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Non-Communicable Disease Service Readiness in Nepal: A Further Analysis of Nepal Health Facility Survey- 2021

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Abstract

Objective: To assess the readiness of public and private health facilities(HFs) in delivering Cardiovascular Diseases(CVDs), Diabetes Mellitus(DM), Chronic Respiratory Diseases(CRDs), and Mental Health(MH) services in Nepal.

Methods: We analyzed data on service readiness for CVDs, DM, CRDs, and MH from Nepal Health Facility Survey 2021 using Service Availability and Readiness Assessment manual of the World Health Organization. Readiness score was measured as the average availability of tracer items in percent, and facilities were considered "ready" for Non-Communicable Diseases (NCDs) management if scored ≥70 (out of 100). We performed weighted descriptive analysis, univariate and multivariable logistic regression to determine association of readiness of HFs with province, type of HFs, ecological region, quality assurance activities, external supervision, client's opinion review, and frequency of HF meetings. The result of regression analysis are presented as odds ratio with 95% confidence interval(CI) and p-value.

Results: Of 1581 facilities offering any NCDs related services, 93.1%(95% CI: 90.9 to 94.7), 75.8%(95%CI: 72.4 to 78.8), 99.3%(95%CI: 98.3 to 99.7) and 26.0%(95%CI: 23.0 to 29.2) provide CVDs, DM, CRDs and MH-related services respectively. The overall readiness score for CVDs, DM, CRDs, and MH-related services were 38.1±15.4, 38.5±16.7, 32.6±14.7 and 24.0±23.1 respectively with readiness score lowest for the guidelines and staff training domain and highest for essential equipment and supplies domain. Peripheral public HFs were more likely to be ready to provide all NCDs-related services as compared to federal/provincial facilities. The HFs with external supervision in past 4 months were less likely to be ready to provide CRDs and DM related services and HFs reviewing client's opinions were more likely to be ready to provide CRDs, CVDs and DM related services.

Conclusion: Readiness of HFs to provide CVDs, DM, CRDs, and MH-related services was sub-optimal in Nepal. It is recommended to reform policy to improve service readiness for NCDs.

Keywords: *health facilities; readiness; cardiovascular; diabetes; chronic respiratory disease; mental health*

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Strengths and limitations of this study

- Nationally representative sample of health facilities in Nepal, with coverage of all seven provinces and 77 districts
- Survey has adopted a highly standardized survey with the globally accepted research protocol. Variables for readiness analysis are based on standardized WHO's SARA guideline and thus, findings are comparable to findings from other countries.
- Weighted analysis has been performed, which takes into account the complex sampling procedures and adjusts for non-response and disproportionate sampling.
- Since the survey was conducted while the COVID-19 pandemic was ongoing, there could be some impact of the pandemic on study results.

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Introduction:

Non-communicable diseases (NCDs) have emerged as leading causes of premature mortality and Disability Adjusted Life Years (DALYs) in Nepal. Of the total 193,331 fatalities estimated in 2019, NCDs were responsible for 71.1% of deaths, while communicable, maternal, neonatal and nutritional conditions accounted for 21.1% of deaths, and the remaining 7.8% of deaths were due to injuries.[1] In 2040, NCDs is projected to attribute 78.64% of total deaths in Nepal. [1] In 2019, cardiovascular diseases (CVD), Chronic respiratory disease and neoplasm were the top three leading causes of death in Nepal, attributing to approximately 24%, 21.1% and 11.2% of total deaths, respectively. Together, these three conditions are responsible for more than half of the total deaths in Nepal.[2]

