.

b) Population Sub-Model: Data on total stocks, newly employed HRH, number of health professional by age group and gender as well as service data, which includes resignation, retirement and death, were obtained from councils / boards, MOH Human Resource Division, and MOH Training Management Division. Age-specific mortality rate was obtained from the Department of Statistic and article by Mohamad Adam Bujang et al. (2012).

c) FTE Sub-Model: Data on distribution of HRH in direct and indirect patient care, post-graduate and post-basic study and maternity leave was obtained from Ministry of Education (Higher Education), MOH Human Resource Division and MOH Training Management Division. HRH average working time was calculated based on working time for the civil servant as stated in General Order (Chapter G), and study on primary care establishment by Hwong et al. (2014).

d) Requirement Model:

- Incidence and prevalence of disease data from The Second Malaysian Burden of Disease and Injury Study (Institute of Public Health, 2012), National Health and Morbidity Survey 2015 (Institute for Public Health. 2015), Malaysia Global Adult Tobacco Survey 2011 (Institute of Public Health, 2011), National Oral Health Survey of Adults 2010 (MOH Oral Health Division, 2012).
- Survival rate and treatment modalities from disease registry (example; Cancer Registry, Renal Transplant Registry)
- Disease severity and length of stay for in-patient care from MOH Casemix system (Medical Development Division, 2012)
- The utilisation of healthcare services and service coverage data were obtained from National Health and Morbidity Survey 2015 (Institute for Public Health. 2015), Health Information Management System (Health Informatic Centre, 2013), MOH Family Health Development Division for preventive care services, Oral Health Programme, Pharmacy Services Division, MOH Forensic Service etc.

In the model development phase, multiple stakeholders such as Programme owners and experts in respective fields were consulted to construct the model. In addition, Clinical Practice Guideline (CPG) of services and Standard Operating Procedures (SOP) were used as a guide.

Table 13 and Table 14 show data source by model parameter and profession after a thorough data validation process. The data validation process is vital to sift through various data obtained from multiple sources as mentioned. During this process, stakeholder was consulted to assist in identifying the most suitable data to be used in the supply and requirement model.

If data is unavailable, inputs from expert opinions were used where Delphi method was applied in this study to obtain experts' opinion and consensus on the unavailable data. Following the Delphi method, engagement with clinical specialists, consultants, experienced health care professionals from relevant disciplines and sub-specialities was carried out in one-to-one sessions to obtain relevant data e.g. levels of service, including time and frequency for services offered. The one-to-one sessions with clinical specialists and consultants also facilitated improvements in the data collection template. For example, the pathology service data collection template was improved by input gained from the initial two sessions with pathologists from Hospital Kuala Lumpur. The improvised template enabled data collection for relevant diagnostic tests and tests for differential diagnosis, which may have been missed otherwise.

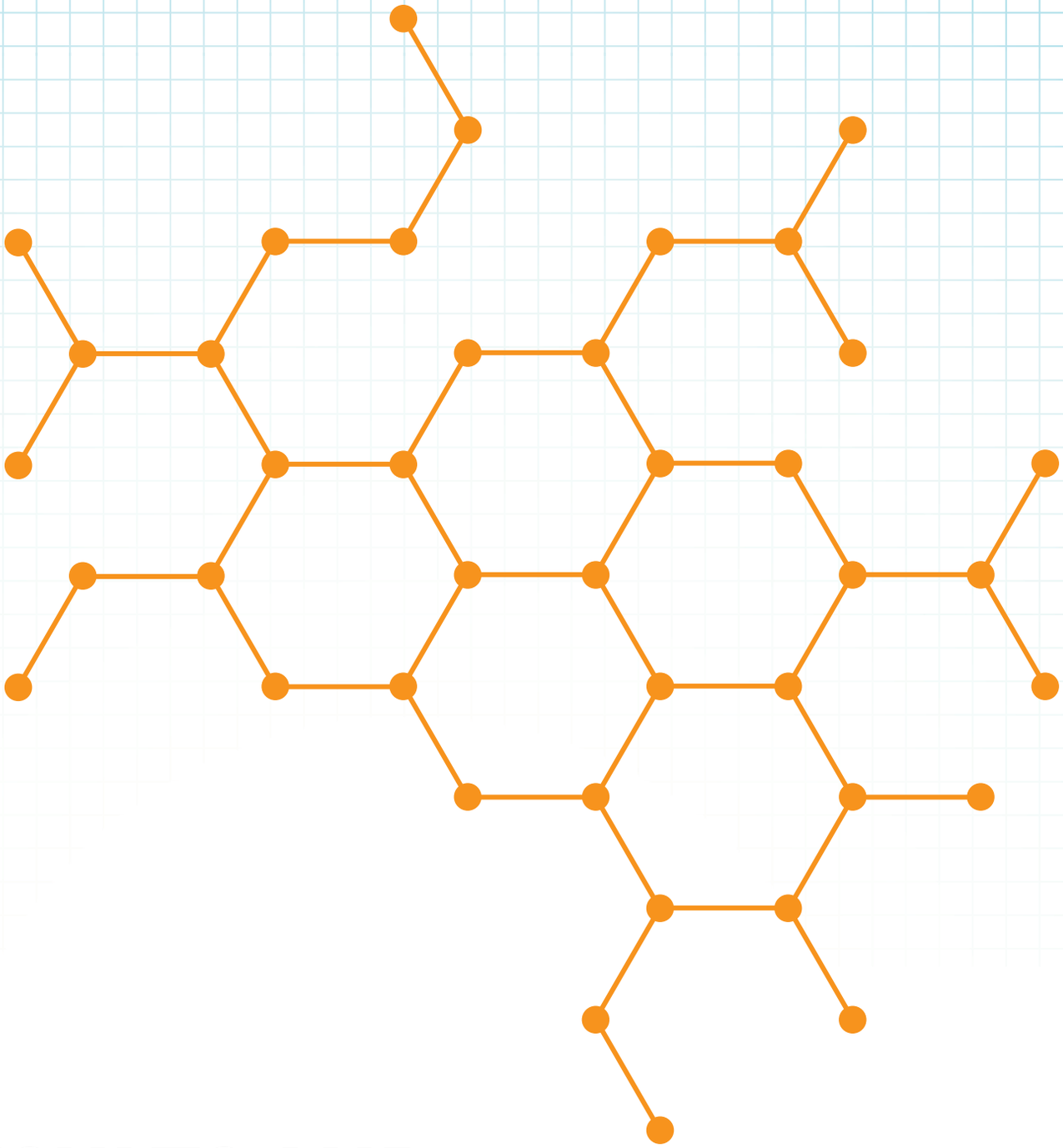
Subsequently, head of services, who were mostly consultants with sub-speciality training, convened to vet through the initial input data obtained through one-on-one engagement. This enabled discussions among consultants from various disciplines or sub-speciality to verify concerns where necessary and ultimately achieved consensus on the data that should be used.

Table 13: Main Data Source by Parameter and Profession in Supply Model

Supply Models Parameter	Main Data Source				
	Doctors	Dentists	Pharmacists	Nurses	AMOs
Student Intake (Local)	Number of Newly Employed HRH: Human Resource Division MOH			Number of Newly Registered: Malaysian Nursing Board	Number of Newly Regis-tered: Medical Assistant Board (MAB)
Student Dropout Rate	Expert Opinion from Boards / Councils and local university representative				
Foreign-trained Graduates	Number of newly employed foreign trained graduate: Human Resource Division MOH			Number of newly registered nurses overseas graduate: Malaysian Nursing Board	
Existing Stock	Number of HRH (total): Health Informatics Centre (2008-2017) Number of HRH (by age, gender): Councils / Boards				
Attrition Rate	Resignation Rate: Human Resource Division MOH Death Rate: DOSM Retirement Rate: Expert Opinion			Resignation Rate: Malaysian Nursing Board Death Rate: DOSM Retirement Rate: Expert Opinion	Death Rate: DOSM Retirement Rate: Expert Opinion
Percentage of Direct Patient Care HRH	Number of HRH in direct patient care: Staffing and distribution of staffs by facilities, state (MOH Human Resource Division, 2014)				
Pregnancy of HRH on study leave	Number of HRH on study leave: Training Management Division MOH				

Table 14: Main Data Source by Parameter and Profession in Requirement Model (Need and Demand)

Requirement Model Parameter	Main Data Source				
	Doctors	Dentists	Pharmacists	Nurses	AMOs
Population	Number of populations by age and gender: Malaysia Populations, 2010-2040 (Department of Statistics Malaysia, 2013)				
Epidemiology	Incidence and prevalence of disease and condition: • The Second Malaysian Burden of Disease and Injury Study (Institute of Public Health, 2012) • National Health and Morbidity Survey 2015 (Institute for Public Health 2015) • National Oral Health Survey (Oral Health Programme, 2010) - Dentist only				
Level of Service	Data on service coverage, proportion of cases base on disease severity, proportion of cases received care in public and private health professional and etc; • School health and family health data from Family Health 2013 Annual Report (Health Informatics Centre, 2014) • Report on MOH casemix, i.e. MalaysianDRG: Benefits realisation (Medical Development Division, 2012) • National Health and Morbidity Survey 2015 (Institute for Public Health. 2015) • Expert Opinion				
Productivity	Service time and working time: • Expert opinion on service time • Available working time used in Modified Workload Indicators of Staffing Needs study (Planning Division, 2016) • General Order (Chapter G) • Study on primary care establishment, which includes private facilities (Hwong et al. 2014).				



3
RESULTS AND DISCUSSIONS

SUPPLY AND NEEDS-BASED REQUIREMENT PROJECTIONS OF HUMAN RESOURCE FOR HEALTH IN MALAYSIA USING SYSTEM DYNAMICS APPROACH 2016 – 2030

FINDINGS, OBSERVATIONS AND RECOMMENDATIONS

This section summarizes, by profession, the key findings, observations and recommendations derived from the study.

Doctors

Dentist

Pharmacist

Nurse

Assistant Medical Officer (AMO)

DOCTOR

3.1.1 Doctor Supply Projection

Based on the baseline data from 2008 until 2015, it is projected that the number of doctor supply increases by 120.7%, from 50,087 doctors in 2016 to 110,523 doctors (including House Officers) in 2030 with an average increase rate of 6.3% each year over 14 years. The average rate of increase in the projected supply of doctors supersedes the average rate of increase in the total population, which is only at 1.1% growth per year. This resulted in an increased number of doctors in 10,000 populations. In 2016, the House Officers made up almost 16% (8,264) of total doctors in Malaysia and the percentage is projected to be reduced to only 9% (10,302) in 2030.

Table 15 presents the actual and projected number of doctor supply in Malaysia from 2015 until 2030.

Table 15: Supply of Doctors, 2015 – 2030

Year	ACTUAL			PROJECTION		
	Malaysia population	Doctor Supply		Malaysia population	Doctor Supply	
		n	Density per 10,000 population		n	Density per 10,000 population
2015	31,186,100	46,491	14.9	-	-	-
2016	31,660,700	50,087	15.8	30,875,400	51,988	16.8
2017	32,049,700	57,831	18.0	31,267,400	56,091	17.9
2018	-	-	-	31,659,700	60,344	19.1
2019	-	-	-	32,051,300	64,423	20.1
2020	-	-	-	32,441,200	68,484	21.1
2021	-	-	-	32,822,900	72,812	22.2
2022	-	-	-	33,200,600	77,136	23.2
2023	-	-	-	33,572,100	81,446	24.3
2024	-	-	-	33,936,900	85,737	25.3
2025	-	-	-	34,294,200	89,981	26.2
2026	-	-	-	34,644,700	94,182	27.2
2027	-	-	-	34,987,600	98,341	28.1
2028	-	-	-	35,322,700	102,452	29.0
2029	-	-	-	35,649,400	106,514	29.9
2030	-	-	-	35,965,700	110,523	30.7

3.1.2 Doctor Requirement Projection

In 2016 it was projected 78,142 number of doctors are required to provide health care services based on needs. If every parameter remains constant, the total doctor requirement based on population health care needs increases by 27.9% in the next 14 years. In 2030, the doctor requirement based on needs projected to be 99,942 doctors (Table 16).

Table 16: Doctor Requirement Projection Based on Needs, 2016 - 2030

Year	Malaysia population	Doctor requirement (Need)		Doctor requirement (Demand)	
		n	Density per 10,000 population	n	Density per 10,000 population
2016	30,875,400	78,142	25.3	62,117	20.1
2017	31,267,400	80,462	25.7	64,194	20.5
2018	31,659,700	82,573	26.1	66,067	20.9
2019	32,051,300	84,465	26.4	67,709	21.1
2020	32,441,200	86,100	26.5	69,107	21.3
2021	32,822,900	87,500	26.7	70,271	21.4
2022	33,200,600	88,859	26.8	71,399	21.5
2023	33,572,100	90,219	26.9	72,524	21.6
2024	33,936,900	91,567	27.0	73,638	21.7
2025	34,294,200	92,905	27.1	74,747	21.8
2026	34,644,700	94,262	27.2	75,873	21.9
2027	34,987,600	95,651	27.3	77,026	22.0
2028	35,322,700	97,053	27.5	78,195	22.1
2029	35,649,400	98,487	27.6	79,391	22.3
2030	35,965,700	99,942	27.8	80,607	22.4

Besides Need, it is also crucial to identify the requirement of doctor based on population health care demands. Health care demand is a reflection of population health-seeking behaviour, which translated into the utilisation of health care services. Based on available data on health care utilisation, doctor requirement based on demand projected to be at 62,117 doctors in 2016 and increases to 80,607 in 2030 (Figure 19). Doctor requirement based on need projected to be 25.0% higher than requirement based on demand.

3.1.3 Gap Analysis

a. **Baseline supply and requirement**

Figure 19 illustrates the trend of existing supply, projected supply and requirement of doctors based on needs and demands. Whilst Table 17 shows the gap between projected supply and requirement based on needs and demand.

