Chapter 5

Social Infrastructure Demand for Health Services

1. Introduction

In Thailand, the main organization administrating the public healthcare service is the Ministry of Public Health (MOPH). The history of public health services has been started in 1888. At the time, the main service was from the Department of Nursing, Ministry of Education. In 1918, the operation was under the Ministry of Interior, where the Public Health Department was established. In 1942, the health services have been consolidated under the Ministry of Public Health according to the Reorganization of Ministries, Sub-Ministries, and Departments Act, B.E. 2485 (1942).

The public health service philosophy has been substantially changed in 2002. The civilian government has introduced a health system with the 'Universal Coverage Scheme' (UCS). The UCS has implemented a nationwide *healthcare coverage* for the major population. The service was managed by a new organization, *National Health Security Office* (NHSO). The philosophy of management is to separate supervision of supply and demand for healthcare. The healthcare *demand* by all clients will be consolidated under the supervision of NHSO. The healthcare supply is provided by the hospitals under the MOPH and private hospital, which are additional providers. Under this scheme, the NHSO functions as a clearinghouse of all health care purchasers.

Clearly, the UCS system has empowered any Thai's accessibility to fundamental healthcare service. The government has shifted the *supply side* budgetary system allocated through the MOPH to the demand side with capitation system. Conceptually, the total cost of supply provision has been equated from the assumed equilibrium between demand and supply of health service, where 'average cost of provision=average buying price of health service per capita'. The former is basically calculated from the *ex-ante* average cost given size of hospital measured by a number of hospital beds. It is calculated by matching allocated budget to each hospital by the number of patients multiplied by a unit cost of medical care per person on the average. The capitation of medical demand price is equated with the average cost per client. Payment is agreed through the budgetary process to the providers via the UCS. Thus, it is a budgeting process of the parliamentary system where the whole feedback loop between demand and supply are determined by population's needs and cost of provisions. The demand side was calculated from the given population cohort weighted by probability of illness of in-out patients, less success rate in precautionary effort. Recently, the stochastic influence of 'non-communicable disease, NCD' has distorted the demand price and cost of supply unexpectedly. As a result, the *ex-post* demand price

and average cost has created wide *margin of gap*. This is currently a hot debate in Thailand among practitioners, NPO and general public of the UCS.

Ideally, a consolidated fraction of financial account of the UCS (fully funded by the government), Social Security (funded through a joint contribution of employee and employer), the Civil Servant Medical Benefit Scheme (CSMBS), and other programs such as private health insurances is ultimate aim of the health system in Thailand. This is still far from actualization. A consolidated demand under the UCS has been claimed to improve social welfare of the Thais households on health accessibility. Problems still remain on the supply side and personnel's welfare i.e., medical doctors and others, as well as capital investment of hospitals owing to the rising marginal cost of supply provision, uneven congestion of demand and spatial inequality of service supply.

In our study, the evolution of Thailand's healthcare service and UCS has been examined and used as the case study. Despite the hot debates of UCS, it was however quoted as "one of the most ambitious healthcare reforms ever undertaken in a developing country" in the report titled *Millions Saved: New Cases of Proven Success in Global Health*.[1] According to this report, Thailand's health care evolution offers the healthcare service covering 98% of the population and costs only $80 per person. A study in infant mortality has documented that this program succeeded in lowering the equity gap in infant health between the rich and the poor.[2]

It was cited by a famous economist such as Amartya Sen as follows.[3]

"... This includes the remarkable achievements of Thailand, which has had for the last decade and a half a powerful political commitment to providing inexpensive, reliable healthcare for all.

Thailand's experience in universal healthcare is exemplary, both in advancing health achievements across the board and in reducing inequalities between classes and regions.

Prior to the introduction of UHC in 2001, there was reasonably good insurance coverage for about a quarter of the population. This privileged group included well-placed government servants, who qualified for a civil service medical benefits scheme, and employees in the privately owned organized sector, which had a mandatory social security scheme from 1990 onwards, and received some government subsidy.

*In the 1990s some further schemes of government subsidy did emerge, however they proved woefully inadequate. The bulk of the population had to continue to rely largely on out-of-pocket payments for medical care. However, in 2001 the government introduced a "**30 baht universal coverage programme**" that, for the*

[1] http://millionssaved.cgdev.org/case-studies/thailands-universal-coverage-scheme
[2] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3998713

[3] **Amartya Sen**, Universal healthcare: the affordable dream, *https://www.theguardian.com/society/2015/jan/06/-sp-universal-healthcare-the-affordable-dream-amartya-sen*

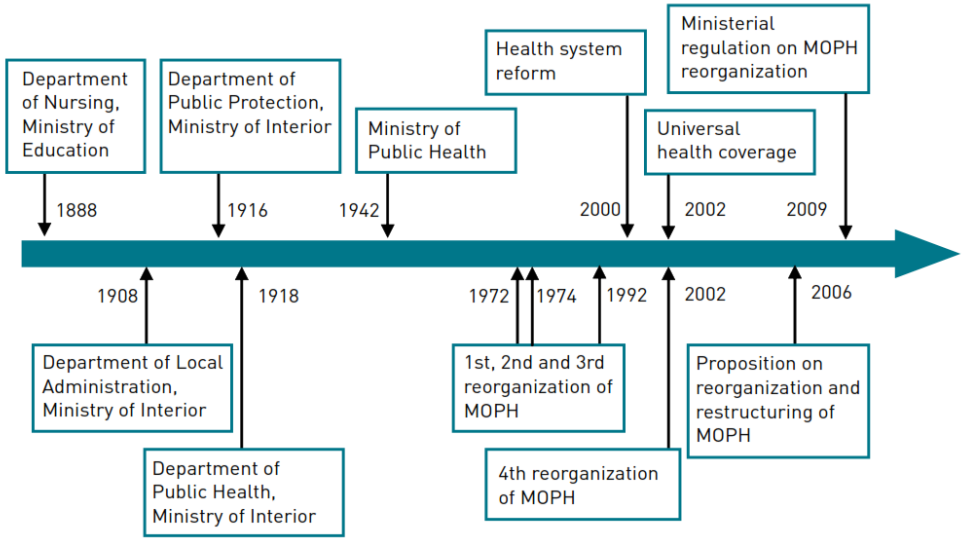
first time, covered ***all*** *the population, with a guarantee that a patient would not have to pay more than 30 baht (about 60p) per visit for medical care (there is exemption for all charges for the poorer sections – about a quarter – of the population).*

The result of universal health coverage in Thailand has been a significant ***fall in mortality*** *(particularly infant and child mortality, with infant mortality as low as 11 per 1,000) and a remarkable* ***rise in life expectancy,*** *which is now more than 74 years at birth – major achievements for a poor country.*

There has also been an astonishing removal of historic disparities in infant mortality between the poorer and richer regions of Thailand; so much so that Thailand's low infant mortality rate is now shared by the poorer and richer parts of the country. …"

Also, the report published by the World Bank indicates that UCS has reduced the number of people reporting themselves to be too sick to work.[4] Although the evolution of healthcare service in Thailand has led to substantial benefits to the nationwide population for 14 years, there still will be challenges in the future due to the aging society in Thailand. Therefore, this report aims at exploring the preparation of health infrastructure to the future change in demographics in Thailand.

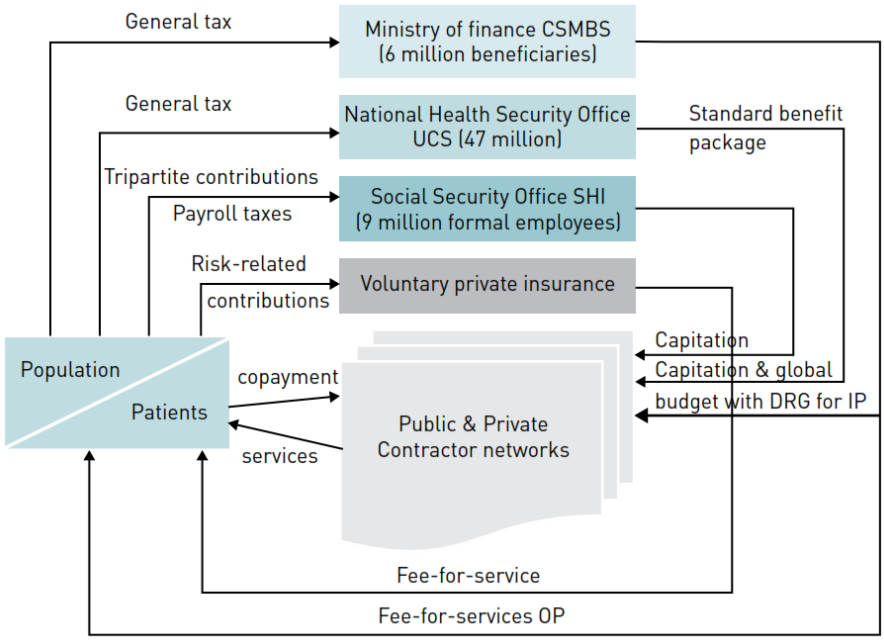
Figure 5.1 Chronology of development of public health in Thailand



Source: Tangcharoensathien et al. (2015) and Wibulpolprasert et al. (2011)

[4] http://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-6119

Figure 5.2 The structure of healthcare coverage and its sources of funds in Thailand



CSMBS: Civil Servant Medical Benefit Scheme; DRG: diagnosis-related group; IP: inpatient; OP: outpatient; SHI: Social Health Insurance; UCS: Universal Coverage Scheme.

Source: Tangcharoensathien et al. (2015)

2. Main Analytical Framework

The analysis is based on the main structure of healthcare service in Thailand. Particularly, the service has been classified into 4 broad categories of service levels, which are provided by the primary hospital, the secondary hospital, the tertiary hospital, and the excellent center. The demographic statistics is the main data source.

The next step of estimation is the computation using the ratio of *required healthcare demand per population* in each level of the hospital. The calculation generates the demand for both human resources and facilities in healthcare service for a particular category of hospital. The last step of computation is the estimate of a required total budget for both human resources and facilities.

The base case projection was obtained from the service plan (2011-2016) of Thailand's Ministry of Public Health. This plan has been formulated to estimate the nationwide demands for both facilities and human resources. In addition, the plan has been used as the main guideline for

administrating public health services which have the hierarchy of services and facilities. Thailand's Ministry of Public Health has classified hospitals into 6 categories.