Recognizing the gravity of the situation, Nepal adopted, contextualized and implemented the Package of Essential Noncommunicable Diseases (PEN) to screen, diagnose, treat, and refer major NCDs such as cardiovascular disease, diabetes, chronic obstructive pulmonary disease, cancer, and mental health at health posts, primary health care centers, and district hospitals.[3] The PEN package has now been expanded to all 77 districts of Nepal.[4] Moving a step further, the PEN Implementation Plan (2016-2020) was developed in accordance with the Multi-sectoral Action Plan for NCD Prevention and Control (2014-2020).[4] Nepal Multi-Sectoral Action Plan for NCDs (2021-2025) focuses on creating high-impact, politically and socially acceptable, and potentially implementable interventions. The plan aims to reduce the burden of NCDs through the whole-of-government and whole-of-society approach. The action plan has an overarching target of reducing premature mortality from NCDs by 25% by 2025 and by one third by 2030.[4 5] The NCD action plan is to achieve 80% availability of cheap basic technologies and necessary medications, including generics, needed to treat major NCDs in both public and private institutions. The multi-sectoral action plan involves medication therapy and counseling (including glycemic management) for 50% of eligible persons (defined as those aged 40 and older with a 10-year cardiovascular risk of more than 30%, including those with established cardiovascular disease).[5]

NCD services have been included in basic health care in Nepal although the service availability and preparedness remain very limited. [6] Apart from disease-specific interventions, Nepal Lancet NCDI poverty commission has pointed out the need for improving governance, strengthening health systems, and monitoring this extended group of priority NCDs. Commission also recommended that structured capacity-building programs for health service providers; promoting care packages, such as the PEN interventions for primary health care; increasing the availability of specialty services and personnel; and expanding progressive vertical programs providing free care for disease-specific areas could be useful in improving service availability and preparedness for NCDs.[7]

The increasing burden of NCDs in Nepal is often not matched with the availability of resources and appropriate healthcare response. There is a need to generate evidence to uncover gaps in

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NCD service readiness to facilitate evidence informed policy making to improve the service availability and uptake.[6 8] We aim to determine services availability and readiness of health facilities in Nepal to provide services related to NCDs including CVDs, CRDs, DM, and MH using nationally representative data from Nepal Health Facility Survey (NHFS), 2021.

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Methods:

Study Design

We analyzed secondary data from the nationally representative cross-sectional survey, NHFS 2021 to assess the availability and readiness of health facilities to provide services related to NCDs namely, cardiovascular diseases (CVDs), chronic respiratory diseases (CRDs), diabetes mellitus (DM) and mental health (MH). Detailed information on survey objectives and methodology is published elsewhere.[9]

Sample and Sampling

A stratified random sample of 1,633 health facilities out of 5,681 eligible health facilities were selected in 2021 NHFS. The process of sample size estimation and sampling procedures are explained in detail elsewhere.[9] We analyzed data of 1487 facilities offering any NCDs services out of which 1387 facilities were offering CVDs services, 1474 were offering CRDs services, 1166 were offering DM services and 558 facilities were offering MH services.

Data collection

Data collection for 2021 NHFS took place between January 27, 2021, and September 28, 2021, with a break for three months from May through July, due to the COVID-19 imposed lockdowns beginning on April 29, 2021. The 2021 NHFS included the use of four types of survey instruments: a) Facility Inventory Questionnaire, b) Health Provider Questionnaire, c) Exit Interview Questionnaires, and d) Observation protocols for antenatal care, family planning services, care for sick children, and labor and delivery. We used data from the first instrument, Facility Inventory Questionnaire.

Patient and public involvement

This article is prepared analyzing secondary data sources. There were no patient and public involvement in the design, conduct and reporting of our research.

Outcome variables and measurement

The variables for services availability and readiness of health facilities to provide NCDs-related facilities were selected based on the WHO Service Availability and Readiness (SARA) manual. [8]

Services Readiness: The service readiness of health facilities was measured based on the availability and functioning of items categorized under three domains- staff and guidelines, essential equipment, and supplies, medicine and commodities and diagnostics. The list of tracer items of each domain for CVDs, CRDs, DM and MH are presented in the **supplementary file 1**. The readiness score of health facilities to provide services on CVDs, CRDs DM and MH were calculated using the Service Availability and Readiness Assessment manual of the World Health Organization.[8] The items in each domain were re-coded as binary variables, taking "1" for the

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presence of the item and "0" for the absence of the item in the facility. The mean score for each domain was computed by adding items followed by dividing by the number of items and multiplying by 100. The average of the score from the three domains was the readiness score. A cutoff of 70 was considered on the overall score to classify the readiness of the facilities towards NCDs-related services. A facility with an overall score of more than or equal to 70 was considered as ready to manage NCDs. [10-12]