Figure 19: Projection of Doctor Supply and Doctor Requirement Based on Need and Demand

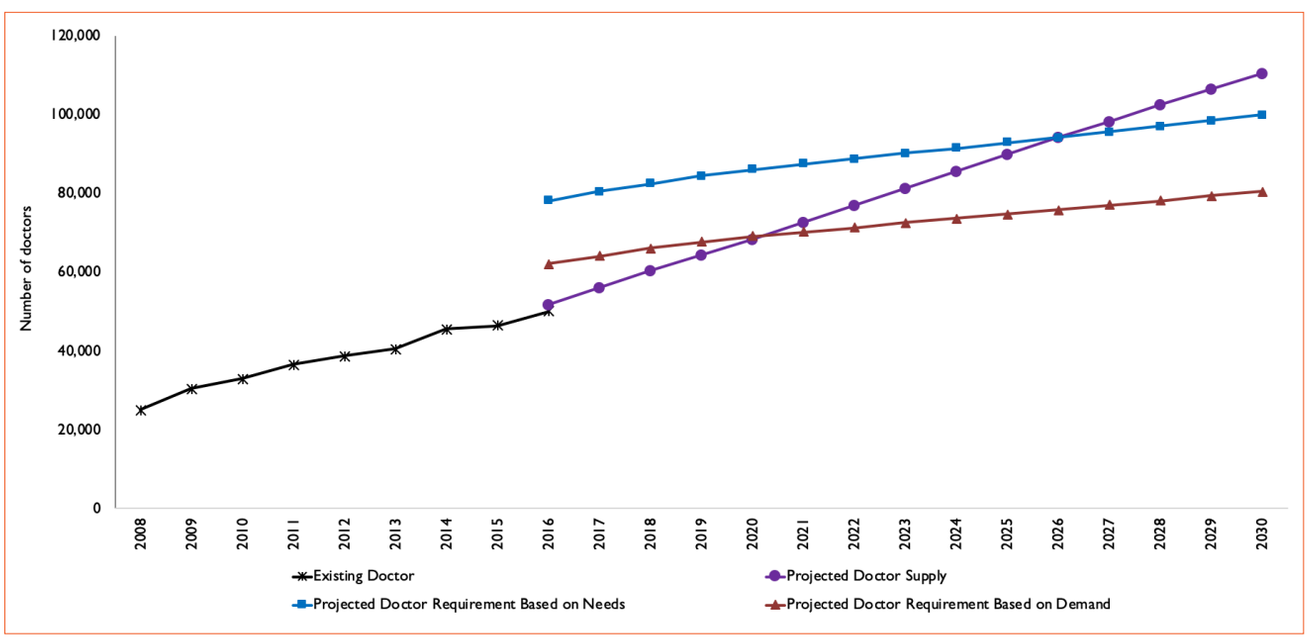


Table 17: The Gap between Supply and Requirement of Doctor in Malaysia, 2016 - 2030

Year	Supply	Requirement (Need)		Requirement (Demand)	
		n	Gap (Supply Scenario - Need)	n	Gap (Supply Scenario - Demand)
2016	51,988	78,142	-26,154	62,117	-10,129
2017	56,091	80,462	-24,371	64,194	-8,103
2018	60,344	82,573	-22,229	66,067	-5,723
2019	64,423	84,465	-20,042	67,709	-3,286
2020	68,484	86,100	-17,616	69,107	-623
2021	72,812	87,500	-14,688	70,271	+2,541
2022	77,136	88,859	-11,723	71,399	+5,737
2023	81,446	90,219	-8,773	72,524	+8,922
2024	85,737	91,567	-5,830	73,638	+12,099
2025	89,981	92,905	-2,924	74,747	+15,234
2026	94,182	94,262	-80	75,873	+18,309
2027	98,341	95,651	+2,690	77,026	+21,315
2028	102,452	97,053	+5,399	78,195	+24,257
2029	106,514	98,487	+8,027	79,391	+27,123
2030	110,523	99,942	+10,581	80,607	+29,916

Notes: Positive (+) gap indicates a surplus, and negative (-) gap indicates a shortage

The undersupply of the doctor in meeting population healthcare needs is apparent in the first ten years. Following a balance between supply and Need in 2026, it can be seen that supply of doctor will exceed population health care requirement or known as oversupply if all parameters remain the same. The supply of doctors will exceed (surplus) the projected Need by 10.0% and projected Demand by 30% in 2030.

It can be seen that by 2021, there will be an oversupply of doctors in Malaysia to fulfil the health care demand. Nevertheless, the requirement projections do not account for existing and future needs of rehabilitation, palliative, geriatric care services, increase in disease burden and incidence as well as advancement in medical care. The needs for these services are presumed to have a significant impact on doctor requirement.

b. Supply scenario

Scenario analysis was carried out to assess the impact of change in certain parameters on the outcome. A scenario in which by awarding less sponsorship equates to less medical student intake was simulated. Table 18 shows the gap between supply following reduce sponsorship and requirement based on needs.

Table 18: The Gap between Supply Following Reduce Sponsorship and Requirement of Doctor in Malaysia, 2016 – 2030

Year	Supply	Requirement (Need)		Requirement (Demand)	
		n	Gap (Supply Scenario - Need)	n	Gap (Supply Scenario - Demand)
2016	40,982	78,142	-37,160	62,117	-21,135
2017	43,730	80,462	-36,732	64,194	-20,464
2018	46,821	82,573	-35,752	66,067	-19,246
2019	50,121	84,465	-34,344	67,709	-17,588
2020	54,150	86,100	-31,950	69,107	-14,957
2021	58,477	87,500	-29,023	70,271	-11,794
2022	62,994	88,859	-25,865	71,399	-8,405
2023	66,071	90,219	-24,148	72,524	-6,453
2024	69,115	91,567	-22,452	73,638	-4,523
2025	72,124	92,905	-20,781	74,747	-2,623
2026	75,096	94,262	-19,166	75,873	-777
2027	78,029	95,651	-17,622	77,026	+1,003
2028	80,920	97,053	-16,133	78,195	+2,725
2029	83,766	98,487	-14,721	79,391	+4,375
2030	86,565	99,942	-13,377	80,607	+5,958

Notes: Positive (+) gap indicates a surplus, and negative (-) gap indicates a shortage

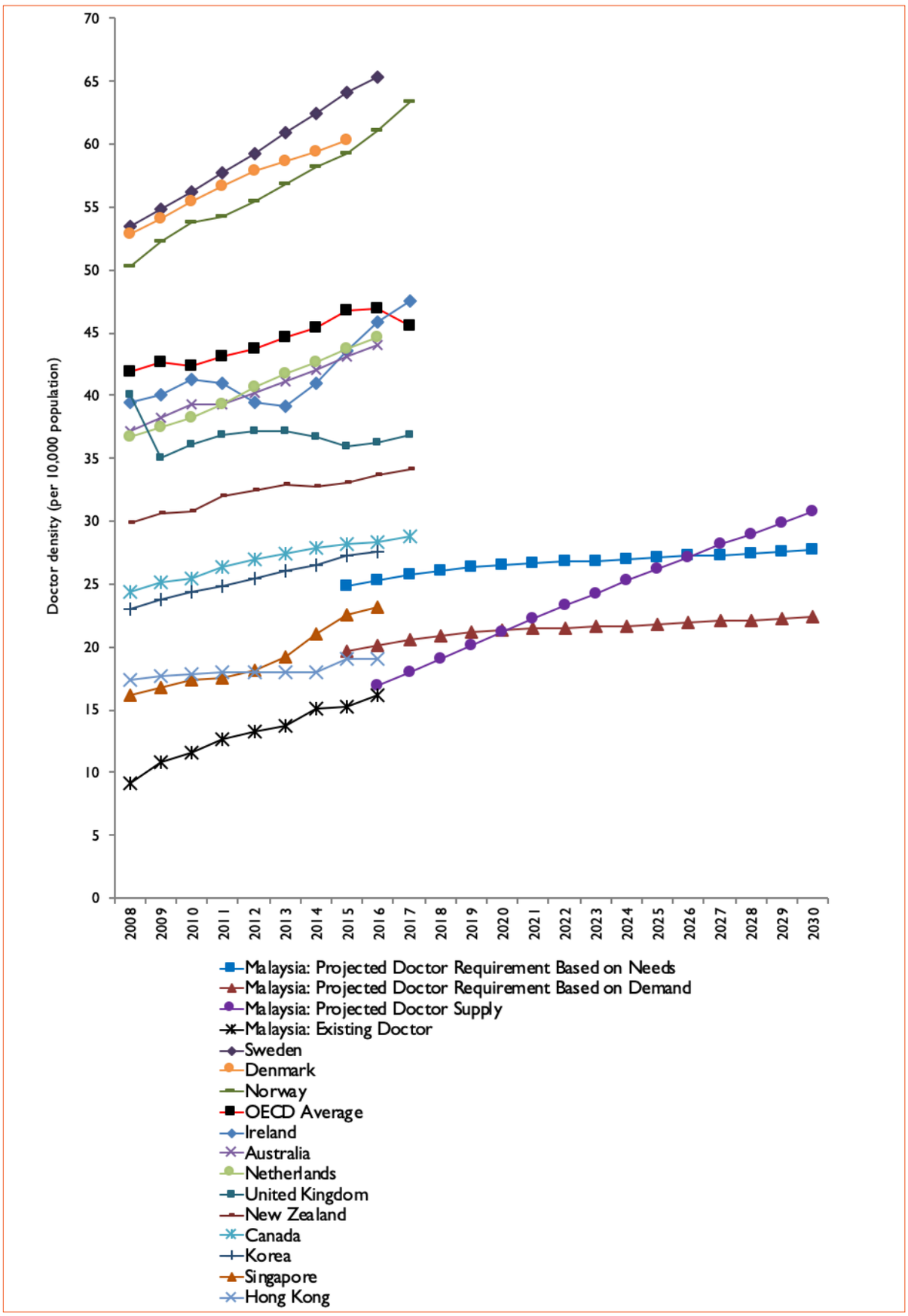
The scenario in which by awarding less sponsorship equates to less medical student intake, it is projected that there will be less supply of doctors. This scenario leads to a significant wide gap in meeting population health care needs and demands as compared to the baseline projection of supply. Nevertheless, this projection may differ to a real situation in which despite a reduction in sponsorship awarded, the number of medical graduates may remain increases over the years. This may be due to an increase in self-paying and student's loan to study medicine.

3.1.4 Comparison with selected high-income countries

Comparison between the Malaysian doctor supply projections to other countries' existing doctors allows decision-makers to gauge the human resource for health performance in Malaysia. This benchmarking process was conducted by comparing projected doctor density in Malaysia with doctor density of a few selected high-income and Organisation for Economic Co-operation and Development (OECD) countries.

Figure 20 demonstrates that the projected supply of doctors in Malaysia is lower than the average actual doctor density in OECD countries. Among the selected high-income countries, Hong Kong has the lowest density of doctors, but Malaysia's doctor's density is still lower than in Hong Kong. Malaysia doctor density is projected to reach Hong Kong's 2016 doctor density by 2019.

Figure 20: Doctor Density Comparison between Projected Doctors in Malaysia with Existing Doctors in Selected OECD and High-Income Countries



DENTIST

3.2.1 Dentist Supply Projection

This study utilised a mixed source of data to identify the number of patients within the target population who requires specific oral health care services. Input variables were supported by published and unpublished data; however, in some area, due to limited data availability; the oral health care providers' judgements were used to identify the population health care needs. The oral health care needs between targeted populations may differ. However, through the Needs-based approach, oral health care providers would be able to address the oral health care needs of the targeted population. The projection of dentist supply and requirement based on needs and demands were primarily focused on fully registered Human Resource for Health (HRH), who are professionals and competent to provide oral health care services to the targeted population.

Table 19 presents the actual number of population and dentists from the year 2015 until 2017 and the projection of the dentist's supply based on the baseline data from the year 2016 until 2030. The projection showed an increase of 185% dental graduates from 7,310 in 2016 to 20,851 in 2030, with a gradual increase of 13% each year within the next 14 years duration.

Table 19: Supply of Dentist, 2015 – 2030

YEAR	ACTUAL			PROJECTION		
		DENTIST			DENTIST	
	Malaysia Population	Supply (n)	Density per 10,000 population	Malaysia Population	Supply (n)	Density per 10,000 population
2015	31,186,100	6,384	2.0	-	-	-
2016	31,660,700	7,186	2.3	30,875,400	7,310	2.4
2017	-	-	-	31,267,400	8,178	2.6
2018	-	-	-	31,659,700	9,105	2.9
2019	-	-	-	32,051,300	10,107	3.2
2020	-	-	-	32,441,200	11,134	3.4
2021	-	-	-	32,822,900	12,199	3.7
2022	-	-	-	33,200,600	13,272	4.0
2023	-	-	-	33,572,100	14,316	4.3
2024	-	-	-	33,936,900	15,332	4.5
2025	-	-	-	34,294,200	16,321	4.8
2026	-	-	-	34,644,700	17,283	5.0
2027	-	-	-	34,987,600	18,216	5.2
2028	-	-	-	35,322,700	19,122	5.4
2029	-	-	-	35,649,400	20,001	5.6
2030	-	-	-	35,965,700	20,851	5.8

3.2.2 Dentist Requirement Projection

In 2016 it is projected 38,846 number of dentists are required to provide oral health care services based on needs). If every parameter remains constant, the total dentist's requirement based on population oral health care needs increases by 22% in the next 14 years. This is equivalent to additional of 8,553 dentists from 38,846 dentists required in 2016. In 2030, the dentist's requirement based on needs is projected to be 47,399 as in Table 20.

Table 20: Dentist Requirement Projection Based on Need and Demand, 2016 - 2030

Year	Malaysia Population	Projected Requirement (Need)		Projected Requirement (Demand)	
		(n)	Dentist per 10,000 population	Supply (n)	Dentist per 10,000 population
2016	30,875,400	38,846	12.6	12,568	4.1
2017	31,267,400	39,448	12.6	12,917	4.1
2018	31,659,700	40,079	12.7	13,302	4.2
2019	32,051,300	40,695	12.7	13,653	4.3
2020	32,441,200	41,308	12.7	14,010	4.3
2021	32,822,900	41,913	12.8	14,349	4.4
2022	33,200,600	42,513	12.8	14,690	4.4
2023	33,572,100	43,108	12.8	15,037	4.5
2024	33,936,900	43,703	12.9	15,396	4.5
2025	34,294,200	44,296	12.9	15,765	4.6
2026	34,644,700	44,906	13.0	16,218	4.7
2027	34,987,600	45,505	13.0	16,663	4.8
2028	35,322,700	46,123	13.1	17,138	4.9
2029	35,649,400	46,756	13.1	17,628	4.9
2030	35,965,700	47,399	13.2	18,128	5.0

Based on the available data on health care utilization, analysis to project the health care demand for oral health care services was carried out. Table 20 shows the projected requirement based on needs and demands. The projected Need is much higher, compared to the projected Demand. It can be seen that the projected supply will meet the projected requirement based on demand sometime in 2024. There is a wide gap between projected requirement need and demand. In the context of this study, Need assumes each individual with an oral health needs will pay a visit to see a dentist but in actual scenario might not visit any facility or dentist due to varies reasons. This information is obtained from National Oral Health Survey of Adults 2010 (NOHSA 2010). Demand on the other hand, reflects to the actual number of individuals that visits the dentist using utilizing data that was made available from facilities. Therefore, that explains the reason of a wide gap between need and demand.