The classification's criteria are the following factors:

(1) Size of a population in that area (for example, the primary hospital has the ratio of one hospital per population of 10,000)

(2) Distance (kilometers) from the center of a particular district to the hospital

(3) Traveling time (minutes) from the center of a particular district to the hospital

Figure 5.3 Main structure of estimation methodology

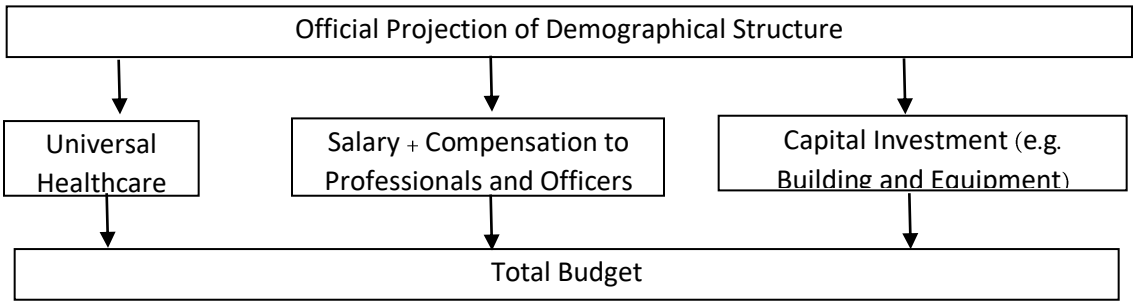
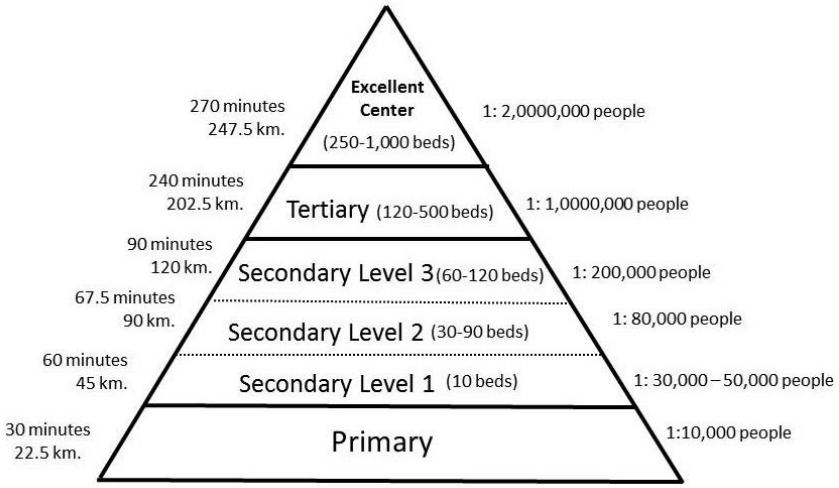


Figure 5.4: Hierarchical classification of public hospitals in Thailand



Source: Ministry of Public Health, Thailand

Among 6 categories, the primary hospital is the smallest one, having 1-2 doctors and capable of offering basic healthcare services. The higher levels are secondary hospitals, which

have three subcategories. When facing complicated symptoms or diseases, the primary hospital transfers the patient to these hospitals because they have the higher capability due to their extended facilities and human resources. However, if the treatment requires more specializations of doctor and medical equipment, the patient can be transferred to the tertiary hospitals, which have medical specialists in all fields and the higher level of medical facilities.

Table 5.1 Main requirement criteria for human resource and location at each level of public hospital

Requirement criteria of human resource demand (per population)	*Primary hospital*	*Secondary (level 1) hospital*	*Secondary (level 2) hospital*	*Secondary (level 3) hospital*	*Tertiary hospital*
Doctor	1 : 10,000		1 : 15,000	1 : 75,000	1 : 62,500
Dentist	1 : 12,500		1 : 75,000	1 : 50,000	1 : 500,000
Pharmacist	1 : 15,000		1 : 50,000	1 : 50,000	1 : 500,000
Nurse	2 : 5,000	1 : 1,500	1 : 4,000	1 : 7,500	1 : 7,500
Dentist Assistant	1 : 10,000		-	-	-
Pharmacist Assistant	1 : 10,000		-	-	-
Public Health Officer	3 : 5,000	1 : 12,500	1 : 25,000	1 : 50,000	1 : 75,000
X-ray Technologist	-	1 : 30,000	1 : 150,000	1 : 250,000	1 : 300,000
Medical Technologist	-	1 : 20,000	1 : 100,000	1 : 150,000	1 : 250,000
Physiotherapist	-	1 : 20,000	1 : 150,000	1 : 250,000	1 : 300,000
Criteria for location selection					
Population in service area	10,000	30,000 - 50,000	80,000	200,000	1,000,000
Traveling time of patient to the hospital (minutes)	30	60	90	120	240
Radius of service area (km.)	0-22.5	0-45	0-67.5	0-90	0-202.5

Source: Ministry of Public Health, Thailand

The criteria of location selection are consistent with a higher level of the public hospital which has a large coverage area of service, and also the broader and deeper capability of services. These specific details of capability and facility of each level of the hospital are described as follows:

The primary and secondary (level 1) hospitals have the similar capability, except the case of offering X-ray service and the possession of operating room which are available in the secondary (level 1) one.

In the next level, the secondary (level 2) hospital has the larger size, providing services to the larger number of both OPD (Out Patient Department) and IPD (In-Patient Department) patients.

The secondary (level 3) hospital has the augmented functions of providing treatments from medical specialties in some fields. The allocation of medical specialties is based on the area-specific demand.

The tertiary hospital is the general hospital that can offer the broad ranges of services from medical specialties in 6 fields. Details of all available areas of services from 6 medical specialties, and also indicates the ratio of one specialty per population is shown. Here, the tertiary hospital has the extended facilities which are not available in the secondary hospitals. These are main physical facilities serve the high level of medical treatments conducted by medical specialties.

Table 5.2 Capability and facility of each level of public hospital

Capability	*Primary hospital*	*Secondary (level 1) hospital*	*Secondary (level 2) hospital*	*Secondary (level3) hospital*	*Tertiary hospital*
Service capability of Out Patient Department (OPD)	0 - 100 patients / day	0 - 100 patients / day	100 - 250 patients / day	200 - 400 patients / day	300 – 500 patients / day
Service capability of In-Patient Department (IPD)	0 -10 patients / day	0 -10 patients / day	10 -50 patients / day	30 -80 patients / day	60 -100 patients / day
Number of doctors	1-2	1-2	2-5	3 -10 (including Medical Specialties in some fields)	8-20 (including Medical Specialties in 6 fields)

Facilities	- Basic Operating Room - Delivery Room - Observation Ward - Dental Clinic	- IPD Ward - Operating Room - Delivery Room - X-ray Room - Dental Clinic	- IPD Ward - Operating Room - Delivery Room - X-ray Room - Dental Clinic	- IPD Ward - Operating Room - Delivery Room - X-ray Room - Dental Clinic	- IPD Ward - Operating Room - Delivery Room - Intensive Care Unit (ICU) - Neo-natal Intensive Care Unit (NICU) - Orthopedic Operating Room - Clinical Laboratory - Radiation Room - Dental Clinic

Source: Ministry of Public Health, Thailand

Table.5.3 List Medical Specialties and requirement criteria of Medical Specialties demand (for the Tertiary hospital)

Medical Specialties	*Ratio per population*
Physician	1 : 65,000
Surgeon	1 : 90,000
Obstetrician	1 : 80,000
Pediatrician	1 : 75,000
Orthopedist	1 : 95,000
Anesthesiologist	1 : 150,000

Source: Ministry of Public Health, Thailand

The excellent center is the highest level of a hospital in the hierarchical structure. In addition to 6 areas of medical specialties, it has specialties specialized in the subfields (i.e. the sub-specialists), and it the total numbers of 205-352 doctors. Most of the excellent centers also function as the medical school at a graduate level, offering the official course of training for specialties.

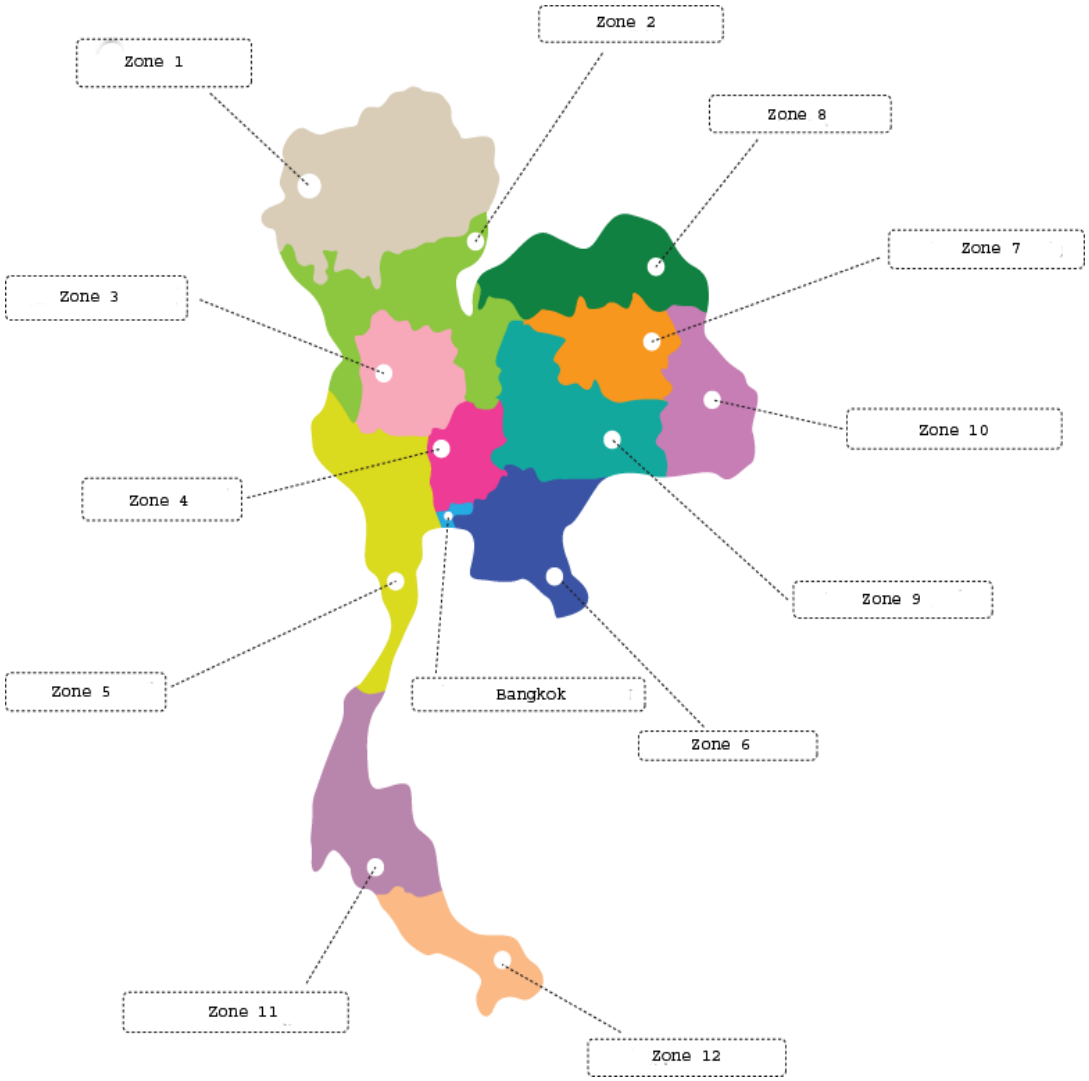
With criteria and specification indicated mention above, Thailand's Ministry of Public Health has utilized GIS (Geographic Information System) techniques to locate hospitals and allocate human resources. Specifically, the coverage of providing services has been categorized into 13 zones, as illustrated in Fig. 5.5. Each zone has its hierarchical system of hospitals, and there are approximately 3 excellent centers functioning as the highest level of services, and there is a network of primary, secondary and tertiary hospitals connected to them.

