National Institute of Public Health
School of Public Health

Study Protocol

Title: Addressing health workforce gaps to meet universal health coverage in Cambodia

Submitted on: ….. August 2024

Version: 01

Contents

I. Introduction

With approximately 15.6 million population [1], Cambodia, one of the low-and middle income countries in the World Health Organization (WHO) Western Pacific region and a Member State of Association of Southeast Asian Nations (ASEAN), has achieved significant economic development before the COVID pandemic, enabling the country to move from low to lower-middle income group [2, 3]. The Cambodia demographic and health survey 2021-2022 showed significant reduction of under-5 mortality from 124 to 16 deaths per 1,000 live births between 2000 and 2021-22 [4]. The survey also revealed a continuing decline in fertility rate from 3.8 children per woman to 2.7 children per woman from 2000 to 2021-22 [4]. The above-mentioned trends indicate stages of demographic transition observed in most countries, leading to decline in dependency ratio which in turn increases resources for human capital formation and capital savings [5]. This demographic transition is very conducive to the potential economic growth on the condition that the working age population are healthy and productive [6]. The Royal Government of Cambodia has emphasized the importance of health as a key role in capacity building of human resources crucial to the continued economic growth in the National Strategic Development Plan [7]. In this seventh mandate, the current government continues to emphasize the importance of health as a key role in capacity building of human resources crucial to nation building and defense, and enhancing performance of the health system that brings health services closer to communities is one of the priorities in the political platform [8]. In 2024, health service coverage index (SCI) has reached 67% [9]. The SCI is used to measure coverage of essential health services, which is one of the Sustainable Development Goals (SDG) related to Universal Health Coverage (UHC)—SDG 3.8.1 [10]. The Royal Government of Cambodia has developed a roadmap toward achieving UHC 2024-2035 [11]. Based on the roadmap, by 2035, the SCI is expected to reach at least 80%.

Achieving UHC is a global priority and a keystone element of the SDGs. The finality of UHC is to ensure that all people are able to access the quality health services they need without suffering undue financial hardship. Health workforce is one of the key health system components essential for improving the quality of health service and its coverage [12]. The need for health workers globally is expected to grow significantly in coming decades as a result of a confluence of factors, including population growth, ageing, changing epidemiology and new technologies. The capacity and adequacy of health workforce reflect the strength of every health system [13] since necessary health services to address population health needs are catered by adequate numbers of health workers who are fit for purpose, motivated to perform, and equitably distributed across the subnational levels to enhance equitable access to health services. However, capacity and resources to develop staffing norms and standards at the national and subnational level and to produce robust, need-based projections remain a challenge in Cambodia.

1.1. Health system context

Cambodian health system is pluralistic, consisting of both public and private providers (including non-for-profit organizations). The public healthcare system has three tiers of administration: (1) district level, (2) provincial level, and (3) national or central level. The primary healthcare approach has been adopted to reflect the Alma-Ata Declaration. Based on implementation of the health coverage plan in 1995, one operational health district (OD) covers a catchment area of population from 100,000 to 200,000 in which one referral hospital provides secondary care and approximately 10-25 health centers provide primary care [14]. Each health center delivers health services to communities with support of community health workers based on national operational and clinical guidelines on a minimum package of activities (MPA)

for health centers [15, 16], and the referral hospital operates health services following a national guideline on complementary package of activities (CPA) to that of the health center [17]. Severe cases can be referred for a tertiary care at a national hospital. Despite the different levels of care, there is no strict practice of using the primary care provider as a gatekeeper. According to a recent update in 2023; across the 25 provinces and capital in the country, there were 103 ODs, 121 referral hospitals, and 1,305 health centers. In the capital, there are also 12 national hospitals and center [9]. Main health care activities at health centers are still prevention and treatment of communicable diseases (such as HIV and AIDS, tuberculosis, and malaria) and maternal and child health. Most health centers have limited capacity to prevent, diagnose and manage NCDs due to lack of equipment and materials, unavailability and inadequacy of essential medicines and supplies, and poor basic infrastructure. This has given opportunities for private providers who are operating largely without sufficient steering and coordination from the government to play the main role in offering treatment and management of NCDs [18]. Figure 1 show structures of the public sector health care system in Cambodia.