3.2.3 Gap Analysis

a. Baseline supply and requirement

Table 21 demonstrates the gap between the projected supply and the requirement according to the scenarios below:

i. baseline supply and baseline requirement (Need), and
ii. baseline supply and requirement (Demand)

By 2030, there will be an increase of 15% dentists in Malaysia to cater for the oral health care demand of the population; however, the oral health care needs of the population will remain unmet. Figure 21 illustrates the gap between the projected supply and requirement. The projection illustrated that neither requirement for dentists based on needs or demand is static over these 14 years. In 2016, if every parameter remains constant, it is projected that the supply will meet the projected requirement based on demand by the year 2025. However, the projected supply will not meet the projected requirement based on Need.

Table 21: The Gap between Supply and Requirement of Dentists in Malaysia, 2016 - 2030

Year	Supply	Projected Requirement (Need)		Projected Requirement (Demand)	
		(n)	Gap (Supply - Need)	Supply (n)	Gap (Supply - Demand)
2016	7,310	38,846	-31,536	12,568	-5,258
2017	8,178	39,448	-31,270	12,917	-4,739
2018	9,105	40,079	-30,974	13,302	-4,197
2019	10,107	40,695	-30,588	13,653	-3,546
2020	11,134	41,308	-30,174	14,010	-2,876
2021	12,199	41,913	-29,714	14,349	-2,150
2022	13,272	42,513	-29,241	14,690	-1,418
2023	14,316	43,108	-28,792	15,037	-721
2024	15,332	43,703	-28,371	15,396	-64
2025	16,321	44,296	-27,975	15,765	556
2026	17,283	44,906	-27,623	16,218	1,065
2027	18,216	45,505	-27,289	16,663	1,553
2028	19,122	46,123	-27,001	17,138	1,984
2029	20,001	46,756	-26,755	17,628	2,373
2030	20,851	47,399	-26,548	18,128	2,723

Notes: Positive (+) gap indicates a surplus, and negative (-) gap indicates a shortage

b. Requirement Scenario

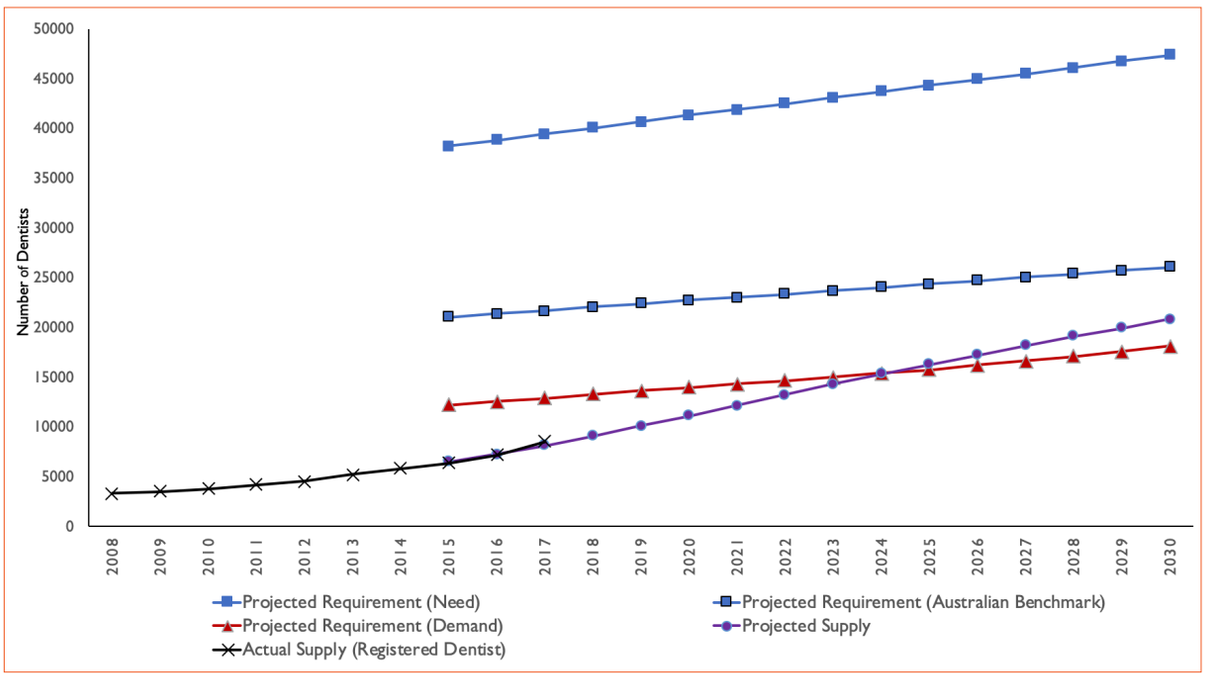
Requirement scenario was carried out to compare the gaps from the chosen scenario. A scenario in which the stakeholder uses the Australian population oral health care utilization to simulate the oral health care service utilization of the Malaysian population in the next 15 years. Thus, the proceeding analysis uses the Australian as a benchmark, where oral health needs 55% requirement of dentists to meet the oral health care demand of the population. The targeted requirement based Australia benchmarking is much higher than current projected requirement based on demand where the number of required dentists for the targeted requirement is 26,070 while the demand requirement is 18,128 at the year 2030 (Table 22 and Table 23). The gap is wider when the projected requirement of Need (47,399) compared to Australian benchmark need (26,070) by the year 2030. Furthermore, the requirement based on Australian benchmark is projected to increase by almost 22% from the year 2016 to 2030 with an average increase of 1.6% over 14 years.

Table 22: The Gap between Supply Following Projected Requirement of Dentists using Australian Benchmark in Malaysia, 2016 – 2030

Year	Supply	Projected Requirement (Australia Benchmark)	
		(n)	Gap Supply - Australian Benchmark
2016	7,310	21,365	-14,055
2017	8,178	21,696	-13,518
2018	9,105	22,044	-12,939
2019	10,107	22,382	-12,275
2020	11,134	22,719	-11,585
2021	12,199	23,052	-10,853
2022	13,272	23,382	-10,110
2023	14,316	23,709	-9,393
2024	15,332	24,037	-8,705
2025	16,321	24,363	-8,042
2026	17,283	24,698	-7,415
2027	18,216	25,028	-6,812
2028	19,122	25,368	-6,246
2029	20,001	25,716	-5,715
2030	20,851	26,070	-5,219

Notes: Positive (+) gap indicates a surplus, and negative (-) gap indicates a shortage

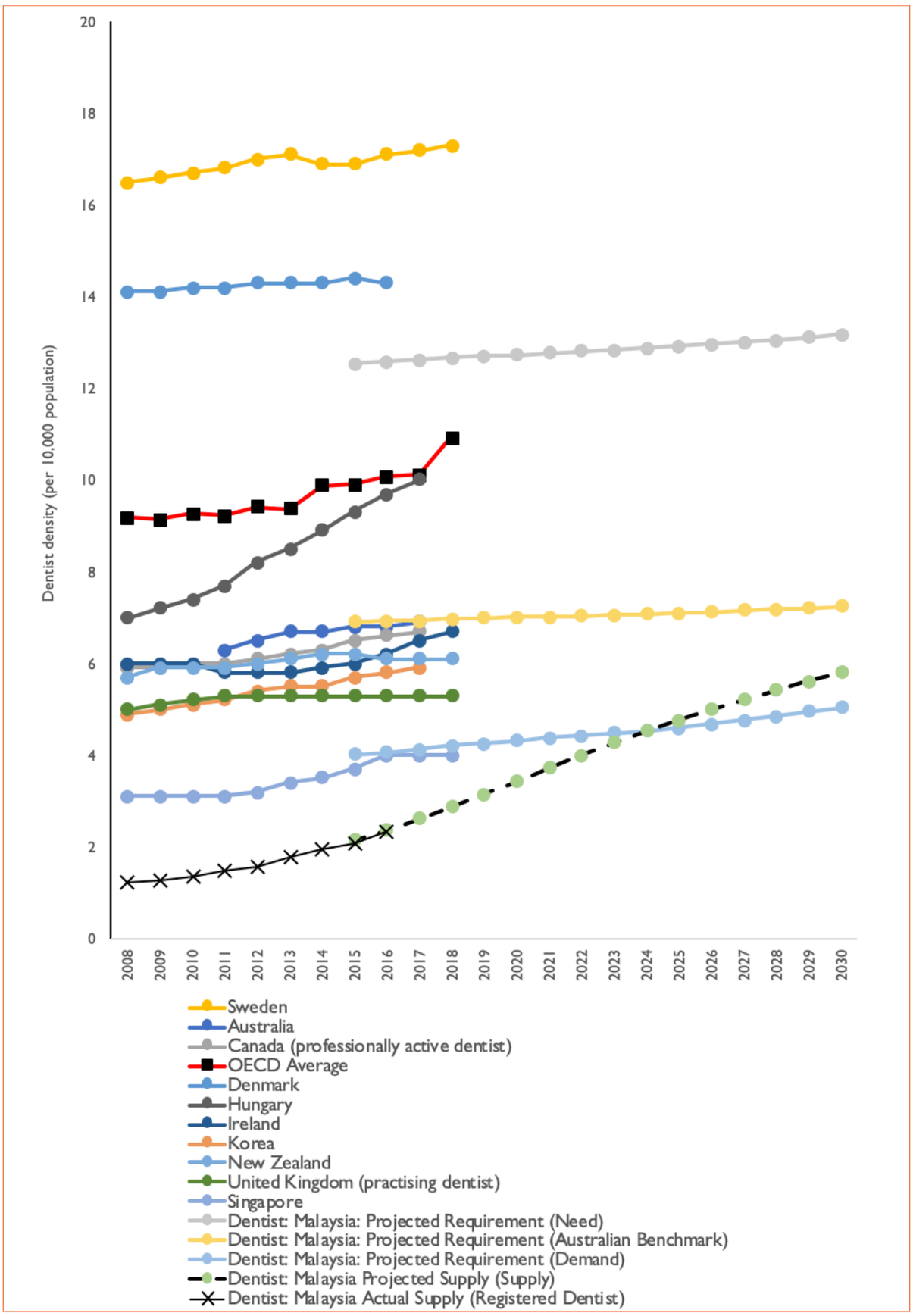
Figure 21: Comparison between Projected Supply and Requirement Based on Demand, Need and Australian Benchmark



3.2.4 Comparison with selected high-income countries

Figure 22 illustrates the comparison between dentist supply projection in Malaysia with other developed and developing countries, thus allowing decision-maker to plan for HRH in the country. The benchmarking was conducted by comparing the projected dentist density in Malaysia to dentist density of a few selected high-income countries and selected the Organization for Economic Co-operation and Development (OECD) countries. Sweden and Australia are among the highest dentist density amongst the selected OECD countries. The simulation result shows that the density of the projected requirement based on the needs of dentists in Malaysia is slightly lower than the practising dentists in Sweden. Similarly, the projected requirement of dentist density for Malaysia at 55% Need is below the average of selected OECD countries.

Figure 22: Dentist Density Comparison between Projected Dentists in Malaysia with Existing Dentist in Selected OECD Countries and Selected High-Income Country



PHARMACIST

3.3.1 Pharmacist Supply Projection

This study identified two components in pharmacy care requirement, which was direct patient care and indirect patient care. Direct patient care services are defined as pharmacists dealing direct patient contact upon delivering pharmacy services, which were further divided into two services; namely, outpatient care services and in-patient care services, where their working scenario and job scope are distinctly different. Substantial numbers of pharmacists are involved in the in-direct patient services in Malaysia, which makes up to 40% of total pharmacists. This is calculated based on the number of registered pharmacists registered in 2015 working in pharmacy management, enforcement pharmacy, regulatory pharmacy, drug information services, pharmaceutical industry, academia and research. To tabulate the total number of pharmacists required based on need and demand, the number of indirect pharmacists were added to the figure produced by the model.

Table 23 presents the actual number of population and pharmacists from the year 2015 until 2017 and the projection of supply pharmacists from 2016 to 2030. The supply projection presented an increase in the number of pharmacists by 211% from 13,490 pharmacists in 2016 to 41,994 pharmacists in 2030. The number of pharmacists gradually increased at an average rate of 8% each year within 14 years duration. The average rate of increase in projected supply supersedes the average rate of increase in the total population, which is only at 1.1% growth per year, which this increased pharmacist's density per 10,000 population and improved pharmacist to population ratio.

Table 23: Supply of Pharmacists, 2015-2030

Year	ACTUAL			PROJECTION		
	Malaysia Population	PHARMACIST		Malaysia Population	PHARMACIST	
		Supply (n)	Density per 10,000 Population		Supply (n)	Density per 10,000 Population
2015	31,186,100	10511	3.37	-	-	-
2016	30,875,400	13490	3.32	30,875,400	13490	4.37
2017	-	-	-	31,267,400	15115	4.83
2018	-	-	-	31,659,700	16716	5.28
2019	-	-	-	32,051,300	18615	5.81
2020	-	-	-	32,441,200	20530	6.33
2021	-	-	-	32,822,900	22462	6.84
2022	-	-	-	33,200,600	24553	7.40
2023	-	-	-	33,572,100	26681	7.95
2024	-	-	-	33,936,900	28824	8.50
2025	-	-	-	34,294,200	31026	9.05
2026	-	-	-	34,644,700	33240	9.60
2027	-	-	-	34,987,600	35452	10.13
2028	-	-	-	35,322,700	37650	10.66
2029	-	-	-	35,649,400	39830	11.17
2030	-	-	-	35,965,700	41994	11.68

3.3.2 Pharmacist Requirement Projection

In 2016 it was projected 37,078 number of pharmacists are required to provide health care services based on needs. If every parameter remains constant, the total pharmacist requirement in the year 2030 based on population health care needs increases by 30% within these 14 years. This is equivalent to an additional of 11,203 pharmacists from 37,078 pharmacists required in 2016. In 2030, the pharmacist requirement based on needs is projected to be 48,281 pharmacists (Table 24).