With these allocations of 13 zones and the hierarchy-network of hospitals within each zone, the table below indicates the nationwide total number of hospitals in each level. It is noted that the number of hospitals is mostly proportionate to the hierarchical system. The exception is the case of secondary hospitals because in many areas the level-2 secondary hospital is well suited for their numbers of the population.

The number of key human resources in health science in Thailand in 2016 is forecasted with a projected number of Thai population and key ratios of demands for healthcare shown in previous tables also indicates the projected demand for key human resources in 2026.

This result suggests the next step of conducting the study, which is the analysis of demand and supply of future health system in Thailand. The supply projection will be estimated based on the nationwide capability of education in health science. The outcome will identify key issues for preparation in both human capital and budget toward the sustainability of the national health system.

Figure 5.5 Map of public-health service zones in Thailand



Source: Ministry of Public Health, Thailand

Table 5.4 Number of the public hospital at each level

Level of hospital	*Number of beds*	*Number of hospitals (in the whole country)*
Excellent center	250 – 1,000	33
Tertiary hospital	120 – 500	118
Secondary (level 3) hospital	60 – 120	71
Secondary (level2) hospital	30 – 90	518
Secondary (level 1) hospital	0-10	35
Primary	0-10	9,976

Source: Ministry of Public Health, Thailand

Table 5.5 Number of public staff at each level

Occupation	*Number of public health personnel in 2016*	*Projected demand for public health personnel in 2026*
Doctor	50,573	62,800
Nurse	149,072	186,700
Dentist	11,575	17,400
Pharmacist	26,187	39,900
Medical Technologist	15,200	23,900
Physiotherapist	4,371	11,100

Source: Ministry of Public Health, Thailand and author's estimate

Table 5.6: Number of graduates in health care fields in Thailand (data as of 2016)

Occupation	*Number of educational institutes*	*Number of graduates (per annual)*
Doctor	21	3,121
Nurse	85	12,000
Dentist	13	826
Pharmacist	18	20,00
Medical Technologist	12	911
Physiotherapist	16	800

Source: Ministry of Public Health, Thailand

3. National Budget for Universal Healthcare Services

The annual budget for national healthcare has been separated into 3 categories.

(1) The annual budget for Universal Healthcare service
   a. In-Patient (IP)
   b. Out-Patient (OP)
   c. Preventive Promotion (PP)
(2) The annual budget for personnel compensation (e.g. salary and benefit)
(3) The annual budget for capital investment

The budget for Universal Healthcare is the largest portion and it has played a major role in the national scheme of public health. Specifically, there are three subcategories of budget allocation under the Universal Healthcare. Each has been estimated based on the per-capita requirement.

As shown in Fig. 5.6 and 5.7, the per-capita budget allocation has been increasing since 2003. However, its ratio as a percentage of total fiscal expenditure has been stable during 2003-2016, as exhibited in Fig. 5.8. Originally, the budget was allocated to financially support the services of *In-Patients (IP)* and *Out-Patients* (*OP*). Later, the *Preventive Promotion* (PP) has been also included in the budget because it can lower the incidences of many diseases, which will subsequently lower the demand for healthcare and the future budget burden.

In our study, the methodology of forecasting the Universal Healthcare Budget was based on the average of *cost per capita*. As earlier stated, the combination of averages of *In-Patient (IP), Out-Patient (OP) and Preventive Promotion (PP)* led to the *average total costs*. The projection of future budget of Universal Healthcare was then computed by using this average with the official projection of population.

Figure 5.6: The historical trends of budget allocated to Universal Healthcare and to Salary and Compensation

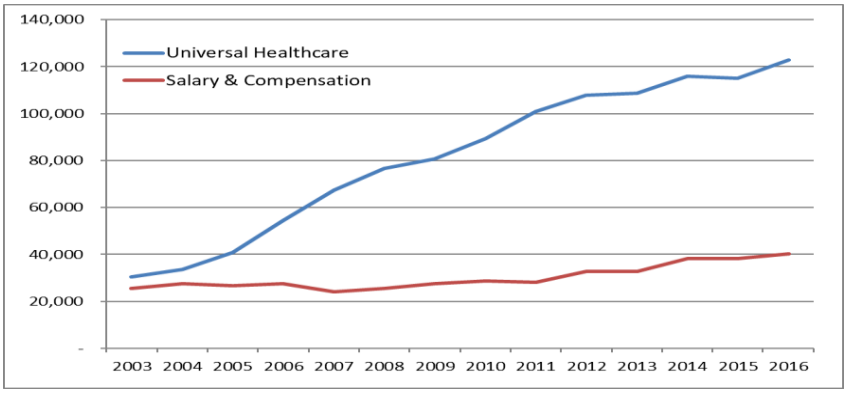
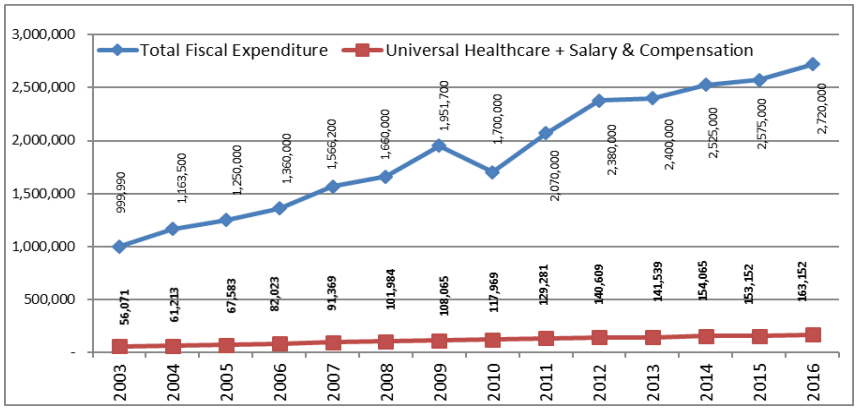


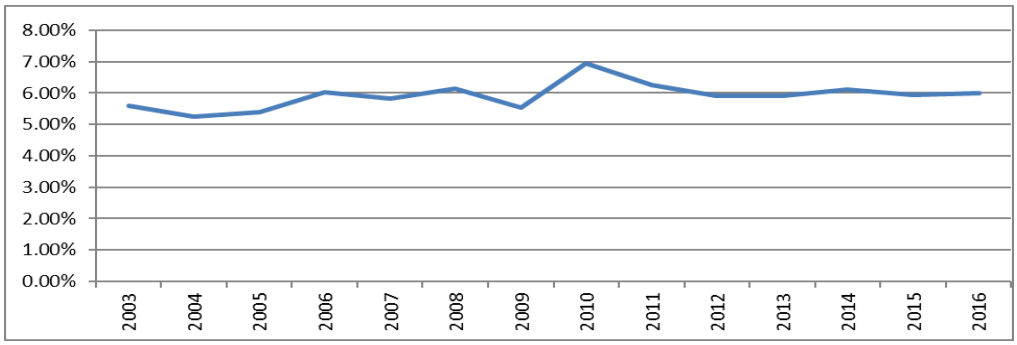
Figure 5.7: Comparison between the total fiscal expenditure and the budget allocated to Universal Healthcare and Personnel Compensation



With the details of this information classified in the *age range* and the *region* of healthcare service, the outcome of projection indicated the interesting trends and combinations of future Universal Healthcare budget. It identifies the national budget to support the future Universal Healthcare service until 2030. The future demographic structure of aging society will incur the rising budget on the healthcare of the aging population.

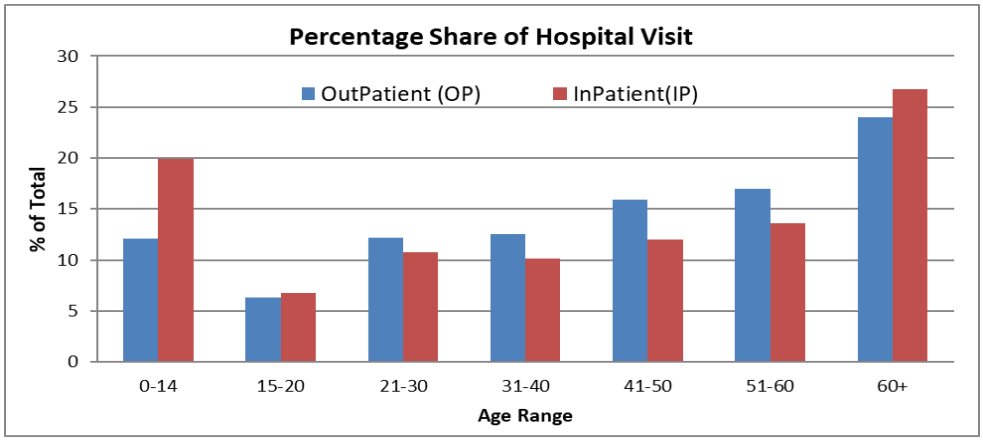
The important trends of future healthcare budget with expenditure for the aging population are likely to increase substantially. In addition, this expenditure will become the largest portion (e.g. region 1,2,3,7 and 9). This projection signifies the urgent requirement for the future allocations of all-related resources to support the region-specific characteristics.

