Health system's readiness to provide cardiovascular, diabetes and chronic respiratory disease related services in Nepal: analysis using 2015 health facility survey

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Abstract

**Background:** The burgeoning rise of non-communicable diseases is posing a serious challenge in resource constrained health facilities of Nepal. The main objective of this study was to assess the readiness of health facilities for cardiovascular, diabetes and chronic respiratory disease services in Nepal.

**Methods:** This study utilized data from the Nepal Health Facility Survey 2015. General readiness of 940 health facilities along with disease specific readiness for cardiovascular diseases (CVDs), diabetes and cardiorespiratory diseases (CRDs) were assessed using service availability and readiness assessment manual of the World Health Organization (WHO). Health facilities were categorized into public and private facilities.

**Results:** Out of a total of 940 health facilities assessed, private facilities showed higher availability of items of general service readiness, except for standard precautions for infection prevention, compared to public facilities. The multivariable adjusted regression coefficients for CVDs (β=2.87, 95%CI: 2.42-3.39), diabetes (β =3.02, 95%CI: 2.03-4.49) and CRDs (β=15.95, 95%CI: 4.61-55.13) at private facilities were higher than public hospitals. Health facilities located in hills had higher readiness index for CVDs (β=1.99, 95%CI: 1.02 - 1.39). Service readiness for CVDs (β=1.13, 95%CI: 1.04-1.23) and diabetes (β=1.78, 95%CI: 1.23-2.59) were higher in the urban municipalities than in rural municipalities. Finally, disease related services readiness index was sub-optimal with some degree of variation at the province level in Nepal. Province 2 for CVDs (β=0.83, 95%CI: 0.73-0.95), and province 4 (β =1.24, 95%CI: 1.07-1.43) and province 5 (β =1.17, 95%CI: 1.02-1.34) had higher readiness index compared to province 1.

**Conclusions:** This study found a sub-optimal readiness of services related to three NCDs at the public facilities in Nepal. Compared to public facilities, private facilities showed higher readiness score for CVDs, diabetes and CRDs. To cope up with the growing burden
of NCDs, urgent improvement in health services, particularly in public facilities are critical to manage common NCDs.

Background

Non communicable diseases (NCDs) are the leading causes of disability adjusted life years (DALYs) and mortality in recent years in Nepal [1]. According to the Global Burden of Diseases report, nearly 82,976 deaths in Nepal in 2017 were reported due to NCDs that included CVDs (49,248 deaths), diabetes (10,145 deaths) and chronic obstructive pulmonary diseases (23,583 deaths) [2]. NCDs collectively contributed to 75 to 82% of total DALYs in 2017 [1]. Almost 80% of the patients attending outpatient departments in Nepal have at least one NCDs and around half of the deaths are due to NCDs [3]. Limited data suggest nearly one-third Nepalese develop hypertension and one-sixth develop diabetes, and this is thought to be underestimated [3]. Inadequate qualities in health services and its coverage for the management of NCDs can contribute to higher disease and disability burden. To combat the rising burden of NCDs, Government of Nepal has developed a multi-sectoral plan for prevention and control of NCDs in 2014 [4]. Although funds have been allocated for prevention and management of NCDs in Nepal, a program implementation has not been initiated even after five years of its inception. Health services in relation to the diagnosis and treatment of NCDs is a demanding undertaking that requires efficient health care system, investment and surveillance [5]. Nepal’s health system suffers from several constraints such as poor and unequal health care services, poor infrastructure, inefficient supply-chain logistics (inadequate supply of essential medicines and equipment) with inadequate human resources and their attrition [6, 7]. A comprehensive assessment of private and public health facilities is thus essential to identify capacity of health facilities to deliver quality NCDs screening and treatment services.
Nepal’s health system is heavily dependent on out of pocket (OOP) health spending. Nearly 70% of health expenditure in Nepal is contributed by OOP [8]. Private sector contributes the bulk of specialized health services, and its contribution to the total share of health services is growing. From 1995 to 2008, the number of private hospitals grew by 78% compared to a mere 23% increase in public sector [9]. Approximately 70% of the total health expenditure in Nepal was estimated from private health facilities, of which 85% were out of pocket [10]. However, there are very few studies on the assessment of readiness of private sectors to provide quality health services. Understanding of systematic differences in service provisions between private and public health service providers in Nepal will be essential to inform health policy, planning and implementation.

With the promulgation of new constitution in 2015 and transformation of Nepal into federal republic from unitary system, the country has been restructured into seven provinces. The seven provinces are sub-divided into 753 local governments comprising six metropolitan cities, 11 sub-metropolis, 276 urban municipal councils and 460 rural municipalities [11]. Likewise, the health system in Nepal has also been restructured in alignment with three tiers of Government (Central, Provincial and local, Figure 1 and 2). These changes have paved a path for new opportunities for better health systems and have also uncovered many new challenges such as severe depletion of health professionals [12].

The WHO has set a target strategy to reduce 25% of mortality due to NCDs by 2025 [13], however, health systems in developing countries such as Nepal face myriad challenges in providing services to NCDs [14-16]. There have not been any studies in the past exploring the challenges and readiness of health systems in tackling the NCDs in Nepal. Readiness of the health system for NCDs is defined as the ability of health system to provide services to these diseases [17]. Readiness assessment is important for benchmarking the
coverage and quality of health system and supporting policy-makers in planning appropriate sustainable responses [17]. The main objective of this study was to assess the readiness of health facilities for cardiovascular, diabetes and chronic respiratory diseases services in a representative sample of public and private health facilities across all seven provinces in Nepal.