Table 24: Pharmacist Requirement Projection Based on Need and Demand, 2016 - 2030

Year	Malaysia Population	Pharmacist Requirement (Need)		Pharmacist Requirement (Demand)	
		(n)	Density per 10,000 population	(n)	Density per 10,000 population
2015	31,186,100	35,723	11.5	27,847	8.9
2016	30,875,400	37,078	12.0	29,067	9.4
2017	31,267,400	38,492	12.3	30,336	9.7
2018	31,659,700	39,756	12.6	31,489	10.0
2019	32,051,300	40,850	12.7	32,510	10.1
2020	32,441,200	41,759	12.9	33,387	10.3
2021	32,822,900	42,510	13.0	34,139	10.4
2022	33,200,600	43,206	13.0	34,850	10.5
2023	33,572,100	43,893	13.1	35,555	10.6
2024	33,936,900	44,547	13.1	36,234	10.7
2025	34,294,200	45,197	13.2	36,912	10.8
2026	34,644,700	45,826	13.2	37,575	10.9
2027	34,987,600	46,458	13.3	38,242	10.9
2028	35,322,700	47,070	13.3	38,894	11.0
2029	35,649,400	47,686	13.4	39,552	11.1
2030	35,965,700	48,281	13.4	40,264	11.2

The projection showed that neither requirement for pharmacist based on needs or demand is static over the years. This can be seen by the increase in density of pharmacist for each 10,000 population. The pharmacist requirement based on needs is projected to be 19% higher than the requirement based on demand. It is crucial to identify the requirement of pharmacists based on population health care demands. Health care demand is the reflection of population health-seeking behaviour, which is translated into the utilisation of healthcare services. Pharmacist requirement based on demand is projected to be at 29,067 pharmacists in 2016 and increased to 40,264 in 2030. Therefore, the requirement based on demand is projected to increase by almost 39% from the year 2016 to 2030 with the average percentage of annual increase at 2.7% over these 14 years.

3.3.3 Gap Analysis

a. Baseline supply and requirement

Figure 23 illustrates the trend of existing supply, projected supply and requirement of pharmacists based on needs and demands. Whilst Table 25 displays the gap between projected supply and requirement:

i. supply and requirement (Need), and
ii. supply and requirement (Demand)

By 2030, there will be an excess of 4.3% of pharmacists in Malaysia to fulfil the health care demand, but the population health care needs are still unmet.

Table 25: The Gap between Supply and Requirement of Pharmacist in Malaysia, 2016 - 2030

Year	Population	Supply	Projected Requirement (Need)		Projected Requirement (Demand)	
			(n)	Gap (Supply – Need)	(n)	Gap (Supply – Demand)
2016	30,875,400	13,490	37,078	-23,588	29,067	-15,577
2017	31,267,400	15,115	38,492	-23,377	30,336	-15,221
2018	31,659,700	16,716	39,756	-23,040	31,489	-14,773
2019	32,051,300	18,615	40,850	-22,235	32,510	-13,895
2020	32,441,200	20,530	41,759	-21,229	33,387	-12,857
2021	32,822,900	22,462	42,510	-20,048	34,139	-11,677
2022	33,200,600	24,553	43,206	-18,653	34,850	-10,297
2023	33,572,100	26,681	43,893	-17,212	35,555	-8,874
2024	33,936,900	28,824	44,547	-15,723	36,234	-7,410
2025	34,294,200	31,026	45,197	-14,171	36,912	-5,886
2026	34,644,700	33,240	45,826	-12,586	37,575	-4,335
2027	34,987,600	35,452	46,458	-11,006	38,242	-2,790
2028	35,322,700	37,650	47,070	-9,420	38,894	-1,244
2029	35,649,400	39,830	47,686	-7,856	39,552	278
2030	35,965,700	41,994	48,281	-6,287	40,264	1,730

Notes: Positive (+) gap indicates a surplus, and negative (-) gap indicates a shortage

b. Supply scenario

Scenario analysis was carried out to assess the impact of change in certain parameters on the outcome. A scenario in which by increasing the student intake to fasten the time to achieve the demand and needs by 2030 was simulated. The adjustment can be made by increasing the local student intake while fixing the number of overseas graduates. Table 26 displays the gap between projected supply and requirement with scenario:

i. Supply scenario increase student intake to meet the Need
ii. Supply scenario increase student intake to meet the Demand

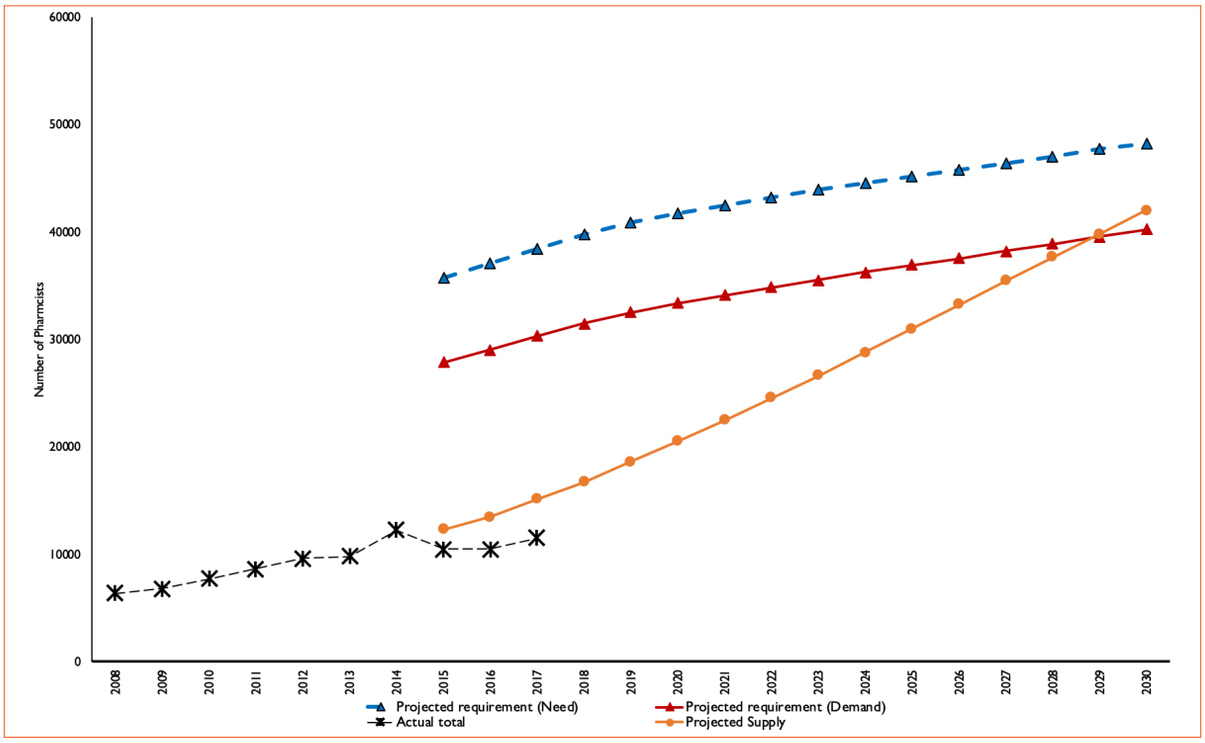
In this scenario, it can be seen the gap reducing in 2030 with a difference of 0.6% as compared to a gap of projected requirement need 13%. This can be achieved by increasing the number of universities offering the degree of pharmacy or increase the student's intake locally while maintaining appropriate lecturer to student ratio. Furthermore, the supply also can be increased by offering more scholarships/sponsorship to those who are interested in studying pharmacy as their first degree and raise of awareness of pharmacist profession to the public.

Table 26: The Gap between Supply Following Increase Student Intake and Requirement of Pharmacists in Malaysia, 2016 – 2030

Year	Supply Scenario (increase student intake)	Requirement (Need)		Requirement (Demand)	
		n	Gap (Supply Scenario - Need)	(n)	Gap (Supply Scenario - Demand)
2016	13,490	37,078	-23,588	29,067	-15,577
2017	15,115	38,492	-23,377	30,336	-15,221
2018	16,716	39,756	-23,040	31,489	-14,773
2019	18,615	40,850	-22,235	32,510	-13,895
2020	20,530	41,759	-21,229	33,387	-12,857
2021	22,462	42,510	-20,048	34,139	-11,677
2022	24,553	43,206	-18,653	34,850	-10,297
2023	28,957	43,893	-14,936	35,555	-6,598
2024	32,807	44,547	-11,740	36,234	-3,427
2025	36,596	45,197	-8,601	36,912	-316
2026	39,634	45,826	-6,192	37,575	2,059
2027	42,663	46,458	-3,795	38,242	4,421
2028	44,945	47,070	-2,125	38,894	6,051
2029	46,461	47,686	-1,225	39,552	6,909
2030	47,984	48,281	-297	40,264	7,720

Notes: Positive (+) gap indicates a surplus, and negative (-) gap indicates a shortage

Figure 23: Projection of Pharmacist Supply and Pharmacist Requirement Based on Need and Demand

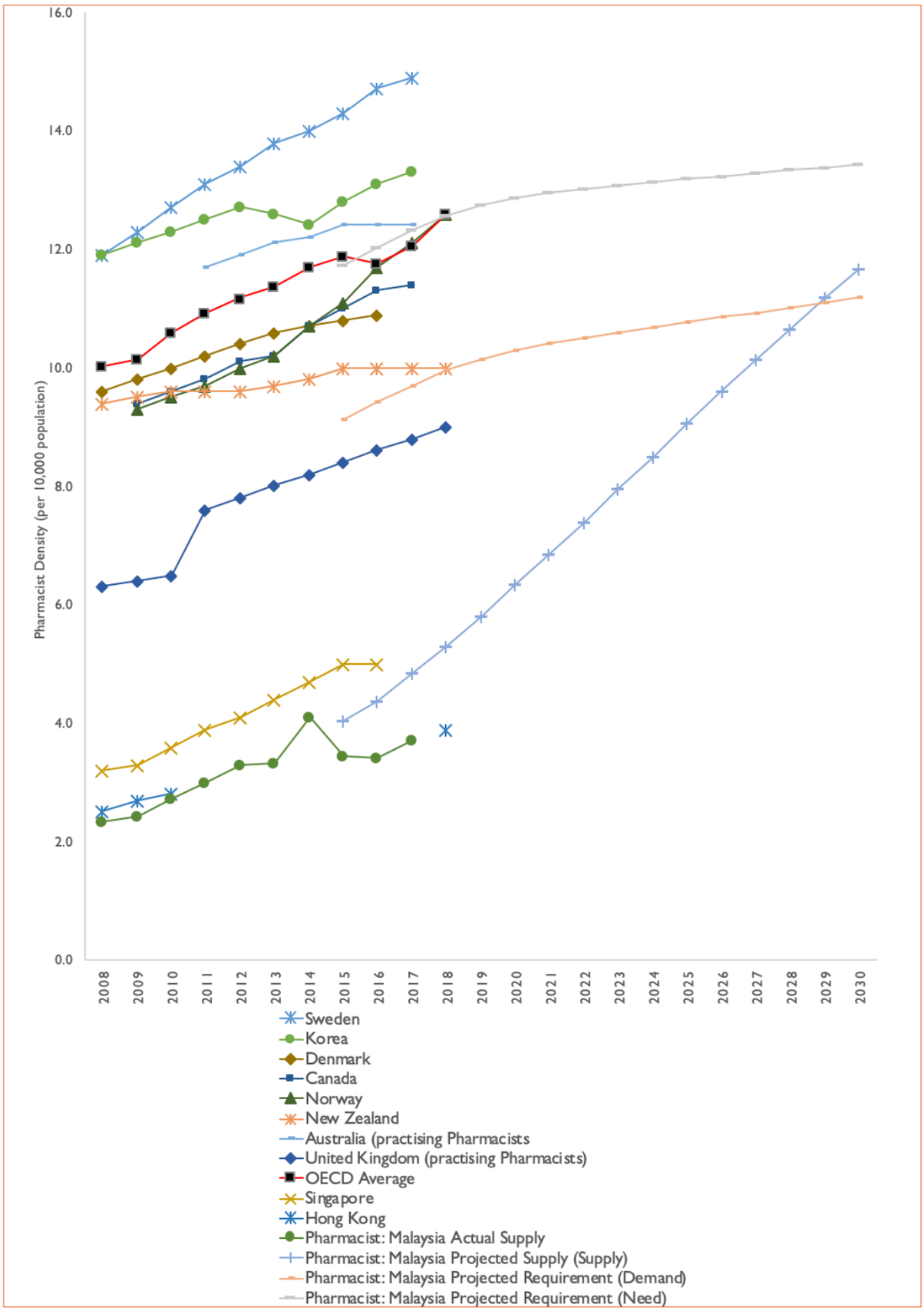


3.3.4 Comparison with selected high-income countries

Figure 24 illustrates that the projected supply of pharmacist in Malaysia is lower than the average selected Organisation for Economic Co-operation and Development (OECD) countries actual pharmacist density. In comparison with other selected higher-income countries, Hong Kong had the lowest density of pharmacist. However, the actual pharmacist's density in Hong Kong is a close range with the actual number of pharmacists in Malaysia. In 2030, it is projected that Malaysia's supply pharmacist density is still lesser as compared to the pharmacist in Sweden and Korea.

The projected requirement of pharmacists based on demand is lower than the current OECD average pharmacist density but higher than pharmacist density levels in Singapore, Hong Kong and the United Kingdom. The projected requirement of pharmacist based on needs is at the higher end of the OECD countries (nearer to countries from Sweden, Korea and Australia). This benchmarking process was conducted by comparing existing pharmacists and projected supply, Demand, Need of pharmacist's density in Malaysia to pharmacist's density of selected OECD and selected high-income countries. Benchmarking with these countries is vital to see where our country stands and to demonstrate projection carried out in this study in comparison with well-established pharmacist profession from other countries.