Independent variables

The independent variables included setting (rural/urban), ecological region (Hill/Mountain / Terai), province (Province-1/ Madhesh / Bagmati / Gandaki /Lumbini / Karnali /Sudurpaschim), type of facility (federal or provincial hospital/peripheral facilities/private hospital), presence of external supervision in past four months (present/absent), quality assurance activities (performed /not performed) and frequency of health facility meeting (none/sometimes/monthly).

The classification of setting into rural and urban was based on the type of municipalities in which the health facilities are located.[9] The type of facilities were classified into federal or provincial hospital, peripheral facilities and private hospitals where peripheral facilities comprised of hospitals, health posts and primary health care centers. The facility that received any external supervision/monitoring from the federal, provincial or municipal level in the past four months was considered to have external supervision.[9] Facility which routinely carries out quality assurance activities and had documentation of a recent quality assurance activity including report or minutes of a quality assurance meeting, a supervisory checklist, a mortality review, or an audit of records or registers were considered to have performed quality assurance activities. [9] The frequency of health facilities stating "no" for routine management/administrative meetings were classified as "None". Similarly, those stating "monthly or more often" were classified as "Monthly" and those stating "irregular or every 2-6 months" were classified as "sometimes".[9] The facility with the system for determining client opinion, procedure for reviewing client opinion, and report of a recent review of client opinion were considered to have performed review of client's opinion.[9]

Statistical Analysis:

We used R version 4.2.0 and RStudio [13 14] for statistical analysis. We used "survey" package [15] and performed a weighted analysis to account for the complex survey design of 2021 NHFS. We summarized continuous variables with weighted and unweighted mean, standard deviation (SD), median and interquartile range (IQR) whereas categorical variables were summarized with both weighted and weighted frequency, percent, and 95 percent confidence interval (95% CI) around percent. We employed univariate and multivariate weighted logistic regression analysis to determine the association of the readiness of health facilities to CVDs, CRDs, DM and MH-related services with independent variables including setting, ecological region, province, type of facility,

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external supervision, quality assurance activities and health facility meeting. A p-value of less than 0.05 is considered statistically significant.

Results

Of the total facilities offering any NCDs (CVDs, CRDs, DM or MH) related services, 46.6% (95% CI: 42.9 to 50.4) were from rural areas. Half of the health facilities with any NCDs related services were from hill region (52.7%; 95% CI: 48.9 to 56.5) followed by terai region (34.4%; 95% CI: 30.8 to 38.2). The health facilities from Bagmati province was the highest of all accounting for 20.5% (95% CI: 17.6 to 23.7) followed by Madhesh province (16.1%; 95% CI:13.1 to 19.7), province-1 (15.7%; 95% CI:13.0 to 18.8) and Lumbini (15.7%; 95% CI:13.2 to 18.6) The quality assurance activities for at least once a year was performed in 23.9% (95% CI: 20.7 to 27.4), external supervision in past 4 months was present in 66.4 (95% CI: 62.8, 69.8). Review of client's opinion in 3.8% (95% CI: 2.7 to 5.3) and monthly health facility meeting was carried out in 65.0% (95% CI: 61.4 to 68.4) of the facilities offering any NCDs related services. (*Table-1*)

Table 1: Characteristics of facilities offering any NCDs related services

Characteristics	Unweighted (N=1487)	Weighted (N=1518)	
	n(%)	n(%)	95%CI
Location			
Urban	953 (64.1)	810(53.4)	49.6 to 57.1
Rural	534 (35.9)	708 (46.6)	42.9 to 50.4
Ecological Region			
Hill	797 (53.6)	801 (52.7)	48.9 to 56.5
Mountain	178 (12.0)	196 (12.9)	10.6 to 15.5
Terai	512 (34.4)	522 (34.4)	30.8 to 38.2
Province			
Province-1	227 (15.3)	238 (15.7)	13.0 to 18.8
Madhesh	170 (11.4)	245 (16.1)	13.1 to 19.7
Bagmati	295 (19.8)	311(20.5)	17.6 to 23.7
Gandaki	220 (14.8)	197 (13.0)	10.8 to 15.5
Lumbini	238 (16.0)	238 (15.7)	13.2 to 18.6
Karnali	143 (9.6)	119 (7.8)	6.4 to 9.6
Sudurpaschim	194 (13.0)	169 (11.1)	9.3 to 13.2