Methods

Nepal’s health system

Nepal’s health system operates under the stewardship of Ministry of Health and Population (MoHP). Nepal’s health structures can be divided into central, provincial and local level. The public and central hospitals are at the top tier to provide tertiary health care. Provincial and district hospitals are regional centers for tertiary care and are entitled for the health care of the population of the province. At the bottom tier are the district hospitals, which supervise community level health centres such as primary health care centres (PHCs), health posts (HPs) and sub-health posts (sHPs). At the community level, locally available health care staff are female community health volunteers and community clinics. All tiered public hospitals have parallel private sector health care institutions.

Study design

This study used the data from the 2015 Nepal Health Facility Survey (NHFS). The 2015 NHFS was the first nationally representative, cross-sectional survey of health facilities consisting a randomly sampled health facilities across all seven provinces in Nepal. The NHFS collects information on the availability of health services including availability of basic services, human resources, logistics, essential drugs, laboratory services and infection control mechanisms following standard procedures in health facilities. Out of a total of 4,719 health facilities (sampling frame), 963 health facilities including all non-specialized government hospitals, all private hospitals with 100 or more inpatient beds,
and all PHCs were selected using stratified sampling from 13 sample domains. The
detailed information on the main objectives and survey methodology of 2015 NHFS is
published elsewhere [18].

Data collection tools
The data in the NHFS were collected using comprehensive tools of the Service Availability
and Readiness Assessment (SARA) endorsed by World Health Organization (WHO), Nepal-
Service Tracking Survey (STS) by the UK Aid, Facility Assessment for Reproductive Health
Commodities Security (FARHCS) by the United Nations Population Fund (UNFPA), and
United States Agency for International Development (USAID)-supported Service Provision
Assessment (SPA) survey of the Demographic Health Survey (DHS) Programme [18]. More
information about these tools are available elsewhere [18]. The facility inventory tool was
used to collect information on general and specific service availability at the health
facilities. The information related to the qualifications, training, clinical experience, level
of education, supervision received and perceptions of the service delivery environment
from a sample of healthcare providers were recorded in the provider dataset. The survey
tools were adapted, validated and pretested in the Nepalese context [18].

Data collection
Data collection of 2015 NHFS was performed in a computer-assisted personal interviewing
(CAPI) programs after three weeks of training and three days of pre-testing. A total of 86
interviewers with experience as health assistants, executed the data collection of this
survey. Eight trainers were assigned to supervise twenty field teams and to monitor data
quality. The first phase of data collection took place in April 20 through 25, 2015 and
resumed on June 4 after the earthquakes and continued through November 5, 2015. Once
data were collected in a facility, all data were entered in a tablet computer. The collected
data were then transferred to a secured server after a team leader conducted consistency
and structural checks to identify any errors or missing information.

**Data analysis**

This study used two datasets from the 2015 NHFS: data from the facility inventory dataset and a provider interview dataset. General service readiness of 940 health facilities was assessed in five domains (e.g. basic amenities, basic equipment, standard precautions for prevention of infection, diagnostic capacity and essential medicine). Also, the analysis specific to service readiness to diabetes, CVDs, CRDs was carried out following the WHO’s SARA manual [17].

Readiness indicators for each item under main service domain were recoded as binary variables, taking value “1” for the availability of tracer item and “0” for the absence of items in the facility. Findings on general service readiness and disease-specific readiness (Supplementary Table 1) were disaggregated into public facilities and private facilities. Altogether, 940 health facilities were included to calculate the service readiness of diabetes-related, CVD-related and cardiorespiratory disease readiness score in this study. Only those facilities having complete data were reported. Since HTCs (Human Immunodeficiency Virus Testing and Counselling centers) that are not supposed to provide services related to CVDs, diabetes and chronic respiratory disease, 51 standalone HTCs were excluded in this study. Availability of basic health services, human resources, logistics, laboratory services and essential medicine were assessed using the WHO-SARA scoring guideline for health services readiness for NCDs [19]. Service readiness scores range between 11.3 to 34.7; higher score reflects better preparedness. Detailed description of each domain is presented in Supplementary Table 1. Level of urbanization was assigned to each health facilities based on government classification: urban and rural categories. We aggregated metropolitan city and sub-metropolitan city into one, considering it as the highest level of urbanization followed by urban municipality and rural
The primary objective of this study was to assess readiness of public health facilities and private facilities that provide services for CVDs, diabetes and CRDs in Nepal. This was initially accomplished using raw readiness scores followed by multivariable models. Following the WHO-SARA guideline of health facilities [17], means and standard deviation (±SD) of all domain raw scores were calculated for general, CVDs, diabetes and CRD-related service readiness index. CRD-related service readiness index is based on the mean availability of items as percentage within that domain. The distributions of readiness indices specific to CVDs, diabetes, and CRDs were negatively skewed. Hence, we calculated median (Q1, Q3) to express the readiness of health facilities.