Figure 24: Pharmacist Density Comparison between Projected Pharmacists in Malaysia with Existing Pharmacist in Selected Organisation for Economic Co-Operation and Development (OECD) and High-Income Countries



NURSE

3.4.1 Nurse Supply Projection

In nurse model, the projection of nurses' supply and requirement based on needs and demands includes both the Registered Nurses (RN) and Community Nurses (CN) (Community Nurse also known as Jururawat Masyarakat (JM)) as the total population of nurses.

The rationale of combining CN and RN is because of the phasing out of CN training programme by the nursing colleges under MOH and there will be no new intake for CN. The existing and qualified CN in MOH will be promoted to RN through PSL Programme for Community Nurses (Peningkatan Secara Lantikan, PSL) and will be upgraded from certificate to diploma level. In 2014, during the study period, it was estimated that 23,000 CN will be involved in training through PSL exercise and was done in stages. During the Health Minister's Retreat in 2013, there was also a proposal to freeze CN Recruitment at MOH.

If the CN were not considered in the projection, this model may lead to an insufficient number of nurses' supply in the nation.

The projected registered nurse supply in the year 2030 is only 143,751. Therefore, in the year 2030, by considering both registered nurses and community nurses, the projected nurse supply is 166,850, which is higher than the number for registered nurse only.

The projection shows an increased number of nurses by 30.65 % from 125,519 nurses in the year 2016 to 166,850 nurses in the year 2030. There is an average increase rate of 2.05% each year over the 14 years duration. This resulted in the increased number of nurses in 10,000 populations and improvement in the ratio of nurse to population. Table 27 presents the actual and projected number of nurse supply in Malaysia from 2015 until 2030.

Table 27: Supply of Nurses, 2015 - 2030

YEAR	ACTUAL					PROJECTION		
	Malaysia Population	Nurse Supply				Malaysia Population	Registered Nurse Supply	
		Registered Nurse (RN) Supply (n)	Community Nurse (CN) Supply (n)	Registered Nurse and Community Nurse	Density per 10000 population (RN+CN)		(n)	Density per 10,000 population
2015	31,186,100	99,925	25,175	125,100	40.1	-	-	
2016	31,660,700	102,564	25,140	127,704	40.3	30,875,400	125,519	40.7
2017	-	-	-	-	-	31,267,400	128,701	41.2
2018	-	-	-	-	-	31,659,700	131,943	41.7
2019	-	-	-	-	-	32,051,300	135,377	42.2
2020	-	-	-	-	-	32,441,200	138,812	42.8
2021	-	-	-	-	-	32,822,900	142,091	43.3
2022	-	-	-	-	-	33,200,600	145,244	43.7
2023	-	-	-	-	-	33,572,100	148,303	44.2
2024	-	-	-	-	-	33,936,900	151,265	44.6
2025	-	-	-	-	-	34,294,200	154,126	44.9
2026	-	-	-	-	-	34,644,700	156,884	45.3
2027	-	-	-	-	-	34,987,600	159,536	45.6
2028	-	-	-	-	-	35,322,700	162,082	45.9
2029	-	-	-	-	-	35,649,400	164,519	46.1
2030	-	-	-	-	-	35,965,700	166,850	46.4

3.4.2 Nurse Requirement Projection

In 2016 it was projected 204,608 number of nurses are required to provide health care services based on needs. If every parameter remains constant, the total nurse requirement based on population health care needs increases by 32.07 % in the next 14 years. This is equivalent to an additional of 65,615 nurses from 204,608 nurses required in 2016. In 2030, the nurse requirement based on needs projected to be 270,223 nurses Table 28. The Need will increase if the disease burden increases especially for Non-Communicable Disease (NCD) among the elderly population by 2030.

Table 28: Nurse Requirement Projection Based on Need and Demand, 2016 - 2030

Year	Malaysia Population	Nurse Requirement (Need)		Nurse Requirement (Demand)	
		n	Density per 10,000 population	n	Density per 10,000 population
2016	30,875,400	204,608	66.3	199,391	64.6
2017	31,267,400	214,395	68.6	209,084	66.9
2018	31,659,700	223,034	70.4	217,659	68.7
2019	32,051,300	230,235	71.8	224,732	70.1
2020	32,441,200	235,880	72.7	230,277	71.0
2021	32,822,900	240,116	73.2	234,412	71.4
2022	33,200,600	243,986	73.5	238,178	71.7
2023	33,572,100	247,658	73.8	241,743	72.0
2024	33,936,900	251,195	74.0	245,173	72.2
2025	34,294,200	254,567	74.2	248,441	72.4
2026	34,644,700	257,874	74.4	261,644	75.5
2027	34,987,600	261,112	74.6	254,779	72.8
2028	35,322,700	264,257	74.8	257,825	73.0
2029	35,649,400	267,306	75.0	260,774	73.1
2030	35,965,700	270,223	75.1	263,594	73.3

It should be noted that there are two values of total projected requirements. One is the nurse projected requirement based on the population needs, and the other one is the nurse projected requirement based on utilisation or demand. Based on available data on health care utilisation, nurse requirement based on demand projected to be at 199,391 nurses in 2016 and increases to 263,594 in 2030. The total projected nurse requirement based on demand is slightly lower because it only considers the population that needs the health services and at the same time seek for the health services. This may even increase further as Malaysia is becoming an ageing population and elderly needs for health care services is higher as compared to other age groups. The demand may also increase when the population has proficient health literacy and empowered to better manage their health and wellbeing.

3.4.3 Gap Analysis

a. Baseline supply and requirement

Figure 25 illustrates the trend of existing supply, projected supply and requirement of nurses based on needs and demands. Whilst Table 29 shows the gap between projected supply and requirement based on needs and demand.

Figure 25: Projection of Nurse Supply and Nurse Requirement Based on Need and Demand

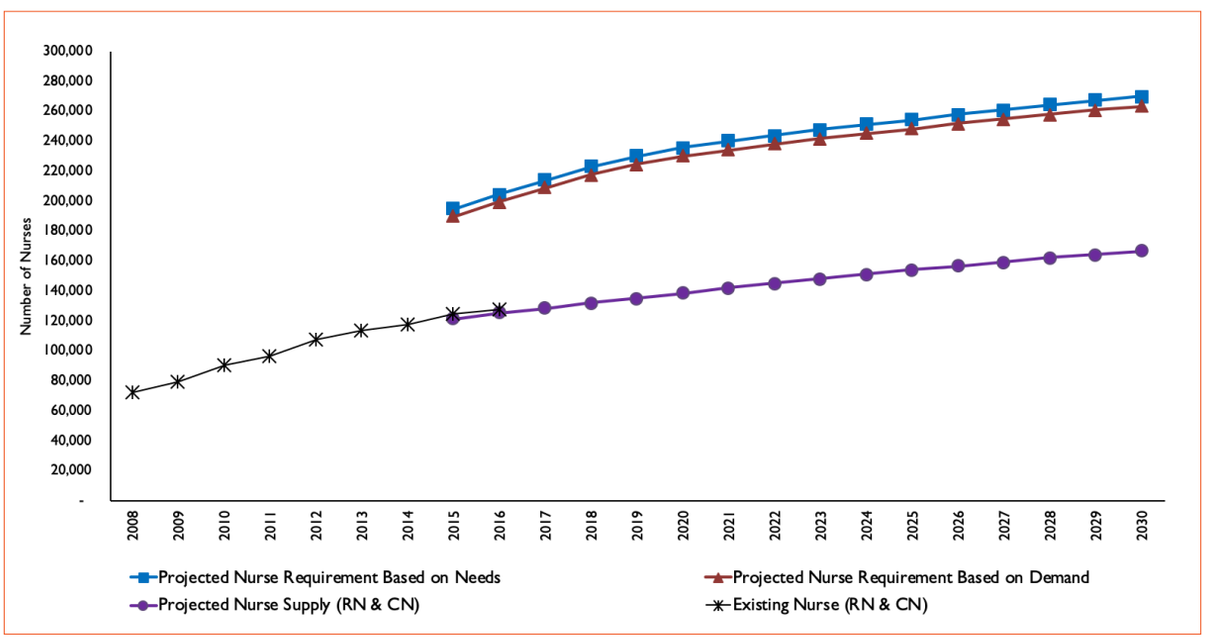


Table 29: The Gap between Supply and Requirement of Nurse in Malaysia, 2016 – 2030

Year	Supply	Requirement (Need)		Requirement (Demand)	
		n	Gap (Supply - Need)	n	Gap (Supply - Demand)
2016	127,704	204,608	-76,904	199,391	-71,687
2017	128,701	214,395	-85,694	209,084	-80,383
2018	131,943	223,034	-91,091	217,659	-85,716
2019	135,377	230,235	-94,858	224,732	-89,355
2020	138,812	235,880	-97,068	230,277	-91,465
2021	142,091	240,116	-98,025	234,412	-92,321
2022	145,244	243,986	-98,742	237,178	-91,934
2023	148,303	247,658	-99,355	241,743	-93,440
2024	151,265	251,195	-99,930	245,173	-93,908
2025	154,126	254,567	-100,441	248,441	-94,315
2026	156,884	257,874	-100,990	251,644	-94,760
2027	159,536	261,112	-101,576	254,779	-95,243
2028	162,082	264,257	-102,175	257,825	-95,743
2029	164,519	267,306	-102,787	260,774	-96,255
2030	166,850	270,223	-103,373	263,594	-96,744

Notes: Positive (+) gap indicates a surplus, and negative (-) gap indicates a shortage

Table 29 shows the gap between projected supply and requirement according to a few scenarios:

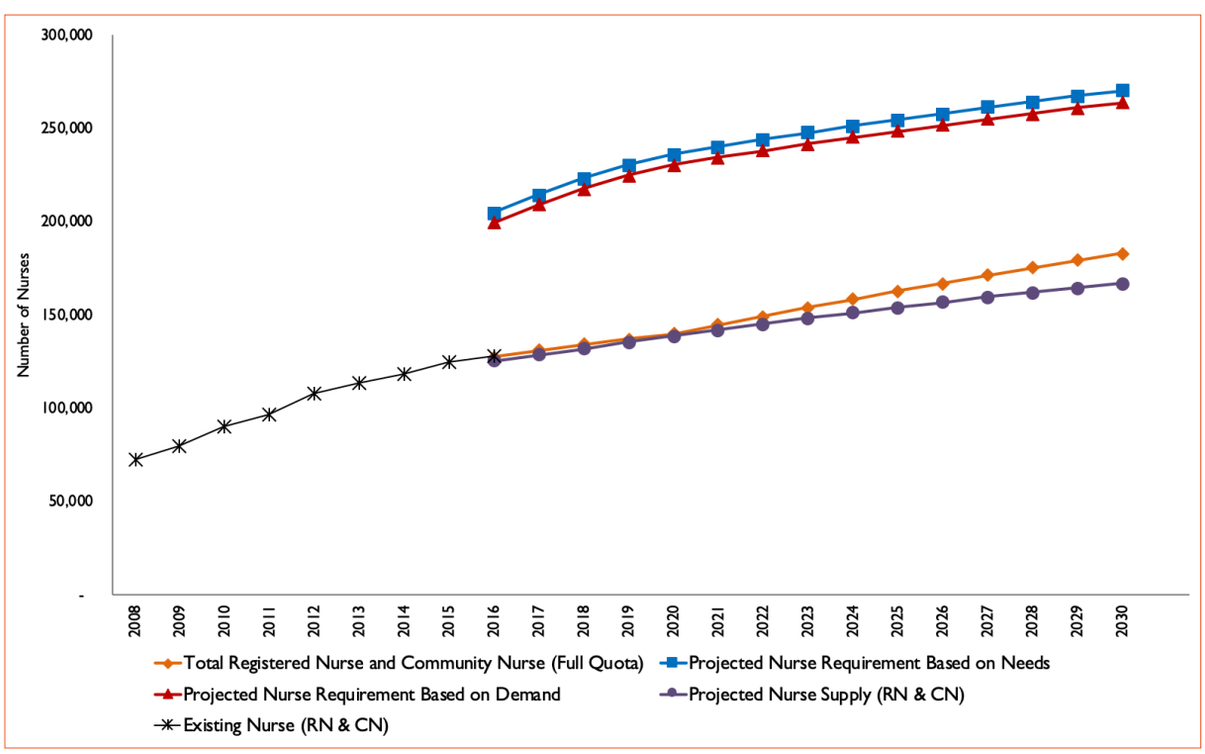
i. Supply (RN and CN) and Requirement (Need),
ii. Supply (RN and CN) and Requirement (Demand), and
iii. Full quota student intake scenario and Requirement (Need)

The undersupply of the nurses in meeting population healthcare needs is apparent beyond 2030. It can be seen that by 2021, there will be an undersupply of nurses in Malaysia to fulfil the health care need and demand. By 2025 and 2030, there will be an undersupply of nurses in comparison with requirement based on demand and need. By 2030, there will be a shortage of 57.9 % of nurses in Malaysia to fulfil the health care demand. There will be also a shortage of 61.9% of nurses based on population health care needs. The gap remains big between projected supply and requirement. Nurse's supply would not be able to meet the requirement even by the year 2030.

However when full quota student intake scenario is applied in this model by using a maximum number of student intake at 9,000 for Diploma Programme, 352 for Degree programme and 359 for PSL student, it can be seen the gap between full quotas projected supply compared with projected requirement based on need reduced in the year 2025 and 2030.

Figure 26 illustrates the pattern of projected nurse supply based on full quota intake of student scenario as compared to the baseline projection. In the full quota intake scenario, the maximum number of student/ nurse supply is constant at 5,832 for Diploma Programme, 352 for Degree programme and 359 for PSL student. The number of the projected nurse is not far different from the baseline up to the year 2020. Based on the simulation of the developed model from the year 2019 to the year 2030, the supply of nurses is projected to increase significantly if the number of student intake at Diploma and degree level is at current situation.