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Ownership			
Private hospitals	255 (17.1)	113 (7.5)	6.2 to 8.9
Public health facilities	1,232 (82.9)	1,405 (92.5)	91.1 to 93.8
Type of facility			
Federal/Provincial hospital	97 (6.5)	27 (1.8)	1.5 to 2.2
Local hospital/PHCC/peripheral	1,135 (76.3)	1,378 (90.7)	89.2 to 92.0
Private Hospital	255 (17.1)	113 (7.5)	6.2 to 8.9
Quality assurance activities			
Not Performed	1,189 (80.0)	1,155 (76.1)	72.6 to 79.3
Performed	298 (20.0)	363 (23.9)	20.7 to 27.4
External Supervision			
No	564 (37.9)	510 (33.6)	30.2 to 37.2
Yes	923 (62.1)	1008 (66.4)	62.8 to 69.8
Review client's opinion			
Not reviewed	1,400 (94.1)	1461 (96.2)	94.7 to 97.3
Reviewed	87 (5.9)	57 (3.8)	2.7 to 5.3
Frequency of health facility meeting			
None	264 (17.8)	225 (14.8)	12.5 to 17.5
Sometimes	303 (20.4)	306 (20.2)	17.4 to 23.3
Monthly	920 (61.9)	987 (65.0)	61.4 to 68.4
Total Health workforce [1]	40.9(122.8); 7.0(3.0,20.0)	18.7±73.5; 6.0 (5.0, 9.0)	
Services availability			
CVDs	1387 (93.3)	1411 (93.1)	90.9 to 94.7
DM	1166 (78.4)	1149 (75.8)	72.4 to 78.8
CRDs	1474 (99.1)	1507 (99.3)	98.3 to 99.7
MH	558 (37.5)	394 (26.0)	23.0 to 29.2

[1] *Mean±SD; Median (IQR)*
CVD: Cardiovascular Disease; DM: Diabetes Mellitus; CRDs: Chronic Respiratory Disease; MH: Mental Health

Table 2 presents the overall readiness score of health facilities for CVDs, CRDs, DM, and MH-related services (Mean±SD) were 38.1±15.4, 32.6±14.7, 38.5±16.7, and 24.0±23.1 respectively. The readiness score for guidelines and staff training domain for NCDs related services ranged

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from 12.1 to 17.6 and was lowest in all sets of facilities offering different NCDs related services whereas the readiness score for essential equipment and supplies domain ranged from 49.1 to 76.4 and was highest in three sets of facilities offering CVDs, DM and CRDs related services. The percent of total facilities which are ready to provide CVDs, CRDs, DM and MH-related services were 3.8% (95% CI: 5.3 to 2.8), 2.3% (95% CI: 1.6 to 3.3), 3.7% (95% CI: 2.6 to 5.1) and 3.3% (95% CI: 1.8 to 6.1) respectively.

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Table-2: Readiness of facilities for services related to NCDs.