Figure 5.8: Percentage of Universal Healthcare + Salary & Compensation per Total Fiscal Expenditure



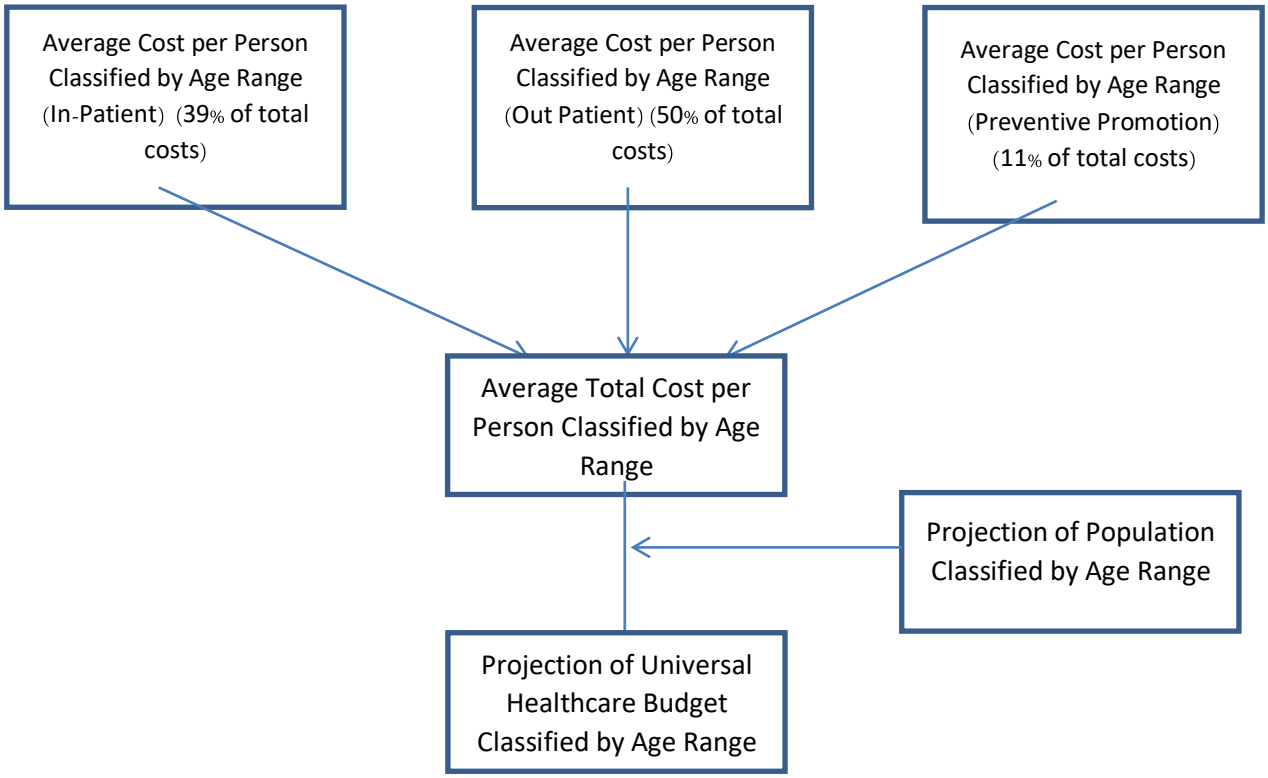
Source: National Health Security Office (NHSO)

Figure 5.9: Proportion of Hospital Visit Classified by Type of Patient and Age Range



Source: National Health Security Office (NHSO)

Figure 5.10: Method of Projecting Universal Healthcare Budget



Source: National Health Security Office (NHSO)

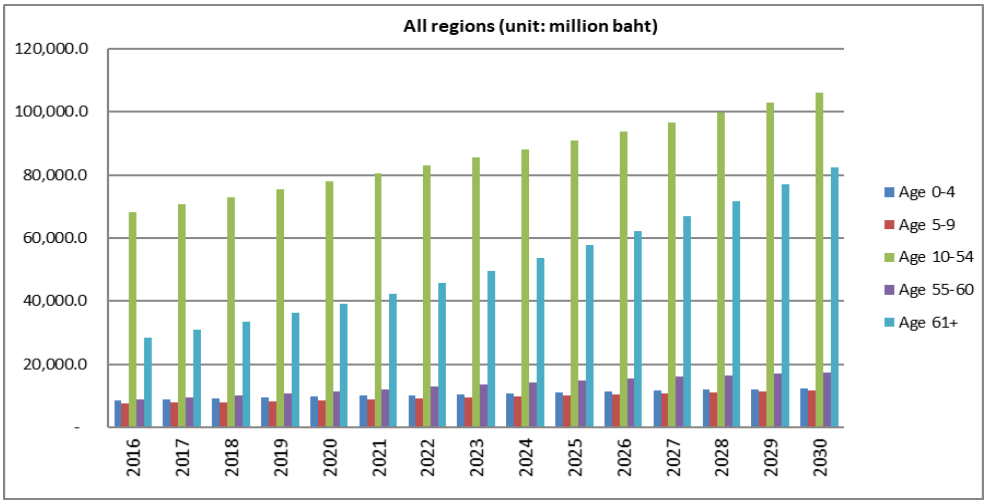
Fig. 5.9 shows that the hospital visit by age range from 15-60 year old has a positive relationship. The dependency age range of 0-14 and 60+ year old has to be mentioned here. The in-patient of the age 0-14 was 20 percent of all visits as compared with out-patient of around 10

percent. The age burden of 60+ populations has a high percentage of visits both type as expected of around 25 percent.

The average cost burden is found that the in-patient share 39 percent of total cost of UCS in Thailand land as compared with 50 percent of the total cost which is borne by out-patient. It is noted here also that the cost burden on average for the preventive promotion is 11 percent of total cost. These parameters will be applied to the cost projection and expenditure for UCS. As Thailand is entering the aging society with rising well being made by income per capita, we may expect also that the common phenomenon of rising *Non-Communicative-Disease (NCD)* would be a new cause of death and sickness among the population. It may be taken into our projection implicitly as the *shift* parameter as well as changing the slope of each cost component over time. Since this is beyond our scope of analysis, we may use the simple rule-of-thumb to account for it in our model.

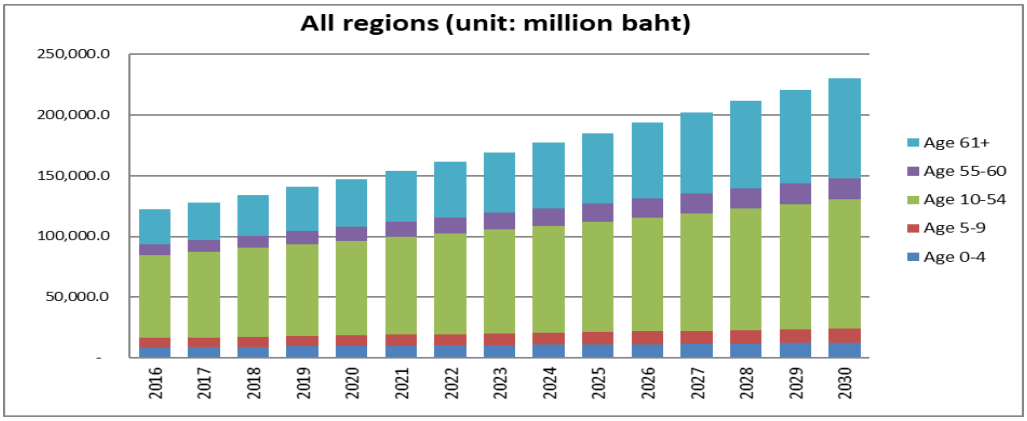
Based on the official population projection by single age and age group, it is clear that the Thai population structure is trending to aging as noted by *NESDB (2013), as graphically shown in Table 5.8. The population projection is applied as a base for* **demand projection of health care needs**. The budget needs are regarded as *inverse demand function of health care* by *region* under the MOPH. The total demand for health care most of the age group are understandable consistent with the population cohort. It is noted that the rising portion of demand for health by aging population 61+ over time 2016-2030.

Figure 5.11: Projection of Nationwide Expenditure on Universal Healthcare Budget Classified by Region and Age



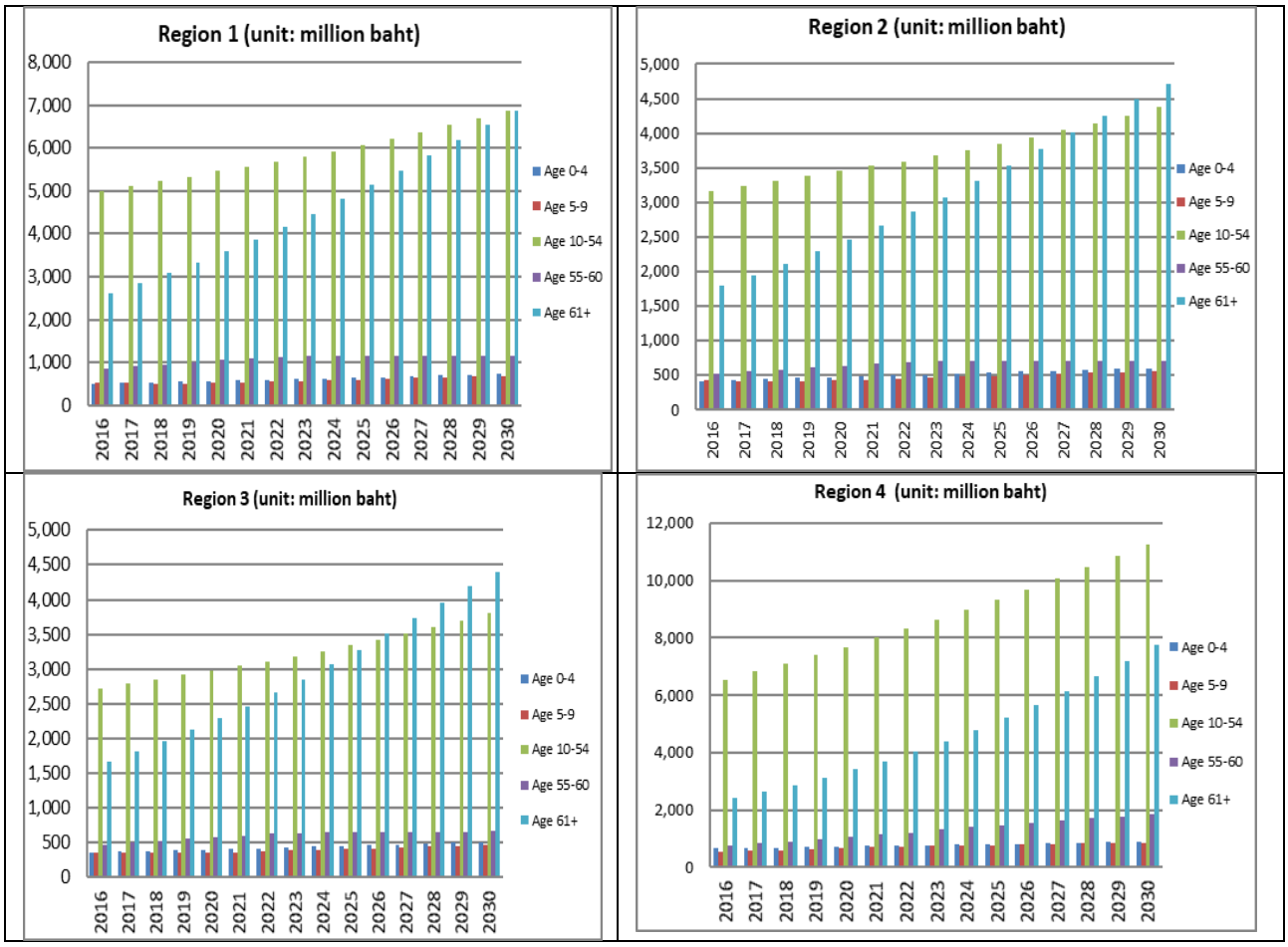
Source: Authors 'calculation (based on NESDB'