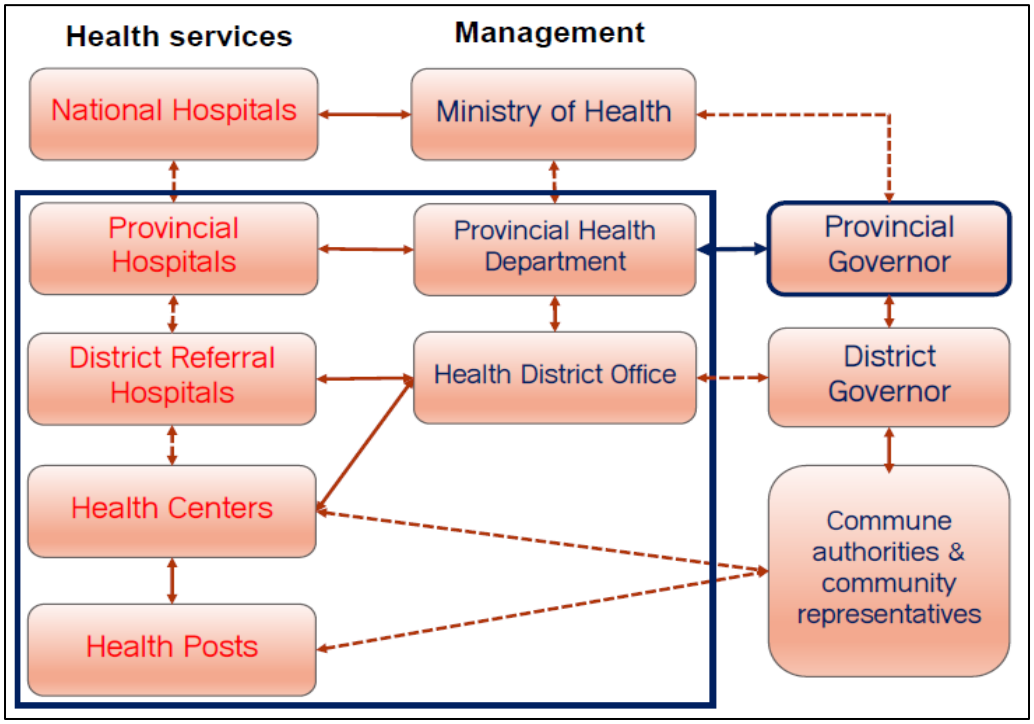

Figure 1. The public sector health care system in Cambodia

From January 2020, health management functions and service provision have been decentralized to sub-national authorities [19]. Provincial-municipal administrations have directive power over health service management related to human resources, financial resources, and other properties.

1.2. Study Rationale

Questions on what health workforce thresholds will be in Cambodia for supporting attainment of UHC at least 80% of the SCI arise. Specific questions includes:

1. What is the SCI at the subnational level?
2. What is index of health workforce density by cadres needed to support attainment of at least 80% of the SCI at the national and subnational level?

1.3. Study goal

The study's prime goal is to gather accurate and comprehensive data about the situation of health workforce in Cambodia and health workforce planning in relation to the projected SCI at the subnational level.

1.4. Study objectives

The specific objectives include:

1. To assess situation of health workforce in Cambodia (stock, supply, demand and needs);
2. To assess the current SCI at the subnational level;
3. To conduct simulation modelling based on health workforce requirements and supply model for reaching at least 80% of the SCI at the national and sub-national levels.

II. Methodology

2.1. Study design

This is a cross-sectional study, employing mixed-methods with concurrent design [20]. Qualitative data and quantitative data will be collected and analyzed to inform and build on each other during a similar timeframe. The study will collect data from multiple sources of data and levels of the health system (population level, healthcare organization level, and policy level) [21].

2.2. Study setting

The study will collect data in the Capital and four provinces purposively selected from each of the four regions (the Tonle Sap region, the Plateau and Mountains region, the Coastal and Sea region, and the Central Plain region) in Cambodia between August-September in 2024.

2.3. Study methods

For study objective 1, a number of methods will be employed including: scoping review, key informant interview, high school survey, and health facility-based survey.

For Study Objective 2 and 3, data on prioritized health needs across life course among different groups of populations required to compute the SCI will be collected in the Capital and four provinces. A population-based survey will be conducted in conjunction with the health facility-based survey and available routine data of national programs. Table 1 shows the data needed and the data sources. Some selected components of social determinants of health such as healthy ageing (intrinsic capacity), health seeking behavior for chronic care, health care access and affordability will also be included [22].

For Study Objective 3, a consultative workshop with relevant stakeholders will be conducted to obtain consensus.