The secondary objective of this study was to understand whether heterogeneity in readiness exist in different regions of Nepal. This was assessed using median readiness index for these diseases stratified by seven provinces, facility type (public and private) and level of urbanization (metropolitan, urban municipality). In addition, multiple linear regression analysis was used to account for potential confounders of service readiness by adjusting for health facility type, ecological region and level of urbanization. Beta coefficient (β) ≥1 from regression models denotes favourable changes in readiness index and vice-versa. The outcome variables were log-transformed before analysis to address the non-normal distribution of residuals detected in the regression models. A two-sided p-value below 0.05 was considered as statistically significant. All analyses were conducted using STATA version 15 (StataCorp LP, College Station, TX, USA) [20] and were adjusted for sample weight.

**Patient and Public involvement**

This study was an analysis of the 2015 Nepal Health Facility Survey (NHFS) database. This research was done without patient involvement and is not applicable for this
study. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

Results

Findings of general service readiness and mean domain score of items are shown in Table 1. Out of a total of 940 health facilities, majority (870; 93%) were public health facilities. The mean domain scores for basic amenities, basic equipment, standard precautions, laboratory capacity, and essential medicines were 53.7 (±SD 21.3), 77.2 (±SD 17.6), 59.2 (±SD 19.1), 16.6 (±SD 30.0) and 33.3 (±SD 15.5) respectively. Except for standard precautions for infection prevention, private facilities possessed a higher availability of items in four domains of general service readiness. Amongst all domains, mean domain score in public facilities was very low for diagnostic capacity. Overall, median readiness index comprising all domains was 53.8 (Q1, Q3: 43.7, 69.4). Private facilities had a higher median readiness index 75.2 (65.8, 84.3) compared to public facilities 50.3 (Q1, Q3: 42.4, 63.3).

Readiness index specific to services for CVDs

In total, 940 health facilities provided information on availability of diagnosis and treatment facility (Table 2). The mean domain score on the availability of guidelines on diagnosis and treatment and trained staff on CVDs treatment was very low; 1.4 and 1.3 respectively. The mean domain index of equipment in the health facilities that provide CVD services was 68.2 (±SD 21.1). The mean domain index for CVD medicine was as low as 5.4 (±SD 15.5) and availability of essential medicines for CVD was low in public facilities and the overall median readiness index for CVDs was 18.8 (Q1, Q3: 18.8, 25.0).

Readiness index specific to services for diabetes

Among all health facilities, the majority of private facilities offered diagnosis and
treatment of diabetes (Table 3). The mean domain score for the availability of guidelines on the diagnosis and treatment for diabetes was 4.1 and less than 2 for the trained health personnel available at the facilities. The mean domain index of availability of equipment that offered diabetes services was 40.4 (±SD 24.4). The mean domain index of diagnostic capacity, and medicine, was 9.0 (±SD 24.3), and 11.1 (±SD 20.7) respectively and the median readiness index for diabetes was 26.4 (Q1, Q3: 20.8, 33.3).

**Readiness index specific to services for chronic respiratory diseases**

Out of 940 health facilities, nearly five percent did not provide service for diagnosis and treatment for CRDs. The mean domain score of availability of guidelines and trained provider related to CRDs was 4.6 and 9.0 respectively. Availability of both equipment and medicines was higher in private facilities. The overall median readiness index specific to services for CRDs service was 11.3 (Q1, Q3: 11.3, 18.8) (Table 4).

Table 5 shows the multiple linear regression for CVDs, diabetes and CRDs-specific service readiness index by province, facility type, ecological region and level of urbanization. There were no major differences in provinces except for higher CVDs-specific readiness noted in provinces 2 (β =0.83, 95%CI: 0.73-0.95), province 4 (β =1.24, 95%CI: 1.07-1.43), and province 5 (β =1.17, 95%CI: 1.02-1.34) compared to province 1. When assessed by health facility type, private facilities had significantly higher readiness compared to public facilities for CVDs (β =2.87, 95%CI: 2.42-3.39, diabetes (β =3.02, 95%CI: 2.03-4.49) and CRDs (β =15.95, 95%CI: 04.61-55.13). Service readiness index by ecological region showed that health facilities in Hills were far better than Terai for CVDs (β =1.99, 95%CI: 0.91-1.11). Urban municipalities had a higher service readiness score than rural municipalities for CVDs (β =1.13, 95%CI: 1.04-1.23) and diabetes (β =1.78, 95%CI: 1.23-2.59).

**Readiness index according to provinces, health facility types, ecological region**
and levels of urbanization

The median readiness index for CVDs, diabetes and CRDs in public health facilities in Nepal was very low ranging between 9.2 to 27.9 (Figure 3). The service readiness score was particularly low in public facilities for CVDs and CRDs. Overall, the median readiness index for CVDs, diabetes and CRDs were low (less than 30%), with little heterogeneity across the seven provinces. Compared to the median values for diabetes, the median values for CVDs, and CRDs were consistently low in Province 2, Province 6 and Province 7 (Figure 4).

The median readiness index by urbanization (metropolitan, urban and rural municipality) and health facility type is shown in Figure 4. In general, the overall median readiness index was less than 40 for CVDs, diabetes and CRDs across these categories. However, the readiness was even lower for public health facilities irrespective of urbanization or disease.