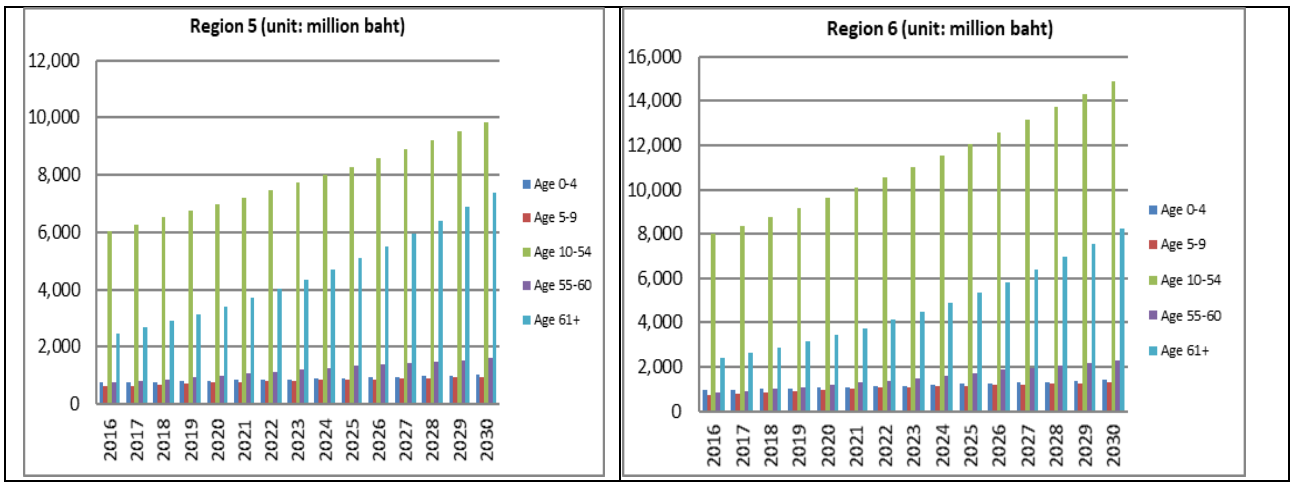
Figure 5.12: Projection of Nationwide Expenditure on Universal Healthcare Budget



Source: Authors 'calculation

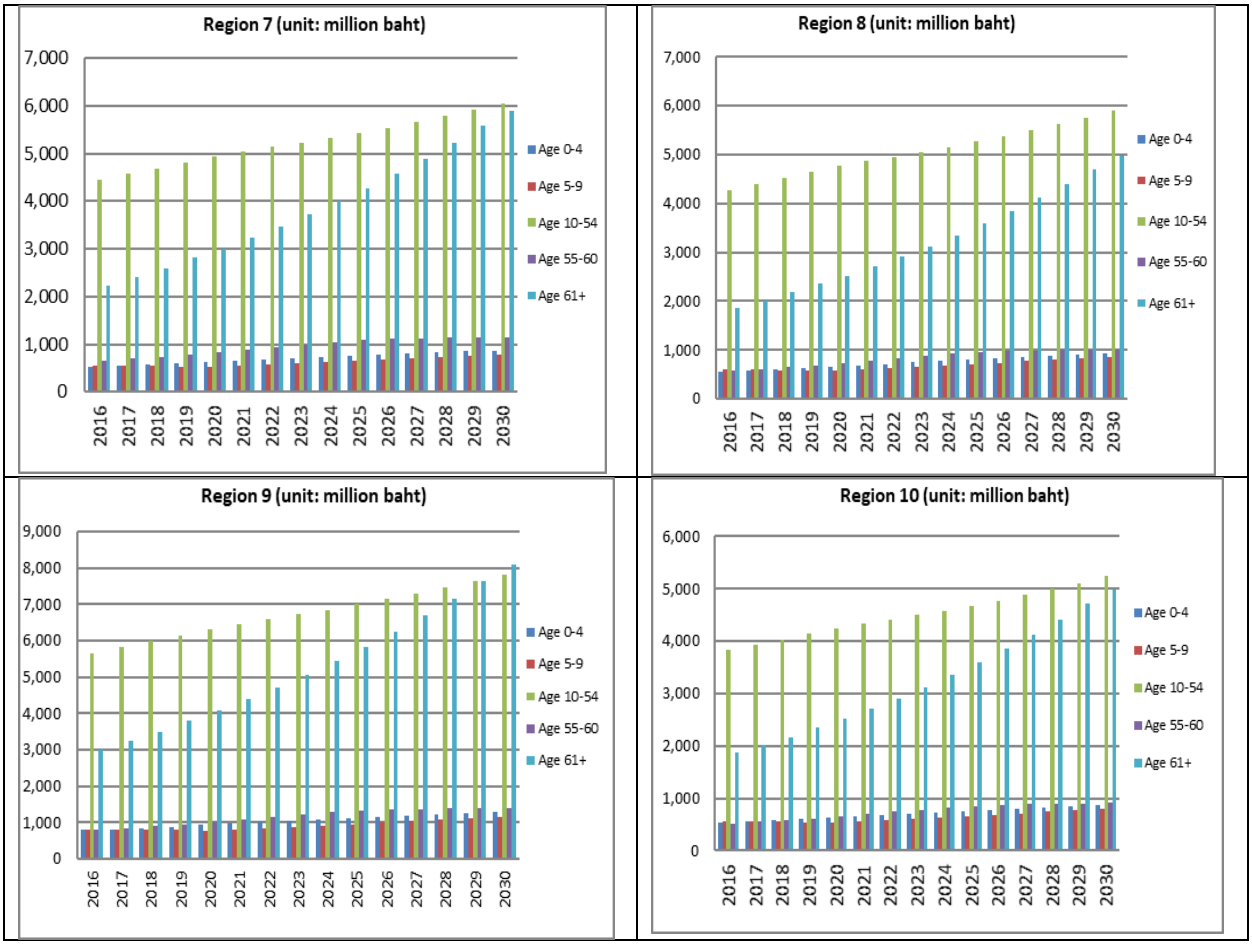
Figure 5.13: Projection of Expenditure on Universal Healthcare Budget Classified by Region and Age