Figure 26: Projection of Nurse Supply, Requirement and Full Quota Student Intake of Nurse

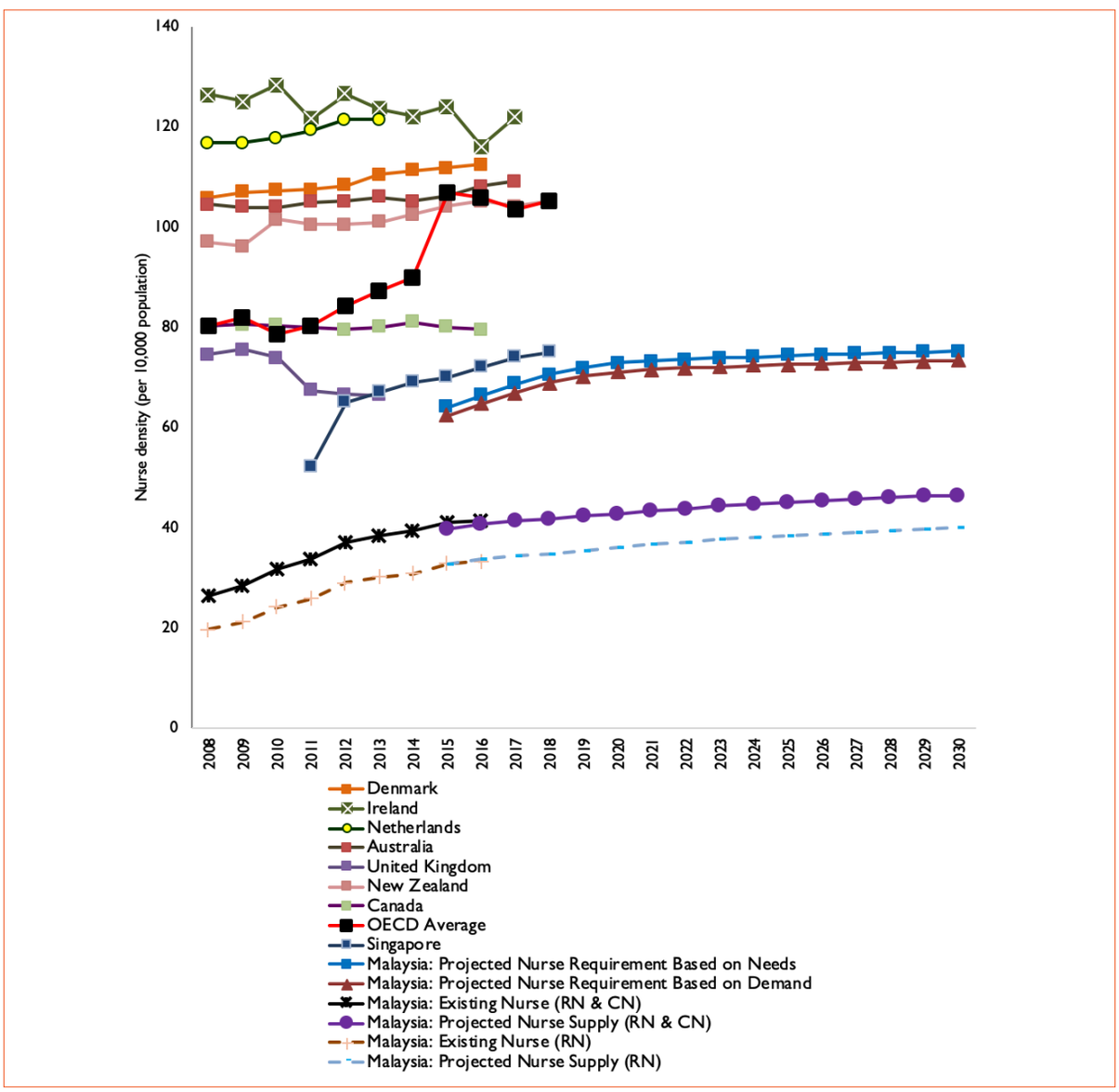


3.4.4 Comparison with selected high-income countries

This study also benchmarked projected nurse density in Malaysia with nurse density of a few selected high-income countries within the OECD in which, most of the countries that are members of the OECD are developed countries that have a high-income economy. Figure 27 demonstrates that Malaysia total nurses' supplies are far behind even the median of the selected OECD countries. Denmark and Ireland are among the highest nurse density amongst selected OECD countries. The simulation result shows that the density of projected requirement based on needs in Malaysia in 2030 is three-fold lower than Ireland.

The projected supply of nurse's density in Malaysia is lower than the average actual nurse density in the selected OECD countries. In 2030, it is projected that Malaysia's nurse density is only half of the OECD average in 2014. The nearest high-income country that has slightly similar nurse density with Malaysia is Singapore. Malaysia nurse density projected supply will not reach the Malaysia nurse density projected requirement even until 2030.

Figure 27: Nurse Density comparison between actual and projected nurses in Malaysia with Nurses in Selected OECD and High-Income Countries



ASSISTANT MEDICAL OFFICER (AMO)

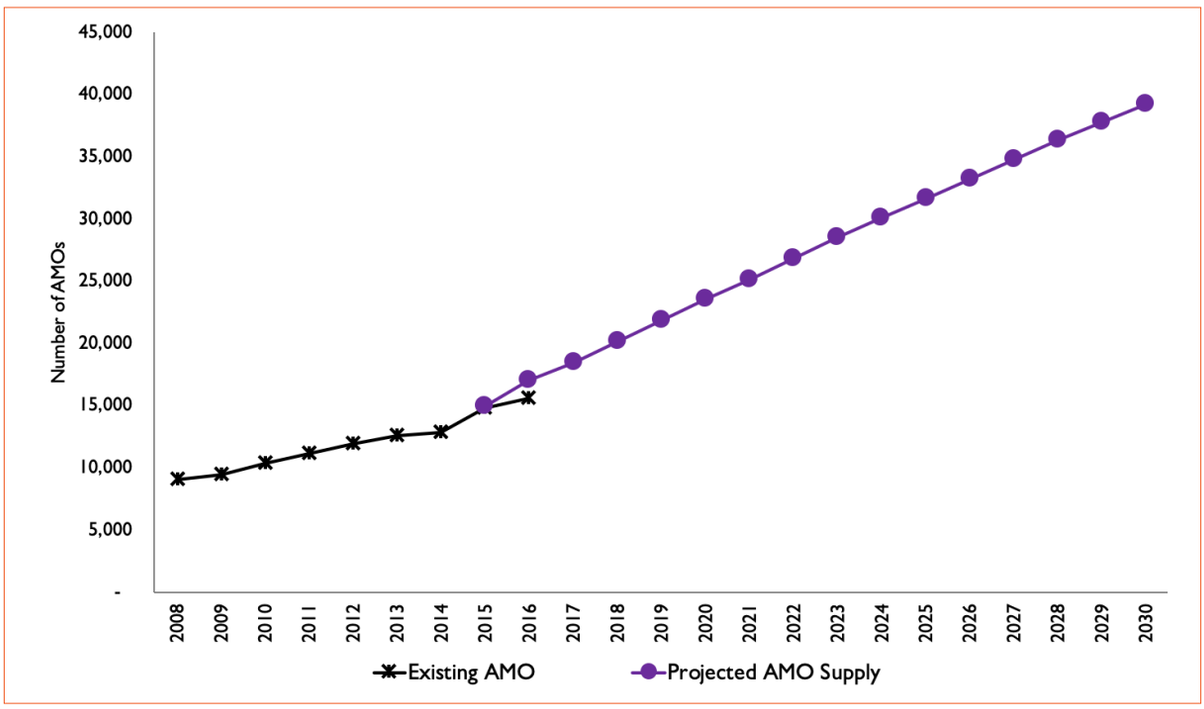
3.5.1 AMO Supply Projection

Table 30 and Figure 28 shows the projected numbers of registered AMOs until the year 2030 based on the number of student intake for AMO training programme for the year 2015 and the projection of AMO supply based on baseline data from 2010 till 2030. The projection shows an increased number of AMO. In 2015, the total number of registered AMOs was 14,724. The projected number of registered AMOs after considering the number of student intake and attrition is 39,244 in 2030, showing an increase of 167% in the period of 15 years. This accounts for 11.1% increase annually over 15 years.

Table 30: Supply of Assistant Medical Officers, 2015 – 2030

Year	ACTUAL			PROJECTION		
	Malaysia Population	AMO		Malaysia Population	AMO	
		Supply (n)	Density per 10,000 Population		Supply (n)	Density per 10,000 Population
2015	31,186,100	14,724	4.7	-	-	-
2016	31,660,700	15,602	4.9	30,875,400	17,015	5.5
2017	-	-	-	31,267,400	18,422	5.9
2018	-	-	-	31,659,700	20,120	6.4
2019	-	-	-	32,051,300	21,808	6.8
2020	-	-	-	32,441,200	23,483	7.2
2021	-	-	-	32,822,900	25,146	7.7
2022	-	-	-	33,200,600	26,793	8.1
2023	-	-	-	33,572,100	28,424	8.5
2024	-	-	-	33,936,900	30,037	8.9
2025	-	-	-	34,294,200	31,631	9.2
2026	-	-	-	34,644,700	33,203	9.6
2027	-	-	-	34,987,600	34,752	9.9
2028	-	-	-	35,322,700	36,277	10.3
2029	-	-	-	35,649,400	37,775	10.6
2030	-	-	-	35,965,700	39,244	10.9

Figure 28: Actual and Projected Supply of Assistant Medical Officers, 2015 - 2030



3.5.2 AMO Requirement Projection

It is also crucial to identify the requirement of AMO based on population health care needs. Health care demand is a reflection of population health-seeking behaviour, which is translated into the utilisation of healthcare services. Based on available data on health care utilisation, analysis based on adjusted needs was carried out to project the health care demand for AMO services. Figure 29 shows the Projection of AMO supply and AMO Requirement based on Need and Demand.

The number required to fulfil Need in 2016 is 27,262 and sees 26% increase in 14 years. Comparatively, the requirement for Demand is 23,022 and 28,203 in 2016 and 2030 respectively (23% increase). The difference in requirement between Need and Demand of AMOs seen in 2030 is 6,202.

Table 31: AMO Requirement Projection Based on Need and Demand, 2016 - 2030

Year	Malaysia Population	AMO Requirement (Need)		AMO Requirement (Demand)	
		n	Density per 10,000 population	n	Density per 10,000 population
2016	30,875,400	27,262	8.8	23,022	7.5
2017	31,267,400	27844	8.9	23,406	7.5
2018	31,659,700	28406	9.0	23,895	7.5
2019	32,051,300	28959	9.0	24,335	7.6
2020	32,441,200	29518	9.1	24,745	7.6
2021	32,822,900	30,063	9.2	25,156	7.7
2022	33,200,600	30,592	9.2	25,526	7.7
2023	33,572,100	31,093	9.3	25,895	7.7
2024	33,936,900	31,618	9.3	26,253	7.7
2025	34,294,200	32,107	9.4	26,585	7.8
2026	34,644,700	32,571	9.4	26,915	7.8
2027	34,987,600	33,044	9.4	27,235	7.8
2028	35,322,700	33,507	9.5	27,563	7.8
2029	35,649,400	33,962	9.5	27,891	7.8
2030	35,965,700	34,405	9.6	28,203	7.8

3.5.3 Gap Analysis

a) Baseline supply and requirement

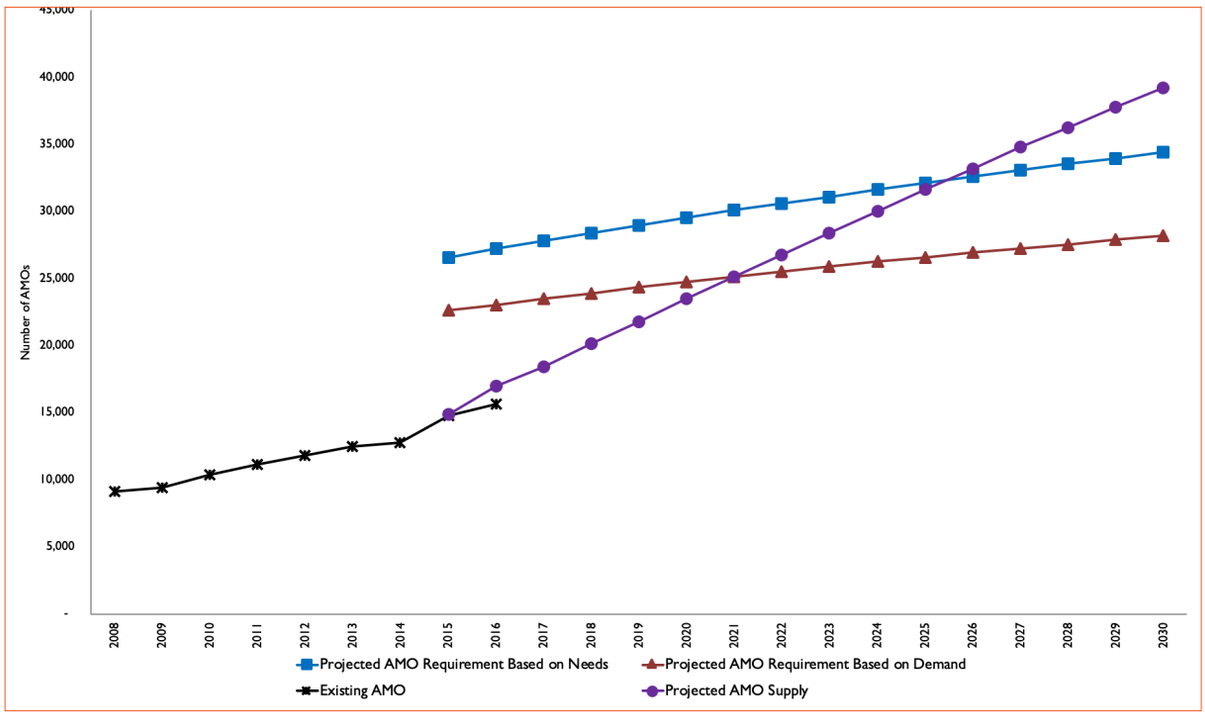
Table 32 and Figure 29 shows the gap between projected supply and requirement according to:

i. Supply and Requirement (Need), and
ii. Supply and Requirement (Demand), and

Table 32: The Gap between Supply and Requirement of Assistant Medical Officers in Malaysia, 2016 - 2030

Year	Supply	Requirement (Need)		Requirement (Demand)	
		n	Gap (Supply - Need)	n	Gap (Supply - Demand)
2016	17,015	27262	-10,247	23022	-6,007
2017	18,422	27844	-9,422	23476	-5,054
2018	20,120	28406	-8,285	23895	-3,775
2019	21,808	28959	-7,151	24335	-2,527
2020	23,483	29518	-6,035	24745	-1,261
2021	25,146	30063	-4,917	25156	-10
2022	26,793	30592	-3,799	25526	1,267
2023	28,424	31093	-2,669	25895	2,530
2024	30,037	31618	-1,580	26253	3,784
2025	31,631	32107	-476	26585	5,046
2026	33,203	32571	632	26915	6,288
2027	34,752	33044	1,708	27235	7,517
2028	36,277	33507	2,770	27563	8,713
2029	37,775	33962	3,813	27891	9,883
2030	39,244	34405	4,839	28203	11,041

Figure 29: Projection of Assistant Medical Officers Supply and Requirement Based on Need and Demand



The undersupply of the AMOs in meeting population healthcare needs is apparent in the first ten years. Following a balance between supply and Need in 2026, it can be seen that supply of AMOs will exceed population health care requirement or known as oversupply if all parameters remain the same. The supply of AMOs will exceed (surplus) the projected Need by 10.0% and projected Demand by 30% in 2030.