Discussion

Overall findings

Current study draws from a nationally representative sample of 940 health facilities and shows that majority of health facilities across all seven provinces had sub-optimal readiness to manage CVDs, diabetes and CRDs based on WHO SARA guideline [13]. Against the backdrop of WHO’s target strategy to reduce 25% of mortality due to NCDs by 2025 [13], health systems in developing countries such as Nepal face significant challenges in providing services to NCDs [14-16]. Private health facilities were better equipped to provide services related to CVDs, than public health facilities. Most of the facilities lacked trained human resources, equipment, drugs, and standard guidelines for effective NCDs care and management.

Readiness of public and private health facilities for NCDs
Compared to the service readiness of private health facilities, the readiness scores for public health facilities was low. There is an increasing trend to visit private health facilities in Nepal for the pursuit of better health care, particularly patients from average to high socio-economic status [10, 21]. Healthcare expenditure in Nepal is mostly out of pocket and constitutes one-third of the total expenses involving both private and public hospitals [22]. In such a context, lack of readiness of public facilities where patients resort for quality health care, poses a major challenge in diagnosis of NCDs and its management. Similar findings have been found in other resource constrained settings of low- and middle- income countries (LMICs) [23, 24]. In general, driven by the lack of political stability and economic constraints, LMICs face significant challenges in maintaining preparedness of health system, coverage and quality of care.

One of the major challenges in Nepal’s health system is the disproportionate lack of human resources, medicines, equipment and supply chain logistics in remote regions of Nepal [6, 7, 25]. In addition, other factors such as patient’s socio-economic status, distance to health centres, transportation, direct and indirect costs associated with attending health centres further compound the utilization of health services in rural regions of Nepal [7, 26] and resonate with other LMICs [27]. Standing at the forefront of health services, health care providers, particularly in PHCs and HPs, significantly lack adequate training and experiences in the management of NCDs echoing with the health systems in sub-Saharan Africa [28]. Even if human resources were ready to serve the patients, the health facilities often lack simple diagnostic materials, equipment such as glucometer or a basic lab equipment to measure blood glucose level.

Most of the public health facilities faced shortfall in the availability of medicines for CVDs and diabetes. Although, the basic diagnostic items such as sphygmomanometer and stethoscope were readily available, unavailability of glucose strips and essential
medicines such as blood pressure lowering drugs and anti-diabetics hinder the quality of NCDs care by health care providers. Our findings resonate with the studies from LMICs settings of Africa and Asia [29-32]. Despite the ample evidence that essential medicines for NCDs reduce the burden of NCDs, public health facilities often lack essential medicines; and health care is often unaffordable in the private sector, particularly for the population from low socio-economic status. Management of NCDs requires prolonged follow-ups with regular access to medicines and health care; any impediment to access and care can prompt patients to discontinue their treatment and may fall prey to poly-visits to both formal and informal health care providers. The latter can include traditional healers who often sell unknown chemical compounds [33] and others constitute drug peddlers, locally known as ‘Jhole doctors’ in Terai region of Nepal [34]. Although these informal drug peddlers are illegal, the ease of access and their local availability can mean that patients rely on their poor diagnostic skills and sub-standard, and counterfeit medications which can delay the health seeking behavior, distort the symptoms and develop complications and death [34]. Although WHO advocates for the global priorities in increasing an access to essential, quality-assured, safe, effective and affordable medical products, countries in LMICs struggle to achieve the universal health coverage [35, 36]. In this study, unavailability of guidelines for early detection, management and prompt referral of CVDs, diabetes and CRDs; poor monitoring and evaluation system for tracking NCDs; and weak referral linkages between primary and higher health care facilities were found to be the major barriers in NCDs prevention and care. Several studies have reported the low service readiness in health facilities in rural parts of the country compared to the health facilities in urban areas [7, 37, 38]. Similar findings were observed in the current study where many health facilities in rural areas were located in hard to reach areas, and often lacked qualified health workers, with high attrition and lack of policy supporting
establishment of health care institutions in the rural regions [25, 39]. Such a chronic shortage of health workforce and resources in the rural regions is likely to persist and can be compounded by the transitioning federal health system of Nepal with high level of unwillingness of health care workers to serve in the rural regions [40]. Although government of Nepal reinforced policy to promote the retention of qualified health human resources particularly doctors in the rural regions, such as through promotion, provision of incentives, opportunities in higher education, in addition to compulsory placement of government funded doctors in the rural settings, the attrition remains a major problem [41, 42]. Chronic shortfall of qualified health human resources in the rural settings are attributed to manifold factors including lack of health infrastructure, shortage of equipment, poor academic/clinical stewardship and urban centric health care system in Nepal [39, 41-43]. The primary health care centers in rural regions of Nepal thus share the disproportionate burden of scarcity in providing health services.