Table 1. Data needed for study objective 2 and 3

	Routine Data	*Population-based survey (source of questions)*	*Health facility-based survey*
Domain: Reproductive, maternal, newborn and child health			
Family planning		√	
ANC		√	
DTP3 immunization		√	
Nutrition status		√	
Domain: Infectious Diseases			
TB	√		
HIV	√		
Basic sanitation (WASH)		√	√
Domain: Noncommunicable Diseases			
Hypertension (measurements)		√	
Diabetes (just self-report)		√	
Cervical screening (just self-report)		√	
Mental health		√	
Tobacco use		√	
Alcohol use		√	
Diet		√	
Awareness of key risk factors and associated interventions		√	
Domain: Service capacity and access			
Number of beds	√		√
Number of health care workers (general doctors, surgeons, psychiatrists, nurses, midwives, cleaners)	√		√
Access to essential medicines			√
Capacity assessment of diabetes services			√
Capacity of data infrastructure and data use			√
Domain: Social determinants of health			
Trust and population satisfaction		√	
Social health protection (HEF and NSSF)		√	
Healthy ageing (intrinsic capacity)		√	
Health seeking behavior for chronic care		√	
Household expenditure on healthcare (OOP)		√	
Access to healthy foods (fruit, vegetables)		√	
Access to places for doing exercises		√	
Access to oral health care		√	

2.4. Sampling and sample

2.4.1. Health-facility survey

To address the three study objectives, the capital and four provinces will be chosen as study sites. The capital city of Phnom Penh will be selected purposefully. Additionally, one province from each of the four regions will be purposively selected based on their characteristics that represent the regions. Those provinces include: Ratanakiri (Plateau and Mountains region), Kampot (Coastal and Sea region), Takeo (Central Plain region), and Siem Reap (Tonle Sap region).

All referral hospitals (CPA1 and CPA2) in each study site will be included. Regarding the health centers, probability proportional to size (PPS) will be used to select health centers from each study site. The list of health centers will be obtained from the Department of Planning and Health Information, and 70% of the total health centers in each study site will be randomly selected. Each health center will be assigned a sequential number (e.g., 1, 2, 3, ..., n). An online application (https://www.randomizer.org) will be used to randomize the health centers for selection. **Table 2** shows the number of referral hospitals and proportion of health centers to be selected.

Table 2. Selected number of referral hospitals and health centers in the study

Study Site	Number of Selected Referral Hospitals	Number of Selected Health Centers (Total)*
Phnom Penh	7	32 (46)
Siem Reap	4	65 (93)
Takeo	6	59 (84)
Kampot	4	46 (66)
Ratanakiri	1	21 (30)
Total	22	223 (319)

**The total number is taken from the national health congress report 2024 [9]*

2.4.2. Population-based survey

SCI will be measured through primary data collection using the population-based survey. The target population is all the household members, and adults aged 18 years and older with the most knowledge of the household are the target respondents. They have to reside within individual households within the last six months and be able to provide informed consent. Institutionalized population is excluded.

The samples per province needed for this study is calculated using the formula for descriptive studies:

*Sample size (n) = [DEFF*Np(1-p)]/ [(d²/Z²$_{1-\alpha/2}$*(N-1) +p*(1-p)] where:*

N = Population size (1,000,000)

p = Estimated seroprevalence rate of 50% where the largest sample can be obtained for all main indicators.

d = Precision of 0.05 (5% margin of error)

DEFF = Design effect of 2

$Z_{1-\alpha/2}$ *= critical value for normal distribution at 95% confidence level (1.96)*

Thus, an estimated minimum sample size of 390 participants was obtained using Open Epi online software. After adjusting for DEFF of 2 and 15% of non-response rate, the sample size for each province increased to 890 and rounded up to 920. In total, the study will need 4600 participants. Our target population are all household members. Based on the latest population census in 2019 [1], the average household size was 4.3. Therefore, we expect to get data about health needs of approximately 19,780 household members.

In the survey, villages will serve as primary sampling units. 40 villages will be randomly chosen from each study site. The list of villages will be derived from each health center of the study sites. We will review the village population size against the data from National Institute of Statistic (NIS). If the size is different, the NIS's data will be taken. Subsequently, in each village, 23 households will be randomly chosen as secondary sampling units. The list of households will be collected from village chiefs. We will work with village chiefs to verify the household list by eliminating households which are already moved out and adding new households. The eligible household should be those who stay in the village at least in the last six months. Within each household, one adult aged 18 or older will be randomly chosen as tertiary sampling units using tablet-based form. All household members aged 18 years or older will be listed in the tablet-based form. These members will be disabled from the list for random selection if they are unable to meet us during our time in the village (within three-day period in each selected village). The sampling will be without replacement. **Table 3** shows the sampling of the population-based survey.

Table 3. Sampling of the population-based survey

Study site	**Name**	**Primary Sampling Units**	**Secondary Sampling Units**	**Tertiary Sampling Units**
The Capital	Phnom Penh	40 villages	920 households	920 participants
The Tonle Sap region	Siem Reap	40 villages	920 households	920 participants
The Plateau and Mountains region	Mondulkiri	40 villages	920 households	920 participants
The Coastal and Sea region	Kampot	40 villages	920 households	920 participants
The Central Plain region	Takeo	40 villages	920 households	920 participants
Total	**5 sites**	**200 villages**	**4600 households**	**4600 participants**

2.5. Data collection

2.5.1. Scoping review

A scoping review of health workforce mapping in Cambodia and ASEAN region will be conducted. This will involve document review of relevant policy documents and peer-reviewed articles. **Annex 1** shows details of search strategies and search terms.