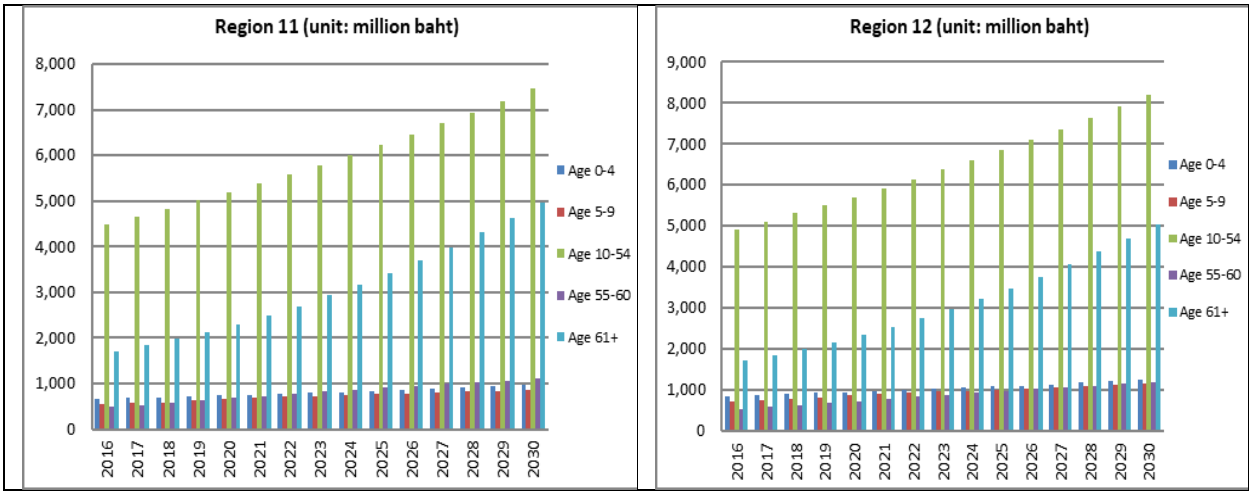




Source: Authors 'calculation

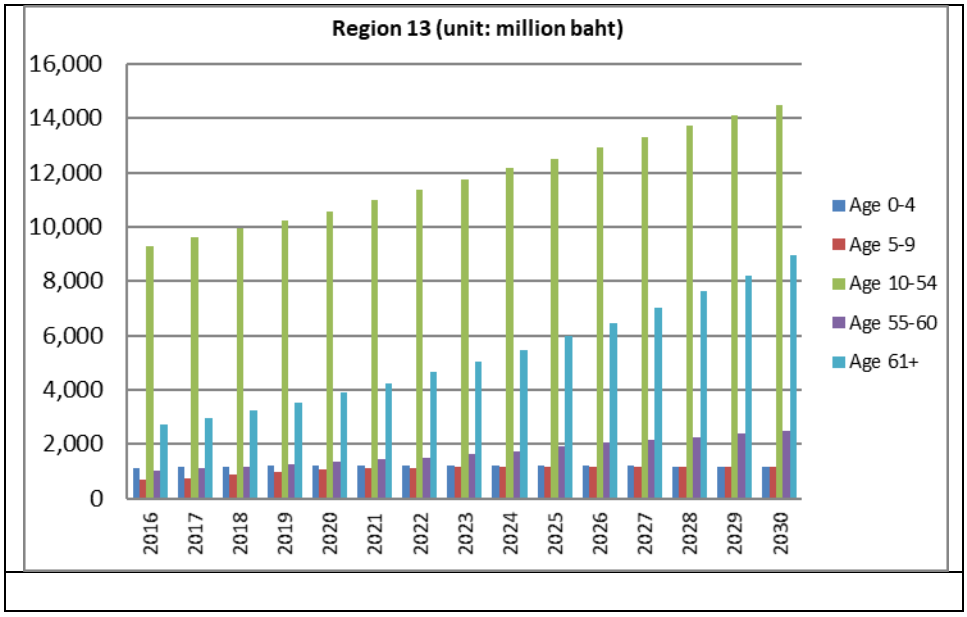
Figure 5.13: Projection of Expenditure on Universal Healthcare Budget Classified by Region and Age (Continued)





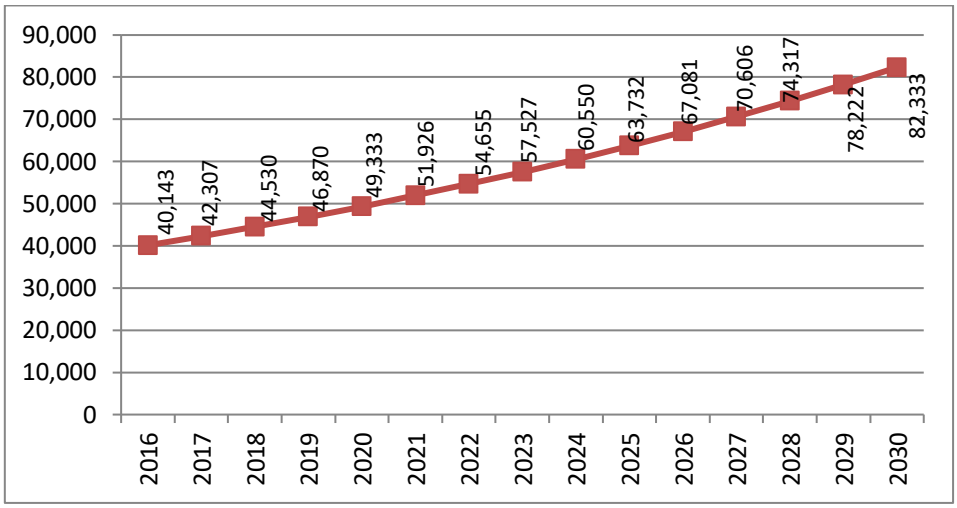
Source: Authors 'calculation

Figure 5.13: Projection of Expenditure on Universal Healthcare Budget Classified by Region and Age (Continued)



Source: Authors 'calculation

Figure 5.14: Budget on Salary and Benefit of Government Officials in Healthcare Service (unit: million Baht)



Source: National Health Security Office (NHSO)

The annual budget for personnel compensation (e.g. salary and benefit) was computed *pro rata* accordingly. The budget allocation has to be prepared under the formal parliamentary system. Fig. 5.16 illustrates the projection of expenditure which is a cost of services by government officials in healthcare service providers in public hospitals.

The last allocation of the budget is the capital investment (e.g. building and equipment and maintenance). The result of the forecasted requirement for the budget is exhibited in Table 5.9. This computation was based on the projection of future demographical structure and the estimated increment of the average of a number of beds per population, which was 5 million baht per bed. The budget was converted into US dollar value by using the exchange of 31.46 baht per US dollar.

All 3 components of the forecasted budget were summed and these total amounts were listed in Table 5.10. Also, the values converted in US dollar were listed in Table 5.11 (the exchange rate applied in this computation was 31.46 baht per US dollar).

Table 5.7: Projected Budgets for Capital Investment in Healthcare Service

Year	Total Beds	Increase of Beds	Beds per 10,000 Population	Required Budget (million baht)	Required Budget (million USD)
2017	162,373	6,245	24.782	31,225.58	992.55
2018	168,868	6,495	25.703	32,474.61	1,032.25
2019	175,623	6,755	26.667	33,773.59	1,073.54

2020	182,648	7,025	27.675	35,124.54	1,116.48
2021	189,953	7,306	28.731	36,529.52	1,161.14
2022	197,552	7,598	29.837	37,990.70	1,207.59
2023	205,454	7,902	30.995	39,510.33	1,255.89
2024	213,672	8,218	32.209	41,090.74	1,306.13
2025	222,219	8,547	33.481	42,734.37	1,358.37
2026	231,107	8,889	34.816	44,443.74	1,412.71
2027	240,352	9,244	36.217	46,221.49	1,469.21
2028	249,966	9,614	37.688	48,070.35	1,527.98
2029	259,964	9,999	39.233	49,993.17	1,589.10
2030	270,363	10,399	40.856	51,992.89	1,652.67

Source: Authors 'calculation

Table 5.8: Projected Total Budget for Healthcare (unit: million baht)

	Universal Healthcare	Salary and Compensation	Capital Investment	Total
2016	122,029.99	40,143.00	31,225.58	193,398.57
2017	127,935.77	42,307.00	32,474.61	202,717.38
2018	134,098.96	44,530.26	33,773.59	212,402.81
2019	140,531.64	46,870.36	35,124.54	222,526.53
2020	147,233.61	49,333.43	36,529.52	233,096.56
2021	154,210.91	51,925.93	37,990.70	244,127.54
2022	161,479.29	54,654.68	39,510.33	255,644.29
2023	169,034.83	57,526.82	41,090.74	267,652.38
2024	176,876.76	60,549.89	42,734.37	280,161.02
2025	185,017.60	63,731.83	44,443.74	293,193.18
2026	193,439.44	67,080.98	46,221.49	306,741.91
2027	202,180.12	70,606.13	48,070.35	320,856.60
2028	211,208.81	74,316.53	49,993.17	335,518.51
2029	220,533.59	78,221.92	51,992.89	350,748.40
2030	230,154.16	82,332.53	54,072.61	366,559.30

Source: Authors 'calculation

Table 5.9: Projected Total Budget for Healthcare (unit: million US Dollar)

	Universal Healthcare	Salary and Compensation	Capital Investment	Total
2016	3,878.89	1,276.00	992.55	6,147.44
2017	4,066.62	1,344.79	1,032.25	6,443.65

2018	4,262.52	1,415.46	1,073.54	6,751.52
2019	4,466.99	1,489.84	1,116.48	7,073.32
2020	4,680.03	1,568.13	1,161.14	7,409.30
2021	4,901.81	1,650.54	1,207.59	7,759.93
2022	5,132.84	1,737.28	1,255.89	8,126.01
2023	5,373.01	1,828.57	1,306.13	8,507.70
2024	5,622.27	1,924.66	1,358.37	8,905.31
2025	5,881.04	2,025.81	1,412.71	9,319.55
2026	6,148.74	2,132.26	1,469.21	9,750.22
2027	6,426.58	2,244.31	1,527.98	10,198.87
2028	6,713.57	2,362.25	1,589.10	10,664.92
2029	7,009.97	2,486.39	1,652.67	11,149.03
2030	7,315.77	2,617.05	1,718.77	11,651.60

Source: Authors 'calculation

4. Conclusion and Implication

In this chapter, we have shown demand oriented projection of social infrastructure needs in Thailand with respect to health services. We have our final note that social infrastructure needs here was demand oriented rather than supply initiation. Here, Thai Universal Coverage Scheme of health care services fundamentally represents the demand side or patients' needs. The needs are expressed *ex-ante* via average '*buying price = cost per head*' of in-patient and out-patients that follow probability of illness. The demand oriented approach, given pro-rata supply parameters may invoke *excess demand* in the UCS health services i.e., if buying price is lower than cost per head, *ex-post.* Nowadays, the NCD has been also unexpectedly overshooting and becoming additional cost burden to Thai population health's service provision.

It is controversial that the total cost allocated from the government to the UCS, as representative of buyer of service from providers each fiscal year cannot match with cost of health services supply provided either by public and/or private institutions. The public hospitals as the main providers, will find difficulties in allocating the receipt income to manage their capital investment as well as personnel cost. There are gaps between demand price and cost of service delivery. Lower buying price of demand than the marginal effective cost of provision per unit has created excess demand for health services in some hospitals. This has made an overload of burden in some urban public hospitals.

The budgetary needs in this study are *ex-ante* demand projection, it has been assumed to cover the cost of *total new investment, maintenance and rehabilitation of buildings, and high technology equipments.* In principle, *the gap of budget needs should be filled up by requesting additional budget by the Ministry of Public Health to parliament.* The tight fiscal policy has always a reason to suppress the request by UCS. Thus, there is outcry by public health providers,

i.e., hospital and health personnel. Especially, the hospital that raises reason that 'average buying price per capita service' is lower than their 'average cost of service' provision. As a result, some hospitals have faced congestion, overloaded of patients for current medical doctors with an inability to comply with the rapid rising demand.

In short, in our projection in this study we have some notes as follows:

(1) The annual budget for universal healthcare service which is based on the demand-side projection of rising number of the in-patient (IP), the out-patient (OP), given limited preventive promotion (PP). They are calculated from changing population structure overtime weighted by probability of illness. Our calculation has to take into account a stochastic drift over time of the demand by a rising NCD as well.

(2) On the supply-side, the annual budget for *personnel compensation* (e.g. salary and benefit) may be subjected to *sub-optimality* of lifetime earnings as compared with their human capital investment of the medical doctor who has invested longer year of schooling. In our projection, we should have benchmarked their life time earnings with international earning opportunity in par with the medical doctor in developed market. The service is tradable, as they can move to higher payment in any developed country. Thus, the gap of earnings over their career path *weighted by purchasing power parity (PPP)* should be compensated in accordance an international price. However, this is not definite in the hot debate among buyer and provider besides we do not have earnings' data of medical doctors in Thailand and in international markets. We refrain from doing so and would treat the projection of the *minimum* level of the inverse effective demand.