The supply chain logistics providing essential medicines including equipment in such hard to reach areas is compounded by the poor road condition, seasonal flooding and landslides. For instance, year round availability of essential medicines in Nepal was 16.6% in health facilities from the Mountains, 57.1% in the Hills and 52.2% in the Terai [44]. A study in Bangladesh reported that the poor supply chain management for essential medicines affected the management of NCDs in the rural settings.[45]

**Implications for health policy and planning**

Sub-optimal availability of NCDs services in Nepal has major implications for country’s aims for sustainable development goal-3. Also, it shows that Nepal is inadequately prepared to achieve the “Global action plan for the prevention and control of NCDs 2013-2020” [13] which has an ambitious target to reduce premature cardiovascular mortality by 25% by 2025 [4]. Although Nepal has set steps and promises towards curbing the current
under coverage of health services to rural regions, the multi-sectoral plan on management of NCDs faces challenges intertwined in the current health system’s functioning. Nepal should strive towards ensuring the functional capacities of PHCs (for example, improving supply chain logistics and provision of adequate number of health human resources, training, capacity development and addressing attrition) together with stringent policy stewardship to improve NCDs care in both PHCs and private hospitals.

The current restructuring of health system in Nepal in alignment with federal setup can be an excellent opportunity for strengthening health facilities in delivering NCDs services. With the increased devolvement of responsibility to provincial and local government in federal context including revenue collection through taxes on tobacco, alcohol and sugary drinks, financial independence thus achieved can be channeled to the management of NCDs.

In order to improve the retention of qualified health human resources in rural regions, augmenting current policies together with infra-structural development is necessary. For instance, physicians may feel motivated when there is an availability of professional supervision, better opportunities for specialized training in addition to current policies of incentives and compulsory placements. In addition, Nepal can adopt the principles inherent in community engagement [46, 47], wherein community and public-private partnership can serve the population in terms of early diagnosis, treatment and management. The intervention approaches to reduce NCDs in low resource settings as recommended by the WHO includes early detection and diagnosis that could curtail medical costs, improve quality of life and productivity in LMICs such as Nepal [16]. Recent evidence of training and mobilization of female community health volunteers in the management of hypertension shed some promising steps for Nepal [48]. Such a strategy could be scaled up together with the partnership of community-public and private health
service providers through various means including subsidization of health care services to enhance the current coverage for the management of NCDs.

**Strengths and limitations**

This is the first study exploring the challenges and readiness of health systems in tackling the NCDs in Nepal and utilized the first nationally representative sample of health facilities across all seven provinces in Nepal, thus the findings from this study are generalizable for all regions of Nepal. The other major strengths of this study are that the medicine, diagnostics and guidelines availability was recorded based on the observations of health facilities by trained survey enumerators. Although several areas were examined in this study such as availability of medicines, diagnostics, and guidelines, most of these were basic assessments and many other equipment and tools required for management of NCDs such as electrocardiogram and other technologies were not considered. Information were missing on one to several items depending on the domains analyzed. Consequently, the sample size was limited to all non-missing items. Our findings are approximate to the original report of Nepal SPA report, 2015 (link: https://dhsprogram.com/pubs/pdf/SPA24/SPA24.pdf), so discrepancies may have occurred due to partitioning of data for analysis. Although reported data were triangulated by observation and through cross-validation (through multiple respondents), information on qualifications, training, clinical experience, and perceptions of the service delivery environment may have incurred desirability and recall bias. Nevertheless, authors’ experience of health services and review of the literature suggest that these public health services, specifically in rural regions suffer from multitude of constraints.

**Conclusions**

This study found sub-optimal readiness of health system for services related to CVDs, diabetes and CRDs particularly at the public health facilities in Nepal. The availability of
services was higher in private health facilities compared to the public health facilities. Geographic variation in service readiness index highlights that some provinces are better prepared to provide NCDs services than other provinces. Given Nepal’s commitment under SDG-3, Global Action Plan on NCDs and commitments under periodic plans and policies, the country needs to strengthen service delivery platforms while improving the overall readiness of health system through increasing the number of qualified health staff, training and provision of equipment and medicines. In addition, future operational and health system research can explore the scalability and practicalities of community-public-private partnership, such as through training of community volunteers, increased engagement with multi-stakeholders and subsidization of basic amenities for detection, treatment and management of NCDs.

List Of Abbreviations

CAPI: Computer Assisted Personal Interviewing; CI: Confident Interval; CVDs: cardiovascular diseases; CRDs: Chronic Respiratory Diseases; DALY: Disability Adjusted Life in Years; DHS: Demographic Health Survey; FARHCS: Facility Assessment for Reproductive Health Commodities Security; FCHVs: Female Community Health Volunteers; LMICs: Low and Middle Income Countries; NCDs: Non-communicable diseases; NHFS: Nepal Health Facility Survey; OPP: Out Of Pocket; PHCCs: Primary Health Care Centers; PHC/ORC: Primary Health Care/Out Research Clinic; SARA: Service Availability and Readiness Assessment; SD: Standard Deviation; SDG: Sustainable Development Goal; STS: Service Tracking Survey; UK Aid: United Kingdom Aid; UNFPA: United Nations Population Fund; USAID: United States Agency for International Development; WHO: World Health Organization

Declarations
**Consent for publication**

Prior consent was taken from the Measure DHS program for the use and publication of this manuscript.

**Availability of data and materials**

All data related to this study are publicly available from the DHS program website at https://dhsprogram.com/pubs/pdf/SPA24/SPA24.pdf

**Ethics approval and consent to participate**

Ethical approval for this study was provided by the Nepal Health Research Council, Ramshah Path, Kathmandu, Nepal.

**Competing interests**

Authors have no competing interest associated with this paper. Bipin Adhikari is on the editorial board of BMC Public Health.