2.5.2. Key informant interviews

Interviews with relevant stakeholders working in the field of health workforce will be conducted. Those might include representatives from related departments of the Ministry of Health, the Ministry of Education, Youth, and Sports, and other related line ministries; training institutions of health professionals; professional regulatory bodies; local health authorities at the sub-national level; and development partners. We expect to get around 30 key informants. The exact number depends on saturation of data.

2.5.3. High school survey

A set of questionnaires (**Annex 2**) will be used to ask high school students (grade 12 in the academic year 2023-2024) regarding preference for health profession education. The study will select public high schools in Phnom Penh as the capital has the largest number of students. Another province (Takeo) which has more than 5000 students studying in grade 12 will also be selected. 3 public high schools will be selected from each site. In total, there will be 6 public high schools with the total sample size of 420 students. Those who refuse to give informed consent, have any acute or chronic conditions that limit the ability to participate in the study, and do not have a plan to further their higher education will be excluded from the study.

2.5.4. Health facility-based survey

A Harmonized Health Facility Assessment that focuses on (1) service availability, (2) service readiness, (3) quality of care, and (4) management and finance [23] will be employed. The assessment also includes the component of staffing and staff management. **Annex 3** shows the assessment questionnaires.

2.5.5. Workload Indicator Staffing Needs (WISN)

Standards of health center and referral hospital with full services will be established based on the MPA and CPA guidelines. Three referral hospitals (CPA1) and six health centers in Phnom Penh will be purposefully selected to perform the WISN based on their assessment results in the previous study. The research team will first review the completeness of service provision of these health facilities against the MPA and CPA guideline through phone call assessment and their submitted reports in the Health Management Information System.

2.5.6. Population-based survey

A structured questionnaire (**Annex 4**) will be developed to capture data indicated in Table 1. A table of the most recent household and population estimates by stratifies (urban/rural), region/state/province, sex, age-groups) will be required prior to starting the interviews.

2.5.7. **Routine or existing survey data**

Necessary routine data related to the study objectives will be obtained from relevant sources of health programs or focal points.

2.6. Data Analysis

2.6.1. Qualitative data

Data from the scoping review and key informant interviews will thematically analysed and coded. Open coding method will also be used for emergent themes and codes. The identified themes and codes will be consulted with all the principal investigators and discussed with other interviewers. The recorded interviews will be verbatim transcribed into the Cambodian language (Khmer). We will use NVivo 12 (Plus) to manage the data.

2.6.2. Quantitative data

The bivariate analysis will be used to identify potential associations. At the initial stage, the Chi-square test will be used to determine the association between explanatory variables and outcome variables (SCI indicators). The explanatory variables will include participants' age, sex, marital status, educational level, household wealth quintile, and health care utilisation. Variables with the significant level at *P*-value < 0.2 will be included in a multiple logistic regression model. In the multiple logistic regression model, backward elimination method will be used. The process will start with all the identified explanatory variables. Then, variables with the highest *P*-value will be eliminated from the model one by one at a time. The process will be repeated until all the variables in the model are statistically significant with a cut-off point of *P*-value < 0.05.

Household weights for analysis at household level and individual weights for analysis at person level will be calculated. These weights will be based on the selection probability at each stage of sampling. Household weights will be post-stratified by region/state/province and locality. Individual weights will be post-stratified by region/state/province, sex and age-groups (18-29, 30-39, 40-49, 50-59, 60-69, 70+). Post stratification adjustments will be based on the most recent household and population estimates provided by the National Statistics Office. Weighted social and demographic characteristics of respondents will be summarized using descriptive statistics. The statistic program 'Stata 18' [40] will be used to perform the quantitative analyses.

The WISN tool will be used to analyze the workload and generate different health service delivery scenarios – representing minimum and maximum services levels [24].

Regarding the health workforce planning, time series analysis to identify the trends and comparative analysis between national and international graduates will be conducted. Also, geospatial analysis will be carried out to create maps illustrating the distribution of health workers across provinces.

Regarding the simulation modelling, we will use the SCI as the outcome measure, using a two-level structural equation model [13]. The first level structure level of the structure will deal with health expenditure per capita which will be used to explain the critical inputs for service delivery/coverage: health workforce density, health facility density, essential medicines readiness, and diagnostic readiness measuring testing capability. In the second level of the model, the critical inputs for service delivery will

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