(3) The annual budget for new *capital investment and maintenance* is another item which has faced several dimensions of insufficiency. There are inequitable distribution of facilities and buildings of hospital across *sizes and areas*. Our estimation which is based on the demand-side has effectively covered this cost by definition. However, it may be artificially lower than the actual social investment needs. We recommend that if the data of capital stock and depreciation of hospital and incorporated medial equipments and facilities are available in detail, the new capital investment and maintenance would need to be addressed to reduce size and spatial inequalities.

The level-up of capital adequacy of the public hospital with qualified medical staffs among regions can potentially solve the overloading demand and spatial inequality. That is to say, we need to take into account both *vertical and horizontal* inequality reduction by proper

benchmark with international medical doctor's earnings, and spatial needs of new capital investment and maintenance.

Up to present, the UCS has successfully increased the vertical equity of welfare among income deciles class in Thailand. The sub-optimal demand price has created excess demand for health services. Simultaneously, it has created an overloading situation on the supply side with rising marginal cost of service. As a result, the UCS has lowered the welfare of health personnel and sub-optimal capital investment and maintenance.

Other ASEAN countries can follow this line of methodology to calibrate the social investment on health services in their own economy. This is by considering mark-up the medical doctor's human capital return as well as new capital investment and maintenance of public hospitals. The free access to health services by mass of low income population can be maintained in the public hospital services in the short-run. In the medium-run, the role of preventive health care movement of the society has to play as circuit brake to the excess demand for health care. The *true price* of the health care services will need to *converge* to its *true social cost* of health service delivery in the long-run. This is to maintain the sustainability of the UCS.

Appendix I: Projection Results of Expenditure of the Universal Healthcare

Table A1: Projection of Total Expenditure on Universal Healthcare (Classified by Age)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0–4	8,675.8	8,955.9	9,233.0	9,507.7	9,774.5	10,037.5	10,303.3	10,576.6	10,849.5	11,126.1	11,404.2	11,678.4	11,952.9	12,228.3	12,498.1
Age 5–9	7,619.7	7,856.7	8,121.4	8,420.8	8,758.2	9,050.3	9,341.4	9,631.1	9,917.8	10,201.8	10,474.0	10,755.5	11,040.3	11,327.4	11,621.8
Age 10–54	68,362.3	70,724.3	73,104.7	75,503.4	77,908.6	80,393.3	82,918.6	85,493.6	88,141.3	90,889.6	93,752.8	96,728.7	99,800.8	102,959.2	106,185.3
Age 55–60	8,857.5	9,479.5	10,131.1	10,808.7	11,505.9	12,224.6	12,964.4	13,700.9	14,406.2	15,057.0	15,627.1	16,124.0	16,569.7	17,023.5	17,532.9
Age 61+	28,514.8	30,919.4	33,508.8	36,291.0	39,286.5	42,505.3	45,951.6	49,632.7	53,561.9	57,743.1	62,181.3	66,893.6	71,845.1	76,995.1	82,316.1
TOTAL	**122,030.0**	**127,935.8**	**134,099.0**	**140,531.6**	**147,233.6**	**154,210.9**	**161,479.3**	**169,034.8**	**176,876.8**	**185,017.6**	**193,439.4**	**202,180.1**	**211,208.8**	**220,533.6**	**230,154.2**

Table A2: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 1

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	503.311	519.345	535.075	550.418	565.834	582.157	597.355	613.751	629.824	646.852	664.206	680.411	696.047	712.206	727.255
Age 5-9	519.071	516.747	515.953	516.248	521.839	538.361	554.841	572.028	588.568	604.913	620.994	638.628	655.997	673.364	692.110
Age 10-54	4,980.230	5,103.475	5,222.597	5,335.164	5,457.335	5,562.690	5,677.842	5,802.148	5,928.307	6,073.027	6,222.913	6,375.011	6,528.995	6,692.135	6,864.094
Age 55-60	869.517	915.046	962.415	1,007.296	1,053.045	1,095.350	1,130.227	1,149.001	1,158.047	1,158.197	1,150.217	1,144.684	1,151.350	1,152.081	1,167.135
Age 61+	2,626.743	2,847.531	3,080.699	3,340.376	3,595.011	3,871.907	4,161.878	4,471.401	4,806.852	5,131.728	5,481.321	5,836.107	6,183.562	6,539.421	6,881.673
TOTAL	9,498.873	9,902.144	10,316.739	10,749.502	11,193.062	11,650.464	12,122.143	12,608.328	13,111.599	13,614.717	14,139.651	14,674.841	15,215.951	15,769.207	16,332.268

TableA3X: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 2

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	418.092	431.071	443.896	457.041	469.958	482.581	495.742	509.476	522.842	537.118	550.969	565.044	578.951	591.439	603.963
Age 5-9	420.977	418.768	418.488	418.143	423.209	436.863	450.149	463.784	477.496	490.675	504.123	517.841	531.499	546.424	560.958
Age 10-54	3,164.193	3,239.365	3,313.048	3,383.984	3,457.360	3,525.068	3,595.303	3,672.340	3,753.131	3,846.359	3,943.265	4,045.104	4,149.116	4,256.967	4,373.441
Age 55-60	526.937	554.599	583.429	610.007	638.988	664.819	686.479	698.743	703.484	705.348	699.705	696.848	700.532	699.155	709.456
Age 61+	1,795.549	1,948.472	2,111.588	2,291.825	2,466.789	2,661.814	2,863.693	3,076.701	3,305.795	3,531.330	3,769.909	4,010.551	4,245.146	4,490.056	4,715.011
TOTAL	6,325.748	6,592.276	6,870.449	7,160.999	7,456.303	7,771.145	8,091.366	8,421.044	8,762.748	9,110.830	9,467.972	9,835.387	10,205.244	10,584.041	10,962.830

Table A4: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 3

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	356.414	367.318	377.745	388.405	399.021	409.559	420.283	431.504	442.279	453.883	466.041	476.583	488.346	498.664	509.828
Age 5-9	350.076	348.904	348.776	350.539	355.400	366.481	378.125	389.032	399.635	410.736	421.465	432.375	443.463	455.068	467.584
Age 10-54	2,721.241	2,789.547	2,854.812	2,919.772	2,986.332	3,047.658	3,112.615	3,182.196	3,253.739	3,337.333	3,422.251	3,512.993	3,604.049	3,701.520	3,801.433
Age 55-60	474.876	500.585	527.612	552.559	580.833	605.496	626.774	639.812	647.760	650.252	648.455	647.940	651.255	652.684	664.664
Age 61+	1,669.312	1,811.712	1,959.604	2,125.995	2,288.418	2,468.186	2,655.548	2,855.291	3,068.164	3,280.740	3,508.093	3,733.257	3,956.316	4,187.401	4,403.064
TOTAL	**5,571.919**	**5,818.066**	**6,068.550**	**6,337.270**	**6,610.004**	**6,897.379**	**7,193.346**	**7,497.836**	**7,811.577**	**8,132.944**	**8,466.306**	**8,803.147**	**9,143.430**	**9,495.338**	**9,846.574**

Table A5: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 4

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	657.977	676.767	694.193	711.100	725.996	740.900	755.488	770.320	786.709	803.808	820.969	839.641	857.293	876.161	895.949
Age 5-9	559.960	581.156	608.611	639.619	682.587	706.290	726.669	745.645	762.990	780.486	795.696	811.452	828.455	845.469	863.890
Age 10-54	6,548.092	6,825.686	7,115.568	7,410.121	7,691.120	8,002.591	8,325.640	8,653.801	8,989.064	9,334.227	9,693.276	10,073.601	10,462.497	10,852.930	11,251.195
Age 55-60	775.604	846.572	914.792	989.531	1,069.867	1,148.415	1,221.218	1,311.398	1,400.745	1,481.408	1,563.289	1,638.551	1,702.386	1,777.020	1,855.640
Age 61+	2,431.529	2,645.305	2,877.573	3,125.188	3,407.548	3,708.972	4,046.582	4,401.258	4,779.916	5,206.675	5,651.461	6,126.744	6,643.953	7,189.066	7,773.689
TOTAL	**10,973.162**	**11,575.486**	**12,210.736**	**12,875.560**	**13,577.118**	**14,307.169**	**15,075.597**	**15,882.423**	**16,719.423**	**17,606.604**	**18,524.692**	**19,489.988**	**20,494.584**	**21,540.646**	**22,640.363**

Table A6: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 5

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	749.317	769.945	788.694	807.670	824.643	842.208	859.506	877.726	896.953	917.619	938.806	959.431	981.683	1,004.526	1,026.738
Age 5-9	632.674	654.798	682.037	714.735	759.879	784.328	805.123	825.220	845.317	864.203	880.777	899.441	919.119	939.220	961.185
Age 10-54	6,057.532	6,283.893	6,518.605	6,749.428	6,973.598	7,222.683	7,478.986	7,745.825	8,016.797	8,294.357	8,588.389	8,889.256	9,202.392	9,518.273	9,838.535
Age 55-60	766.212	825.306	880.903	943.158	1,010.029	1,079.580	1,140.395	1,208.474	1,275.153	1,334.681	1,387.749	1,443.242	1,496.621	1,547.783	1,604.946
Age 61+	2,464.553	2,678.594	2,906.756	3,154.081	3,422.282	3,707.666	4,024.476	4,351.663	4,710.177	5,100.981	5,508.543	5,941.604	6,392.041	6,875.554	7,378.808
TOTAL	**10,670.289**	**11,212.536**	**11,776.994**	**12,369.071**	**12,990.430**	**13,636.464**	**14,308.486**	**15,008.908**	**15,744.396**	**16,511.841**	**17,304.263**	**18,132.973**	**18,991.856**	**19,885.356**	**20,810.212**