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**Contributors**

SRM, NS and UG conceived the idea of the study; SRM, NS, UG and BA conceptualized the study; UG and NS conducted the statistical analysis; BA, NS and UG drafted the manuscript with contribution from SRM, YP and SM. All the authors reviewed and agreed on the final version of the manuscript.

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**Tables**

| Table 1: Status of general service readiness indicators of the facilities |
|--------------------------------------------------|
| General readiness | Public facilities n=870 | Private hospitals n=70 | Total n=940 |
|-------------------|-------------------------|-------------------------|-------------|
| Basic amenities | | | |
| Power | 44.3 | 99.4 | 4 |
| Water source | 80.0 | 89.4 | 8 |
| Room with privacy | 76.7 | 95.7 | 7 |
| Adequate sanitation facilities | 80.0 | 98.4 | 8 |
| Communication equipment | 12.1 | 98.4 | 1 |
| Access to computer with internet | 4.2 | 78.7 | 9 |
| Emergency transportation (ambulance) | 56.4 | 94.5 | 5 |
| Mean domain score of basic amenities (±SD) | 50.5 (18.6) | 93.5 (9.6) | 5 |
| Basic equipment | | | |

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| Equipment                                | Mean | SD  | Domain Score |
|------------------------------------------|------|-----|--------------|
| Blood pressure apparatus                 | 94.0 | 95.6| 9            |
| Stethoscope                              | 97.9 | 96.7| 9            |
| Adult scale                              | 88.2 | 94.1| 8            |
| Child scale                              | 40.3 | 25.6| 3            |
| Thermometer                              | 92.8 | 96.4| 9            |
| Light source                             | 47.6 | 88.8| 5            |
| **Mean domain score of basic equipment** | 76.8 | 17.5| 7            |
| Standard precautions for infection prevention |      |     |              |
| Safe final disposal of sharps            | 84.0 | 85.4| 8            |
| Safe final disposal of infectious wastes | 81.5 | 74.6| 8            |
| Appropriate storage of sharps waste      | 81.1 | 34.0| 7            |
| Appropriate storage of infectious waste  | 4.8  | 4.7 | 4            |
| Disinfectant                            | 62.4 | 63.1| 6            |
| Single-use, standard disposable or auto-disable syringes | 84.2 | 60.1| 8            |
| Soap and running water or alcohol-based hand rub | 55.8 | 73.9| 5            |
| Disposable latex gloves                  | 79.6 | 83.0| 7            |
| Guidelines on standard precautions       | 3.3  | 5.3 | 3            |
| **Mean domain score of standard precautions for infection prevention** | 59.6 | 18.8| 5            |
| **Diagnostic capacity**                  |      |     |              |
| Blood glucose test                       | 3.7  | 58.0| 7            |
| Hemoglobin test                          | 9.3  | 93.3| 1            |
| HIV diagnostic capacity                  | 8.9  | 87.1| 1            |
| Malaria diagnostic capacity              | 18.6 | 95.3| 2            |
| Syphilis RDT                             | 5.6  | 78.1| 1            |
| Urine test for pregnancy                 | 25.4 | 90.0| 3            |
| Urine dipstick- protein                  | 9.8  | 90.5| 1            |
| Urine dipstick- glucose                  | 7.7  | 91.8| 1            |
| **Mean domain score of diagnostic capacity** | 11.1 | 22.9| 1            |
| Essential medicines                      |      |     |              |
| Amitriptyline tablet                     | 4.7  | 58.3| 9            |
| Amlodipine tablet or alternative calcium channel blocker | 5.1 | 68.3| 1            |
| Amoxicillin syrup/suspension or dispersible tablet | 21.6 | 57.4| 2            |
| Amoxicillin tablet                       | 89.6 | 71.4| 8            |
| Ampicillin powder for injection          | 4.0  | 36.7| 6            |
| Beclometasone inhaler                    | 3.2  | 33.0| 6            |
| Ceftriaxone injection                    | 18.0 | 43.6| 1            |
| Enalapril tablet or alternative ACE inhibitor e.g. lisinopril, ramipril, perindopril | 13.9 | 57.0| 1            |
| Fluoxetine tablet                        | NA   | NA  | N            |
| Gentamicin injection                     | 63.5 | 64.4| 6            |
| Glibenclamide tablet                     | 1.4  | 30.3| 4            |
| Ibuprofen tablet                         | 18.0 | 74.3| 2            |
| Insulin regular injection                | 4.3  | 50.8| 1            |
| Metformin tablet                         | 2.6  | 67.8| 7            |
| Medication                                                                 | Public facilities | Private facilities | Total          |
|---------------------------------------------------------------------------|-------------------|-------------------|--------------|
|                                                                       | (n=870)           | (n=70)            | (n=940)      |
| Omeprazole tablet or alternative such as pantoprazole, rabeprazole       | 46.2              | 72.8              | 4            |
| Oral Rehydration Solution (ORS)                                          | 93.3              | 77.8              | 9            |
| Paracetamol tab/injection                                                | 99.4              | 73.3              | 9            |
| Salbutamol tab or inhaler                                               | 78.2              | 68.0              | 7            |
| Simvastatin tablet or other statin e.g. atorvastatin, pravastatin, fluvastatin | 0.6               | 19.5              | 2            |
| Zinc sulphate tab                                                        | 98.1              | 61.3              | 9            |
| Mean domain score of items of essential medicine (±SD)                   | 31.4 (10.6)       | 56.0 (35.7)       | 3            |
| General services readiness (Median (Q1, Q3))                            | 50.3 (42.4, 63.3) | 75.2 (65.8, 84.3) | 5            |

Fluoxetine tablet was not available in the dataset

Ibuprofen tablet was not available in the NHFS dataset, Diclofenac was used instead

Enalapril tablet or alternative ACE inhibitor e.g. lisinopril, ramipril, perindopril was not available in the NHFS dataset, Atenolol was used instead.