Diseases	Tracer items		Unweighted		Weighted		
			n (%)	Score[1]	n (%)	95% CI	Score[1]
CRDs	Guidelines and Training	Guidelines	154 (10.5)	12.3 ±25.9 ; 0.0 (0.0,0.0)	166 (11.0)	8.9 to 13.6	12.4±26.4; 0.0 (0.0, 0.0)
		Staff Training	207 (14.1)		206 (13.7)	11.3 to 16.5	
	Essential Equipment and supplies	BP apparatus	1,440 (98.0)	54.5±21.3; 40.0 (40.0,80.0)	1,469(97.6)	95.9 to 98.6	49.1±17.8; 40.0 (40.0, 60.0)
		Stethoscope	1,447 (98.4)		1,483(98.4)	97.1 to 99.2	
		Oxygen Flow meter	399 (27.1)		251(16.7)	14.3 to 19.4	
		Oxygen	543 (36.9)		394 (26.2)	23.1 to 29.5	
		Spacers	178 (12.1)		101(6.8)	5.3 to 8.6	
	Essential Medicines	Salbutamol	1,294 (88.0)	42.8±27.8; 40.0 (20.0,60.0)	1,368 (90.8)	88.6 to 92.7	36.5±22.3; 40.0 (20.0, 40.0)
		Beclomethasone	140 (9.5)		59 (3.9)	3.0 to 5.1	
		Prednisolone	402 (27.3)		197 (13.1)	11.2 to 15.3	
		Hydrocortisone	685 (46.6)		550(36.6)	33.1 to 40.2	
		Epinephrine	628 (42.7)		570 (37.9)	34.3 to 41.6	
	Overall Readiness Score		36.5±17.6; 33.3 (20.0,46.7)		32.6±14.7; 26.7 (20.0, 40.0)		
	Facility with readiness score ≥70, % (95% CI)		80 (5.4)	-	2.3% (95% CI: 1.6 to 3.3)		-
CVDs	Guidelines and Training	Guidelines	152 (11.0)	12.5±25.9; 0.0 (0.0,0.0)	158 (11.2)	9.1 to 13.8	12.1±25.6; 0.0 (0.0, 0.0)
		Staff Training	193 (14.0)		182 (12.9)	10.5 to 15.8	
	Essential Equipment and supplies	BP apparatus	1,352 (97.9)	77.1±19.1; 80.0 (60.0,100.0)	1,375 (97.4)	95.6 to 98.5	72.6±17.5; 60.0 (60.0, 80.0)
		Stethoscope	1,359 (98.4)		1,388 (98.4)	96.9 to 99.2	
		Weighing scale	1,308 (94.7)		1,342(95.1)	93.2 to 96.5	
		Pulse Oximeter	764 (55.3)		628(44.5)	40.7 to 48.4	
		Oxygen	540 (39.1)		389(27.6)	24.4 to 31.1	
	Essential Medicines	Thiazide	216 (15.6)	38.4±32.3; 25.0 (25.0,50.0)	95 (6.7)	5.5 to 8.3	29.6±26.2; 25.0 (0.0, 50.0)
		Atenolol	547 (39.6)		457(32.4)	28.9 to 36.1	
		Aspirin	432 (31.3)		249 (17.7)	15.3 to 20.4	
		Amlodipin	927 (67.1)		870 (61.6)	57.7 to 65.4	
	Overall Readiness Score		42.7±18.0; 36.7(28.3,58.3)		38.1±15.4; 35.0 (28.3, 45.0)		
	Facility with readiness score ≥70, % (95% CI)		103 (7.5)	-	3.8% (95% CI: 5.3 to 2.8)		-