It can be seen that by 2021, there will be an oversupply of AMOs in Malaysia to fulfil the health care demand. Nevertheless, the requirement projections do not account for existing and future needs of rehabilitation, palliative, geriatric care services, increase in disease burden and incidence as well as advancement in medical care. The needs for these services are presumed to have a significant impact on AMOs requirement.

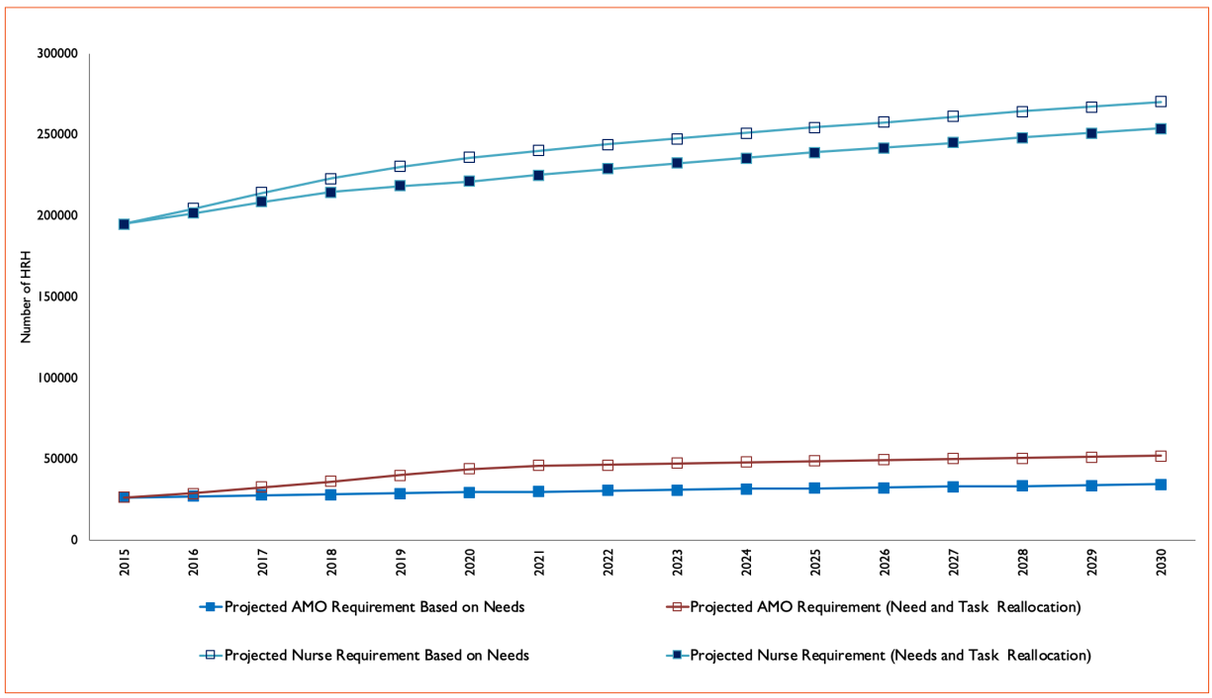
b) Scenario Task Reallocation

At present, there are many areas where AMOs and nurses have similar functions, although technically a certain portion of tasks are handled entirely by the AMOs. This is based on the training syllabus of the AMO diploma program. However, there was overlapping or task-sharing along time with nurses due to HRH shortage in certain areas of service, as well as the post-basic programs and on-job training offered to nurses. The scenario depicted here is based on assumptions that certain areas are totally handled by either the AMOs or nurses from the year 2020 onwards. Baseline requirement based on need follows current practice at the facility level.

Currently, the boundary between the job scopes of nurses and AMOs are unclear. There is a lot of task-sharing between these two professions whereby either one could do the job depending on the availability of staff at a particular time. For example, nurses have been known to be posted in the emergency department despite it being the territory of AMOs based on formal training. Due to the overlapping roles between nurses and AMOs, projections into their requirement are difficult to attain. Therefore, one of the way forward is to clearly delineate their roles and streamline the job scopes. For example, services like the emergency department, haemodialysis, outpatient department can be delegated to AMO while services in psychiatry ward and school health are to be done by nurses.

Figure 30 shows that 52,064 AMOs are required based on the population's needs in 2030 if the tasks mentioned above have been fully shifted to the AMOs, which is 17,659 more than what is required if there is no task shifting (reallocation). Compare that to the nurses, and it could be observed that the requirement for nurses in 2030 is slightly less than the requirement based on need if there is task shifting (reallocation). This indirectly indicates that a lot of the AMOs' job scopes are currently being covered by the nurses.

Figure 30: Requirement Projections of Assistant Medical Officers and Nurses Before and After Task Reallocation



It is noted that the supply of nurses even by the year 2030 would not be able to meet the requirement if task shifting is fully in practice, whereby if the current task-sharing continues, the supply will meet requirement of the population needs by the year 2025. The production of AMO might be a result of their roles being taken over by nurses, giving the impression that there is no longer high demand for AMOs. Apart from that their roles in outpatient consultations have also been gradually be replaced by doctors.

Redifining job scope by focusing services in emergency, pre-hospital care and handling / assisting procedures in specific disciplines such as orthopaedic, cardiothoracic, neurosurgery, neurology which will need to be discussed and decided between Nursing Division and AMO Board.

Table 33: The Proportion of Task-Sharing Between AMO and Nurses for Current Task Allocation and Proposed Task Reallocation Scenario

Department / Service	Current Task-Sharing Allocation		Proposed Task-Sharing Reallocation	
	Nurse (%)	AMO (%)	Nurse (%)	AMO (%)
Emergency Department	50	50	0	100
Outpatient Department	50	50	0	100
School Health	91	9	100	0
Adolescent Health	50	50	0	100
Men's Health	80	20	0	100
Haemodialysis	50	50	0	100

Figure 31: AMOs Requirement Projections Before and After Task-Sharing

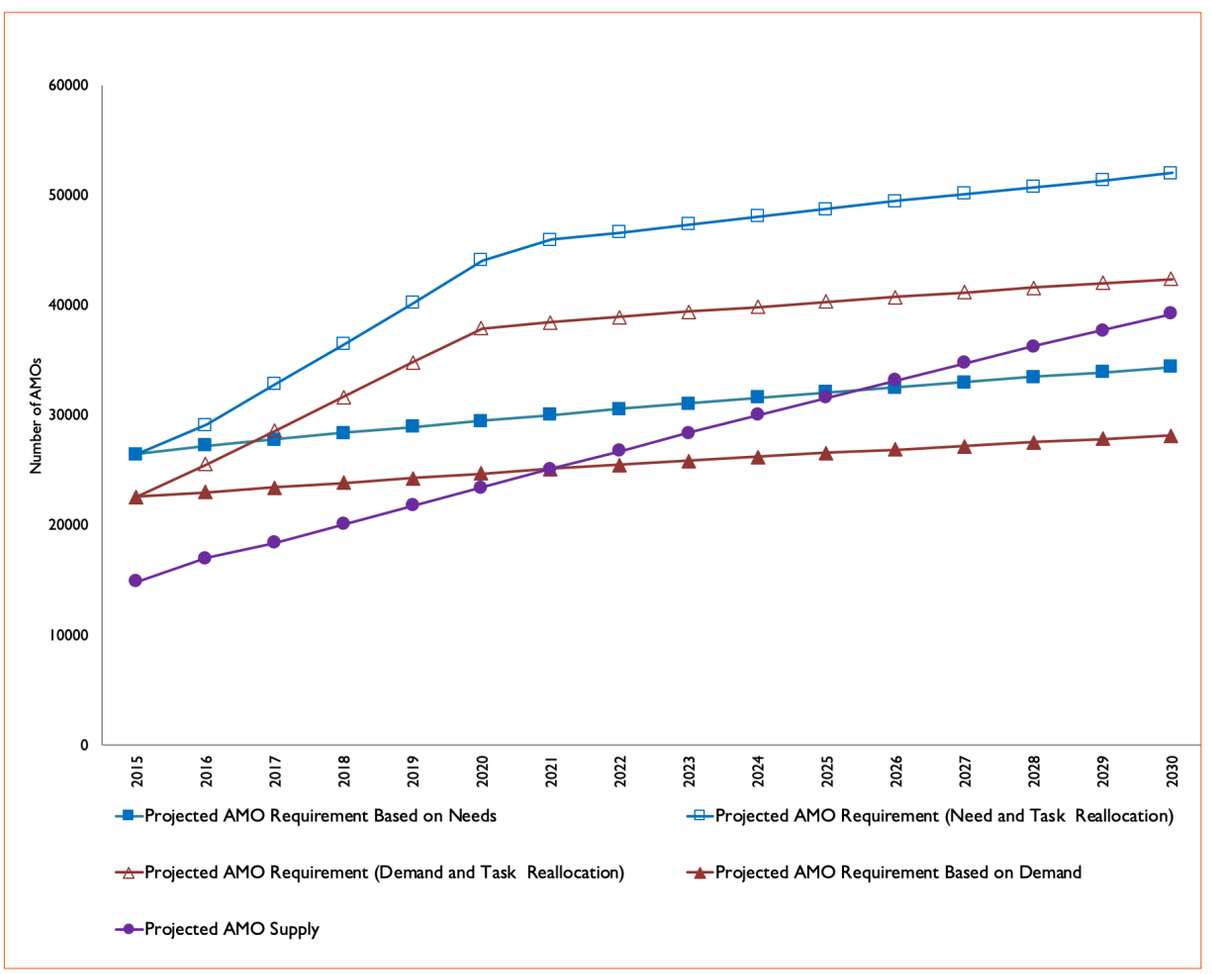
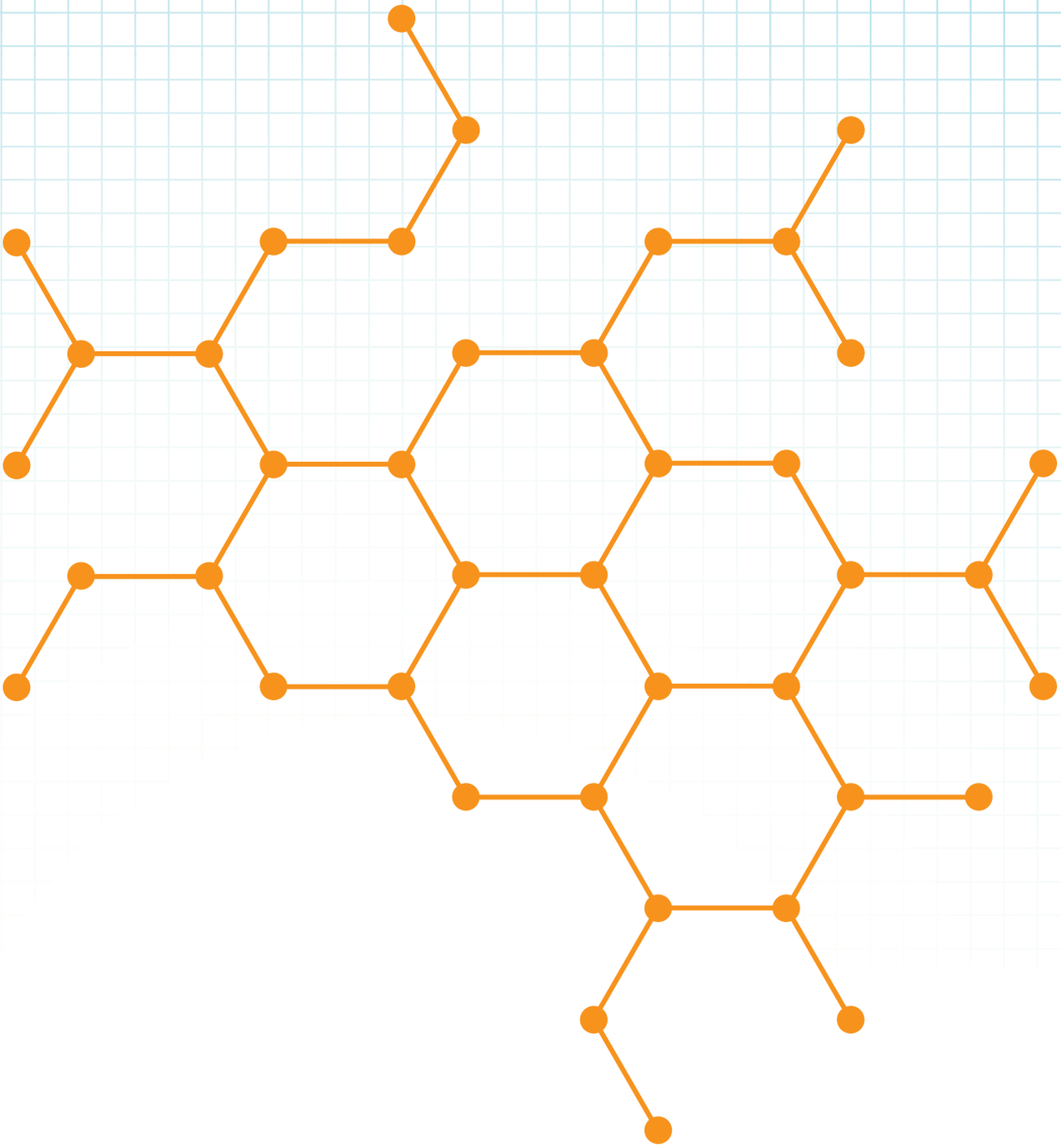