Table 2: Readiness index scores specific to services for CVD and domain scores by facility

| Services for CVD                              | Public facilities (n=870) | Private facilities (n=70) | Total (n=940) |
|------------------------------------------------|---------------------------|--------------------------|--------------|
| Diagnosis and treatment facilities            | 71.3                      | 94.6                     | 73.1         |
| Guidelines on diagnosis and treatment§        | 1.4                       | 1.3                      | 1.4          |
| Mean guidelines domain index (±SD)             | 1.4                       | 1.3                      | 1.4          |
| Trained staff§                                 | 1.4                       | 3.1                      | 1.3          |
| Mean trained staff domain index (±SD)          | 1.4                       | 3.1                      | 1.3          |
| Equipment§                                     |                           |                          |              |
| Stethoscope                                   | 97.9                      | 96.9                     | 97.8         |
| Blood pressure                                | 93.5                      | 95.7                     | 93.7         |
| Adult weighing scale                          | 87.0                      | 93.5                     | 87.6         |
| Oxygen                                        | 4.4                       | 55.1                     | 9.3          |
| Mean equipment domain index (±SD)              | 67.1 (20.2)               | 81.2 (27.4)              | 68.2 (21.1)  |
| Medicines§                                     |                           |                          |              |
| Amlodipine/nifedipine                         | 5.1                       | 68.3                     | 11.2         |
| Beta-blockers (atenolol)                       | 13.9                      | 57.0                     | 18.0         |
| Aspirin                                       | 4.2                       | 63.5                     | 9.9          |
| Thiazide                                      | 2.1                       | 26.2                     | 4.4          |
| Mean medicines domain index (±SD)              | 2.6 (9.8)                 | 39.1 (29.0)              | 5.4 (15.5)   |
| Readiness index specific to services for CVD (Median (Q1, Q3)) | 18.8 (18.8, 18.8) | 31.3 (18.9, 37.5) | 18.8 (18.8, 25.0) |

This analysis is limited to a sub-sample of Public facilities (n=621), Private facilities (n=66) and all combined (n=687).
Table 3: Readiness index scores specific to services for diabetes and domain scores by facility

| Services for diabetes                          | Public facilities n=870 | Private facilities n=70 | Total n=940 |
|------------------------------------------------|-------------------------|-------------------------|-------------|
| Diagnosis and treatment facilities            | 15.1                    | 95.2                    | 21.1        |
| Guidelines for diagnosis and treatment§       | 4.8                     | 2.5                     | 4.1         |
| Mean guidelines domain index                  | 4.8                     | 2.5                     | 4.1         |
| Trained staff§                                | 1.5                     | 2.5                     | 1.9         |
| Mean staff domain index                       | 1.5                     | 2.5                     | 1.9         |
| Equipment§                                    |                         |                         |             |
| Blood pressure                                | 93.5                    | 95.7                    | 94.2        |
| Adult weighing scale                          | 84.8                    | 93.5                    | 87.7        |
| Height board/stadiometer                      | 26.7                    | 35.9                    | 29.8        |
| Mean equipment domain index (±SD)              | 37.9 (22.3)             | 71.4 (27.5)             | 40.4 (24.3) |
| Diagnostic capacity§                          |                         |                         |             |
| Blood glucose                                 | 5.5                     | 24.7                    | 11.9        |
| Urine protein                                 | 39.7                    | 82.2                    | 53.9        |
| Urine glucose                                 | 40.2                    | 85.1                    | 55.3        |
| Mean diagnostics domain index (±SD)            | 4.7 (17.6)              | 63.1 (30.5)             | 9.0 (24.3)  |
| Medicines§                                     |                         |                         |             |
| Metformin                                     | 16.5                    | 69.5                    | 34.3        |
| Glibenclamide                                 | 6.4                     | 30.1                    | 14.3        |
| Injectable insulin                            | 4.3                     | 50.8                    | 19.9        |
| Injectable glucose solution                   | 46.7                    | 69.9                    | 54.5        |
| Mean medicines domain index (±SD)              | 7.7 (13.7)              | 54.4 (38.0)             | 11.1 (20)   |
| Readiness index specific to services for diabetes (Median (Q1, Q3)) | 26.4 (16.7, 30.6) | 34.7 (26.4, 40.3) | 26.4 (20) |

This analysis is limited to a sub-sample of Public facilities (n=132), Private facilities (n=66) and all combined (n=198).