Table A7: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 6

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	951.772	985.480	1,017.282	1,046.565	1,075.693	1,103.125	1,130.977	1,160.803	1,190.827	1,222.359	1,255.162	1,289.685	1,325.292	1,365.628	1,407.027
Age 5-9	732.380	786.135	844.625	909.124	978.003	1,017.453	1,053.091	1,086.986	1,119.368	1,149.946	1,179.314	1,209.451	1,240.712	1,272.138	1,306.171
Age 10-54	7,997.737	8,384.053	8,782.736	9,196.264	9,611.581	10,069.595	10,543.538	11,023.440	11,527.252	12,036.728	12,568.886	13,129.023	13,707.716	14,299.814	14,897.247
Age 55-60	841.139	921.000	1,003.171	1,093.122	1,186.418	1,281.829	1,382.083	1,500.409	1,614.024	1,738.916	1,858.515	1,967.475	2,058.978	2,175.150	2,284.420
Age 61+	2,422.474	2,644.473	2,887.108	3,143.848	3,442.031	3,762.195	4,117.665	4,494.781	4,902.052	5,360.027	5,844.020	6,372.348	6,957.105	7,559.128	8,232.185
TOTAL	**12,945.501**	**13,721.141**	**14,534.921**	**15,388.923**	**16,293.726**	**17,234.198**	**18,227.353**	**19,266.419**	**20,353.523**	**21,507.977**	**22,705.898**	**23,967.982**	**25,289.802**	**26,671.858**	**28,127.050**

Table A8: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 7

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	529.913	550.977	574.153	598.835	624.024	649.983	677.023	704.561	730.935	756.925	782.398	806.836	829.267	850.168	869.291
Age 5-9	547.270	545.490	542.833	537.417	533.693	553.425	575.162	599.088	625.127	651.423	678.522	706.748	734.507	762.667	790.474
Age 10-54	4,443.670	4,572.404	4,695.957	4,819.878	4,947.118	5,044.855	5,140.724	5,237.123	5,324.847	5,438.660	5,544.023	5,662.340	5,784.053	5,912.105	6,058.161
Age 55-60	660.049	697.077	741.358	781.658	826.912	882.587	942.247	991.764	1,048.861	1,083.360	1,111.856	1,125.185	1,142.693	1,139.596	1,153.047
Age 61+	2,238.444	2,413.397	2,602.500	2,812.790	3,015.069	3,241.718	3,473.844	3,729.237	4,000.975	4,270.803	4,579.777	4,899.561	5,231.076	5,587.575	5,904.837
TOTAL	**8,419.347**	**8,779.344**	**9,156.800**	**9,550.578**	**9,946.816**	**10,372.569**	**10,808.999**	**11,261.773**	**11,730.745**	**12,201.172**	**12,696.576**	**13,200.670**	**13,721.596**	**14,252.111**	**14,775.810**

Table A9: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 8

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	561.694	584.570	608.888	634.750	661.709	689.236	717.608	747.147	775.293	803.129	829.816	855.858	880.328	902.154	922.606
Age 5-9	596.821	594.374	591.565	584.990	582.060	603.063	627.122	653.210	680.942	710.141	739.683	769.823	801.190	831.783	861.039
Age 10-54	4,274.145	4,396.497	4,515.524	4,636.301	4,763.099	4,860.477	4,957.714	5,058.481	5,150.806	5,268.288	5,379.620	5,501.925	5,626.409	5,758.285	5,910.179
Age 55-60	581.448	614.355	653.645	688.450	728.865	777.959	830.919	873.632	923.835	953.428	978.360	990.930	1,006.182	1,003.649	1,013.973
Age 61+	1,870.120	2,018.099	2,176.022	2,350.813	2,524.470	2,713.078	2,910.288	3,124.171	3,352.657	3,581.679	3,838.766	4,112.295	4,388.475	4,690.016	4,960.516
TOTAL	**7,884.227**	**8,207.895**	**8,545.644**	**8,895.304**	**9,260.203**	**9,643.813**	**10,043.650**	**10,456.640**	**10,883.533**	**11,316.665**	**11,766.244**	**12,230.832**	**12,702.585**	**13,185.887**	**13,668.313**

Table A10: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 9

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	789.573	820.702	854.844	892.001	929.940	968.625	1,008.620	1,048.699	1,088.737	1,127.914	1,165.988	1,201.224	1,235.454	1,266.455	1,294.981
Age 5-9	805.698	801.660	798.514	789.623	785.485	813.716	846.023	881.217	918.713	958.676	998.859	1,039.466	1,081.065	1,121.932	1,162.545
Age 10-54	5,667.336	5,834.074	5,994.234	6,157.440	6,326.881	6,459.339	6,588.170	6,720.180	6,841.966	6,997.072	7,140.429	7,297.707	7,459.910	7,630.356	7,826.263
Age 55-60	805.207	850.612	903.939	953.540	1,008.827	1,076.576	1,149.781	1,209.017	1,279.113	1,321.423	1,355.526	1,372.917	1,392.740	1,390.681	1,406.270
Age 61+	3,009.982	3,251.151	3,508.333	3,794.829	4,073.071	4,384.221	4,706.388	5,060.526	5,438.935	5,815.088	6,241.948	6,691.758	7,152.988	7,653.227	8,104.485
TOTAL	**11,077.795**	**11,558.200**	**12,059.863**	**12,587.432**	**13,124.203**	**13,702.477**	**14,298.982**	**14,919.640**	**15,567.464**	**16,220.172**	**16,902.750**	**17,603.072**	**18,322.158**	**19,062.650**	**19,794.543**

Table A11: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 10

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	527.323	548.034	571.088	595.643	621.253	647.097	673.415	700.490	727.347	753.188	778.859	802.782	824.660	846.169	865.542
Age 5-9	550.493	548.427	546.110	539.693	536.301	555.895	577.734	601.768	627.359	654.911	682.155	710.533	738.120	765.747	794.394
Age 10-54	3,821.543	3,928.753	4,032.859	4,139.373	4,251.367	4,333.373	4,415.666	4,500.088	4,580.772	4,681.969	4,777.855	4,883.689	4,993.208	5,111.584	5,249.951
Age 55-60	519.179	547.582	582.543	613.699	650.283	693.354	740.448	779.398	823.984	851.485	874.018	884.165	897.973	895.793	905.604
Age 61+	1,862.929	2,011.719	2,169.954	2,346.600	2,519.768	2,709.159	2,908.928	3,125.942	3,357.454	3,588.213	3,850.776	4,126.473	4,407.585	4,712.636	4,989.260
TOTAL	7,281.468	7,584.514	7,902.554	8,235.008	8,578.972	8,938.879	9,316.191	9,707.685	10,116.917	10,529.766	10,963.663	11,407.642	11,861.547	12,331.929	12,804.751

Table A12: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 11

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	661.744	681.426	700.834	719.347	737.634	755.620	774.127	794.431	815.411	837.442	860.602	884.977	910.658	938.144	965.092
Age 5-9	536.393	562.904	589.161	619.133	662.197	684.558	704.805	724.211	743.454	762.173	780.860	800.729	820.900	842.732	865.316
Age 10-54	4,475.033	4,650.473	4,826.832	5,008.725	5,184.714	5,381.073	5,583.564	5,790.595	6,005.411	6,230.632	6,463.957	6,695.839	6,940.811	7,195.124	7,453.177
Age 55-60	492.026	533.121	579.442	629.156	675.275	721.639	772.517	818.232	864.151	908.349	946.750	989.651	1,026.160	1,063.992	1,107.893
Age 61+	1,695.146	1,829.189	1,979.252	2,132.315	2,302.838	2,494.960	2,699.422	2,926.497	3,164.840	3,422.562	3,697.049	3,991.370	4,308.124	4,633.014	4,975.595
TOTAL	**7,860.342**	**8,257.112**	**8,675.521**	**9,108.677**	**9,562.659**	**10,037.851**	**10,534.435**	**11,053.966**	**11,593.268**	**12,161.158**	**12,749.219**	**13,362.567**	**14,006.653**	**14,673.006**	**15,367.073**

Table A13: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 12

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	848.426	873.422	898.518	922.595	945.180	967.760	992.385	1,017.699	1,045.358	1,073.217	1,103.000	1,133.773	1,167.117	1,201.673	1,236.251
Age 5-9	705.187	741.027	775.569	814.433	871.312	900.397	927.050	953.290	978.435	1,003.441	1,027.018	1,052.711	1,080.080	1,108.930	1,138.667
Age 10-54	4,920.237	5,111.516	5,305.484	5,504.563	5,695.878	5,913.107	6,135.882	6,365.034	6,603.746	6,849.448	7,106.823	7,363.434	7,631.456	7,908.762	8,190.811
Age 55-60	527.549	572.462	621.749	675.299	725.741	774.705	829.615	878.792	928.361	976.409	1,017.335	1,063.811	1,103.072	1,143.757	1,190.615
Age 61+	1,716.185	1,851.658	2,002.656	2,159.402	2,334.186	2,529.572	2,739.555	2,970.424	3,214.654	3,470.604	3,750.693	4,051.833	4,368.930	4,700.421	5,039.680
TOTAL	**8,717.584**	**9,150.085**	**9,603.976**	**10,076.292**	**10,572.297**	**11,085.539**	**11,624.487**	**12,185.238**	**12,770.554**	**13,373.119**	**14,004.869**	**14,665.562**	**15,350.654**	**16,063.543**	**16,796.024**

Table A14: Projection of Total Expenditure on Universal Healthcare (Classified by Age) in Region 13

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Age 0-4	1,120.202	1,146.807	1,167.802	1,183.357	1,193.604	1,198.656	1,200.812	1,200.024	1,197.021	1,192.644	1,187.407	1,182.128	1,177.843	1,174.877	1,173.560
Age 5-9	662.657	756.335	859.148	987.137	1,066.221	1,089.440	1,115.473	1,135.614	1,150.441	1,160.050	1,164.544	1,166.318	1,165.195	1,161.955	1,157.429
Age 10-54	9,291.316	9,604.564	9,926.436	10,242.416	10,562.186	10,970.756	11,362.941	11,742.315	12,165.450	12,501.545	12,901.157	13,298.753	13,710.217	14,121.390	14,470.844
Age 55-60	1,017.743	1,101.186	1,176.095	1,271.203	1,350.793	1,422.302	1,511.680	1,642.196	1,738.684	1,893.764	2,035.327	2,158.604	2,239.721	2,382.197	2,469.199
Age 61+	2,711.815	2,968.078	3,246.732	3,512.907	3,895.016	4,251.805	4,643.346	5,044.777	5,459.416	5,982.634	6,458.903	6,999.652	7,609.778	8,177.594	8,957.322
TOTAL	**14,803.733**	**15,576.970**	**16,376.214**	**17,197.020**	**18,067.820**	**18,932.959**	**19,834.252**	**20,764.926**	**21,711.012**	**22,730.638**	**23,747.339**	**24,805.456**	**25,902.755**	**27,018.013**	**28,228.353**