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DM	Guidelines and Training	Guidelines	155 (13.4)	14.5±27.4; 0.0 (0.0,0.0)	161(14.1)	11.4 to 17.3	14.2±27.5; 0.0 (0.0, 0.0)
		Staff Training	180 (15.5)		164 (14.3)	11.6 to 17.5	
	Essential Equipment and supplies	BP apparatus	1,138 (98.2)	77.5±18.9; 66.7 (66.7,100.0)	1,124 (97.9)	96.0 to 98.9	76.4±18.8; 66.7 (66.7, 100.0)
		Height Board	454 (39.2)		416 (36.2)	32.2 to 40.5	
		Weighing Scale	1,101 (95.0)		1,091 (95.0)	92.6 to 96.6	
	Essential Medicines	Metformin	874 (75.4)	42.5±25.9; 50.0 (25.0,50.0)	753 (65.6)	61.2 to 69.7	34.1±22.6; 25.0 (25.0, 50.0)
		Glibenclamide	116 (10.0)		50 (4.4)	3.2 to 5.8	
		Injectable Insulin	213 (18.4)		86 (7.5)	6.1 to 9.1	
		Injectable Glucose	766 (66.1)		680(59.2)	54.8 to 63.4	
	Diagnostics	Test: Blood Glucose	337 (29.1)	42.6±40.4; 33.3 (0.0,66.7)	268 (23.3)	20.0 to 27.0	29.2±37.8; 0.0 (0.0, 66.7)
		Test: Urine Glucose	574 (49.5)		374(32.6)	28.9 to 36.6	
		Test: Urine Glucose	571 (49.3)		365 (31.8)	28.1 to 35.7	
	Overall Readiness Score		44.2±18.7; 43.8 (29.2,60.4)		38.5±16.7; 35.4 (22.9, 52.1)		
	Facility with readiness score ≥70, % (95% CI)		91 (7.9)	-	3.7% (95% CI: 2.6 to 5.1)		
MH	Guidelines and Training	Guidelines	51 (9.2)	16.9±27.4; 0.0(0.0,50.0)	47(11.9)	8.0 to 17.4	17.6±28.3; 0.0 (0.0, 50.0)
		Staff Training	137 (24.6)		92 (23.4)	18.2 to 29.7	
	Essential Medicines	Amitriptyline	358 (64.4)	45.2±35.4; 37.5(12.5,75.0)	195 (49.5)	42.8 to 56.3	30.3±32.2; 12.5 (0.0, 62.5)
		Fluoxetine	216 (38.8)		93 (23.6)	18.9 to 29.0	
		Carbamazepine	204 (36.7)		105 (26.7)	21.5 to 32.6	
		Phenobarbitone	201 (36.2)		87(22.1)	17.7 to 27.2	
		Sodium Valproate	255 (45.9)		126 (32.1)	26.5 to 38.2	
		Risperidone	177 (31.8)		82 (20.9)	16.4 to 26.2	
		Alprazolam	263 (47.3)		116 (29.4)	24.3 to 35.0	
		Diazepam	336 (60.4)		149 (37.9)	32.0 to 44.1	
	Overall Readiness Score		31.0±23.5; 31.2(6.2,50.0)		24.0±23.1; 18.8 (0.0, 37.5)		
	Facility with readiness score ≥70, % (95% CI)		29 (5.2)	-	3.3% (95% CI: 1.8 to 6.1)		-

[1]Mean±SD; Median (IQR)

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[Figure 1 is here]

Figure 1: Facilities and district-wise readiness score of facilities to provide services related to NCDs (A: Readiness of facilities to provide CVD-related services; B: Readiness of facilities to provide DM related services; C. Readiness of facilities to provide CRDs related services; D: Readiness of facilities to provide MH related services)

Figure 1 shows the readiness of facilities to provide NCDs services grouped by district. Facilities are represented by red points for readiness scores ranging from 0 to 20 and white points for readiness scores ranging from 80 to 100, while districts with readiness scores from 0 to 20 are represented by yellow color and with readiness scores from 80 to 100 in blue. These legends are consistent across all the sub-figures A through D.

Gardner-Altman estimation plot to compare the readiness score of health facilities for providing different NCD-related services by province showed the readiness score of facilities vary by province. (**Supplementary file 2**)

Table 3 and 4 presents the factors associated with services readiness of health facilities to provide NCDs-related services. In univariate analysis, service readiness of health facilities to provide chronic respiratory disease were significantly associated with the type of facility and presence of supervision and revision of client opinion. Similarly, the readiness of health facilities for CVDs were significantly associated with the revision of client opinion and type of health facility. The readiness of facilities for diabetes mellitus was significantly associated with the type of facility, presence of quality assurance performed at least once a year, presence of external supervision, and revision of client opinion. The readiness of facilities for mental health services were associated with the type of facility.