Table 4: Readiness index scores specific to services for chronic respiratory diseases and domain scores by facility
| Services for chronic respiratory disease | Public facilities n=870 | Private facilities n=70 | Total n=940 |
|----------------------------------------|------------------------|------------------------|-------------|
| Both diagnosis and treatment facilities | 94.1                   | 94.9                   | 94.1        |
| Guidelines on the diagnosis and treatment § | 4.9                    | 0.6                    | 4.6         |
| Mean guidelines domain index           | 4.9                    | 0.6                    | 4.6         |
| Trained staff §                        | 9.4                    | 3.4                    | 9.0         |
| Mean staff domain index                | 9.4                    | 3.4                    | 9.0         |
| Equipment §                            |                        |                        |             |
| Stethoscope                            | 97.8                   | 96.9                   | 97.7        |
| Oxygen flow meter                      | 2.5                    | 49.3                   | 6.0         |
| Spacers for inhalers                   | 2.1                    | 25.0                   | 3.8         |
| Oxygen                                 | 3.4                    | 54.9                   | 7.2         |
| Mean equipment domain index (±SD)      | 25.0 (11.4)            | 53.9 (33.7)            | 27.2 (16.1) |
| Medicines §                             |                        |                        |             |
| Salbutamol inhaler                     | 79.7                   | 68.2                   | 78.8        |
| Beclomethasone inhaler                 | 3.0                    | 32.9                   | 5.3         |
| Prednisolone cap/tabs                  | 3.4                    | 64.9                   | 8.0         |
| Hydrocortisone injection               | 6.9                    | 69.9                   | 11.6        |
| Epinephrine injectable                 | 5.2                    | 59.1                   | 9.2         |
| Mean medicines domain index (±SD)      | 19.3 (14.3)            | 57.9 (39.6)            | 22.2 (20.2) |
| Readiness index specific to services for chronic resp. (Median (Q1, Q3)) | 11.3 (11.3, 16.3) | 26.3 (6.5, 37.5) | 11.3 (11.3, 18) |

This analysis is limited to a sub-sample of Public facilities (n=819), Private facilities (n=66) and all combined (n=885).

Table 5: Multiple regression analyses of health facility characteristics with the service readiness index

| CVD a | Adjusted β (95%CI) | p-value | Diabetes a | Adjusted β (95%CI) | p-value | Chronic | Adjusted β (95%CI) |
|-------|--------------------|---------|------------|-------------------|---------|---------|-------------------|
| Province |                    |         |            |                    |         |         |                   |
| Province 1 | ref                |         | ref        | 0.94 (0.53-1.66) | 0.89    | ref     | 1.18 (0.)        |
| Province 2 | 0.83 (0.73-0.95)  | 0.01    | 1.38 (0.86-2.23) | 0.33    | ref     | 1.29 (0.)        |
| Province 3 | 1.05 (0.92-1.19)  | 0.46    | 1.98 (1.08-3.61) | 0.88    | ref     | 1.36 (0.)        |
| Province 4 | 1.24 (1.07-1.43)  | 0.00    | 1.21 (0.73-2.01) | 0.22    | ref     | 1.13 (0.)        |
| Province 5 | 1.17 (1.02-1.34)  | 0.02    | 1.15 (0.58-2.29) | 0.83    | ref     | 0.73 (0.)        |
| Province 6 | 0.01 (0.85-1.21)  | 0.87    | 1.34 (0.73-2.45) | 0.33    | ref     | 1.25 (0.)        |
| Province 7 | 0.06 (0.91-1.24)  | 0.47    | ref        | 3.02 (2.03-4.49) | 0.00    | ref     | 15.95 (5.13)     |

Health facility type
|                  | Public facilities | Private facilities | ref | 2.87 (2.42-3.39) | 0.00 | 3.02 (2.03-4.49) | 0.00 | ref | 15.95 (5.13) |

Ecological region
|                  | Mountains         | 1.88 (0.78-0.99) | 0.68 | 1.19 (-0.14-0.9) | 0.49 | 1.07 (0.)        |
|                  | Hills             | 1.99 (0.91-1.11) | 0.03 | 1.15 (0.78-1.707) | 0.46 | 1.13 (0.)        |
|                  | Terai             | ref              |      | ref              |      | ref              |

Urbanization
|                  | Metropolitan     | 0.99 (0.80-1.22) | 0.92 | 1.59 (0.89-2.85) | 0.12 | 0.80 (0.)        |
|                  | Urban Municipality | 1.13 (1.04-1.23) | 0.01 | 1.78 (1.23-2.59) | 0.00 | 1.02 (0.)        |

a dependent variable were log-transformed before analysis

β regression coefficient was calculated based on the antilog of unstandardized
regression coefficient. $\beta$ of $\geq 1$ denotes favourable changes in readiness index while assessing the relationship with the predictor variable. The model is adjusted for health facility types, ecological region and urbanization.

CI: confidence interval (unstandardized regression coefficient)

Figures

Figure 1

Number of health facilities included in the current study by provinces
Figure 2

Organization of Nepal’s health system
(A) Cardiovascular disease

(B) Diabetes

(C) Chronic respiratory disease
Figure 3

Differences between the service readiness indexes in health facilities across seven provinces (The figure shows the medians and interquartile range for cardiovascular, diabetes and chronic respiratory disease-specific readiness index at the provinces level in Nepal)

(A) Cardiovascular disease
Differences between the service readiness indexes of metropolitan, municipality, and rural health facilities

Supplementary Files

This is a list of supplementary files associated with the primary manuscript. Click to download.

Supplimentary-Table-1.docx