Table 34: The Gap between Supply and Requirement Following Task Reallocation of Assistant Medical Officers in Malaysia, 2016 - 2030

Year	Supply	Requirement (Task Reallocation)	
		n	Gap (Supply - Need)
2016	17,015	29126	-12,111
2017	18,422	32835	-14,413
2018	20,120	36472	-16,352
2019	21,808	40218	-18,410
2020	23,483	44118	-20,635
2021	25,146	45993	-20,847
2022	26,793	46634	-19,841
2023	28,424	47361	-18,937
2024	30,037	48086	-18,049
2025	31,631	48785	-17,154
2026	33,203	49483	-16,280
2027	34,752	50169	-15,417
2028	36,277	50739	-14,462
2029	37,775	51398	-13,623
2030	39,244	52064	-12,820

Notes: Positive (+) gap indicates a surplus, and negative (-) gap indicates a shortage



4

LIMITATION

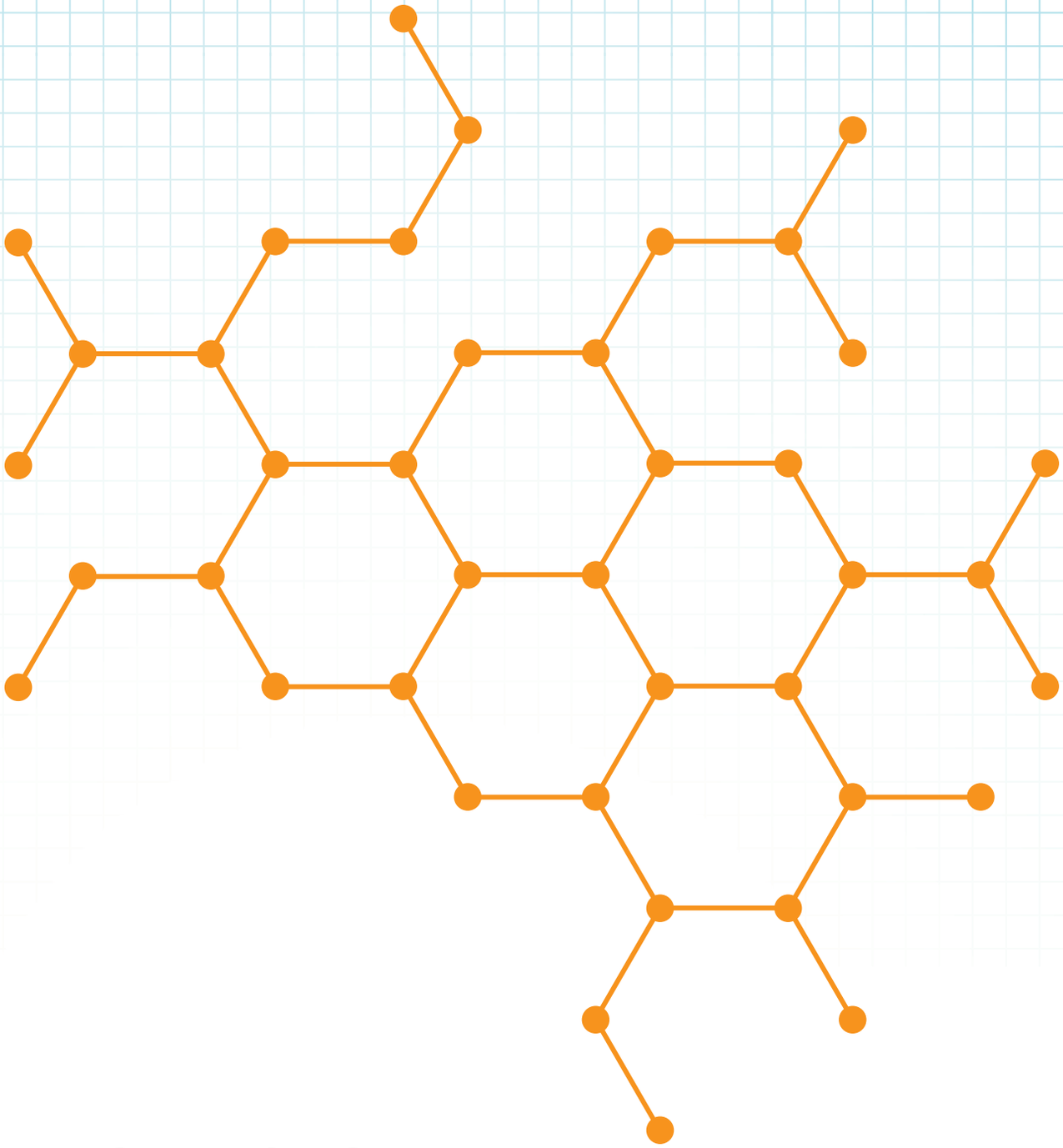
SUPPLY AND NEEDS-BASED REQUIREMENT PROJECTIONS OF HUMAN RESOURCE FOR HEALTH IN MALAYSIA USING SYSTEM DYNAMICS APPROACH 2016 – 2030

4. LIMITATION

The study on the projection of HRH supply and requirement based on need and demand were based on various sources of data, including experts' opinion and consensus, for some of the data that were not available. Subsequent research in similar areas must attempt to verify these data through comparison with data available in the new health information system, research, or clinical audit.

As for health services provided by trained HRH, population health care needs for rehabilitation medicine, palliative and geriatric care were not included in this study. This study also did not venture in detail on indirect health care services, community-based services, and administrative works perform by HRH as well as system inefficiency, which may influence HRH's productivity. These are the areas that can be included in the review of HRH projections or studied separately in future.

The study on the projection of human resource for health (HRH) supply and requirement based on need and demand were based on various sources of data including expert opinion for some of the data which was not available. Subsequent research in a similar area must attempt to verify these data through comparison with data available in a new health information system, research or clinical audit.



5

CONCLUSION

SUPPLY AND NEEDS-BASED REQUIREMENT PROJECTIONS OF HUMAN RESOURCE FOR HEALTH IN MALAYSIA USING SYSTEM DYNAMICS APPROACH 2016 – 2030

5. CONCLUSION

5.1 Meeting Population Health Care Requirement

Government and stakeholders should aim to satisfy population health care requirement based on need as compared to merely focus on demand to ensure Malaysia population has equitable access to health care services. Some profession in this study (e.g. nurse) has a wider gap in meeting the need and demand as compared to other professions. The presence of a gap between HRH supply and requirement for their health services should be reviewed together or compared to health care service performance. This is because; any shortfalls in meeting patient's safety and quality of care may have a direct or indirect relationship to HRH as HRH is the most important 'tool' in health care services.

5.2 Addressing Shortages and Potential Oversupply

To ensure the quality of service delivery as well as patients' safety, strategy to address the undersupply of dentist and nurses need to be in place. Since it takes three (3) to five (5) years for basic training of HRH not including additional professional training for registration and/or competency purposes, relevant stakeholders need to continue to strengthen HRH planning which includes;

- Reallocation of a task. Task shifting and/ or re-allocation between nurses and AMOs with re-focusing of nursing roles in inpatient care to minimise the significant gap in supply and requirement of nurses.
- Initiative to retain trained HRH in the country to reduce the number of trained HRH serve in a foreign country.
- Recruitment of foreign-born HRH to serve in Malaysia in a limited period of time, while waiting for the "production" of HRH to pick up. Drastic measures to increase the locally trained HRH to meet health care needs or demand in short period shall not be considered as this may create additional long-term challenges to control the potential oversupply and poor quality of HRH.
- Re-employ and encourage re-entry into the workforce among professionally inactive and retired HRH.
- Create more post or job opportunity for HRH to meet the population's health care needs and demand

As for the potential oversupply in some professions such as doctors and AMO's, relevant stakeholders, namely the Ministry of Education and local training institutions should review and amend the total number of students intake accordingly. This will directly influence the number of graduates and increase the probability to gain employment. Besides that, it will indirectly improve their quality by ensuring better students to trainer ratio as well as optimal training opportunity during basic education in the in early years of their professions.

EXTENDED EXECUTIVE SUMMARY 79

5.3 Data Availability

This study identifies a dire need for an improvement in data availability and quality on HRH, epidemiology and health care service. Although it is known that there are a lot of data, however

- The information on HRH is not integrated and consistent across professions, which may be due to different act that governs each profession. The information on total stock, inactive HRH and professional attrition rate can be obtained by regularly updating the registry including liaising with the National Registration Department if necessary.
- Data documenting individual patient care at the level of care as well as utilisation of health service data by population are not comprehensive. This study relied on experts and the Ministry of Health data to estimate health care needs and utilisation of health services.
- Comprehensive data on out-migration of health personnel was not available during the study period. However, as the registration process of health personnel improves over the years, data on out-migration may be made available to better project HRH supply in the future, e.g. Malaysia Nursing Board documented an in creasing trend on nurses leaving Malaysia and working abroad from the year 2016 to 2018 (which is an almost two-fold increase). This data information will help the policymaker to address out-migration issue in future

Relevant stakeholders are also encouraged to conduct disease projections to document and visualise the probable future of Malaysians health status. This information will greatly help relevant policymaker to prepare the resources needed to address b health needs.

5.4 Addressing Task-Sharing and Task Reallocation

It is observed, based on practice, that there is an overlap between nurses and AMO job scope and unclear task demarcation at Out-patient, Emergency Department, School Health, Adolescent Health, Men's Health and Haemodialysis. This may create inefficiency, reduce productivity, ineffective distribution of health professional, and lastly, it could affect the post-basic training plan to suit service needs. This task demarcation should be made clear across the profession of nurses and AMO's and those with post-basic training.

Therefore, some of the solutions are to reallocate the nurse tasks with AMO according to their basic training to ensure quality and smooth service delivery. To enhance the relevance of AMO service in healthcare service, clearer demarcation of job scope should be endorsed by top management. Enhancing the role and capacity of AMO could further improve the care of patients and contribute to the survival rate of emergency department patients. To increase access to effective services, some strategies i.e. task reallocations, are applied.

Although task-sharing and reallocation is suggested to compensate human resource shortage, our study illustrates that this approach can increase productivity. This could also entail an opportunity for integration of new programs in the facilities without employing new workforces. In fact, the focus could be on appropriate task-sharing in facilities with sufficient human resources to increase productivity as well as task shifting to address human resource shortages. Apart from this, a guide or a task-sharing policy should be looked into, to prevent burn-out of healthcare worker from either profession.

SUPPLY AND NEEDS-BASED REQUIREMENT PROJECTIONS OF MALAYSIAN HUMAN RESOURCES FOR HEALTH USING SYSTEM DYNAMICS APPROACH 2016 - 2030

5.5 Addressing Basic Education

There is also an effort by the government to upgrade the nursing profession so that it is equivalent to other careers or profession by specifying the entry requirements from Diploma to Degree. In general, the job scope of any professions in a government setting is different between Diploma and Degree holder / entry requirement. In this study, based on practice, the requirement model did not differentiate between diploma and degree holder of nurses. In future, if there is a different role between diploma and degree holder the requirement, then it should be identified.

It is timely for Malaysia to identify either need to increase the nurse stock with Diploma or Degree certification and to review the projection of nurses requirement in the future. It is also proposed that a detailed study on quality of patient care and competent nurses regardless of qualification in Diploma and Degree to be conducted in the future to ensure there is a clear segregation of task for these two qualifications. Without proper planning, there will be a conflict between and across nursing professions.

5.6 Human Resource for Health Projections Study

As new data and changes in the trend are important parameters evolve over time, the study on HRH projection should be periodically reviewed at least every five years, or as regular as when new data and circumstances arise, to assist long term country's HRH planning. The study shall also coincide with every two cycles of the Malaysia Plan.

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GLOSSARY

Attrition rate	Percentage at which health personnel professionally becomes inactive due to death, complete retirement or outmigration, exit compulsory training period to obtain full registration without completion
Complete retirement	Complete retirement refers total withdrawal from occupation; professionally inactive
Demand	Demand is the number of health workers that the health system (both public and private) can support in terms of funded positions or economic demand for services (Scheffler et al. 2016). However, demand in this study refers to the 'adjusted need' which is defined as the health care needs adjusted to follow close the current health care utilizations.
Direct patient care	Direct patient care is defined as health care services encompassing the entire spectrum of care provided directly to patient as an individual, ranging from preventive care, and primary to tertiary care.
Drop out	Students from a cohort leaving health workforce education and training without completion
Expert opinion	Data obtained from consensus of expert panels on the subject; panel of experts as source of input data
Full Time Equivalent (FTE)	One (1) full time equivalent of health personnel is defined as one-health personnel working full time providing direct patient care. Respective profession has its own FTE
House Officer	House Officer in this study refers to medical graduates undergoing housemanship training at selected healthcare facilities in Malaysia. House Officer obtains provisional licencing with Malaysia Medical Council
Indirect patient care	Indirect patient care revolves around public health services, administration, academic, research and regulatory.
Health care personnel to population ratio	Health care personnel to population ratio can be calculated from health care professional density by dividing the number of population to the number of health care professionals Eg. Five (5) AMOs in 10,000 population in year 2015 = 10,000 / 5 = 2,000 Therefore, the AMOs to population ratio in 2015 was 1 AMOs to 2,000 population (1:2000)
Human resource for health (HRH)	All people engaged in actions whose primary intent is to enhance health (Scheffler et al. 2016).
Need	Need in this study refers to population health care needs for preventive, disease-based and other health care services based on health care provider's perspective, and estimated using Needs-based approach. "Need" for human resource for health in the analysis is defined as the number of health workers required to fulfil the Malaysia population healthcare service requirement.
Needs-based	Needs-based is the approach used in this study to estimate the total population health care needs as the basis for determining the number of HRH workforce required to serve all the need.

Registered Pharmacist	Registered pharmacist means a provisionally registered pharmacist under section 6 or a fully registered pharmacist under section 6B, under Registration of Pharmacist Act (ROPA) 1951
Supply	Supply in this study refers to the number of health workers that are available in a country to work as a competent health personnel. Future supply is estimated based on a variety of parameters, including training and attrition.
Task-sharing	Task-sharing in this study refers to the delegation of tasks between nurses and AMOs according to their basic training

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