In the adjusted multivariable analysis, the odds of being ready for chronic respiratory disease-related services were 0.04 (95% CI: 0.02 to 0.09) times in the peripheral public health facilities and 0.37 (95% CI: 0.16 to 0.87) times in facilities compared to federal/provincial facilities, and 3.43 (1.64 to 7.20) times in facilities with external supervision in past 4 months compared to facilities without external supervision in past 4 months after adjusting for other variables. The odds of being ready for CVDs related services were 2.04 (95% CI: 1.02 to 4.09) times in rural areas compared to urban, 0.24 (95% CI: 0.09 to 0.65) times in mountain compared to the hill, 0.24 (95% CI: 0.07 to 0.78) in Madhesh compared to Province-1, 0.12 (95% CI: 0.05 to 0.28) times in peripheral public health facilities compared to federal/provincial hospital and 2.68 (95% CI: 1.26 to 5.70) times in facilities reviewing client's opinions compared those facilities that did not review client's opinions. The odds of readiness of health facilities towards diabetes were 3.31 (95% CI: 1.23 to 8.87) times higher in Sudurpaschim compared to Province-1, 92% [AOR=0.08

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(95% CI: 0.04 to 0.18)] less in peripherals compared to federal/provincial hospitals, and 2.56 (95% CI: 1.29 to 5.08) times in facilities with external supervision in past 4 months. Similarly, the odds of being ready for mental health services were 83% less in private hospitals [AOR=0.17 (95% CI: 0.03 to 0.95)] and 84% less in peripheral public health facilities [AOR=0.14 (95% CI: 0.04 to 0.55)] compared to federal/provincial hospitals.

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Table 3: Factors associated with readiness of health facilities to provide NCDs related services (unadjusted)

Characteristics	Chronic Respiratory Disease related services		Cardiovascular Disease related services		Diabetes Mellitus related services		Mental Health related services	
	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p
Location								
Urban	Ref		Ref		Ref		Ref	
Rural	0.70 (0.31 to 1.57)	0.39	1.03 (0.52 to 2.03)	0.93	0.49 (0.21 to 1.11)	0.09	0.83 (0.16 to 4.17)	0.80
Ecological region								
Hill	Ref		Ref		Ref		Ref	
Mountain	0.99 (0.29 to 3.33)	0.98	**0.22 (0.09 to 0.57)**	**0.00**	0.74 (0.32 to 1.74)	0.50	1.18 (0.13 to 10.78)	0.90
Terai	0.78 (0.37 to 1.64)	0.51	0.80 (0.40 to 1.60)	0.52	1.42 (0.68 to 2.96)	0.40	0.79 (0.26 to 2.41)	0.70
Province								
Province-1	Ref		Ref		Ref		Ref	
Madhesh	0.50 (0.19 to 1.33)	0.17	**0.25 (0.09 to 0.73)**	**0.01**	0.56 (0.23 to 1.37)	0.20	0.61 (0.11 to 3.53)	0.60
Bagmati	1.65 (0.64 to 4.26)	0.30	0.97 (0.33 to 2.89)	0.96	2.09 (0.81 to 5.39)	0.13	2.24 (0.46 to 10.76)	0.30
Gandaki	2.46 (0.84 to 7.16)	0.10	1.15 (0.38 to 3.43)	0.80	1.50 (0.51 to 4.37)	0.50	0.48 (0.09 to 2.72)	0.40
Lumbini	1.51 (0.47 to 4.79)	0.49	1.04 (0.34 to 3.15)	0.95	1.36 (0.48 to 3.87)	0.60	0.43 (0.09 to 2.00)	0.30
Karnali	0.26 (0.06 to 1.19)	0.08	0.49 (0.10 to 2.42)	0.38	0.46 (0.13 to 1.64)	0.20	0.59 (0.10 to 3.38)	0.60
Sudurpaschim	1.50 (0.68 to 3.31)	0.31	0.79 (0.27 to 2.36)	0.68	**2.49 (0.97 to 6.38)**	**0.06**	2.98 (0.61 to 14.59)	0.20
Type of facility								
Federal/Provincial hospitals	Ref		Ref		Ref		Ref	

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Peripheral health facilities	**0.06 (0.03 to 0.13)**	**<0.001**	**0.15 (0.08 to 0.31)**	**<0.001**	**0.08 (0.04 to 0.17)**	**<0.001**	**0.17 (0.05 to 0.58)**	**0.01**
Private hospital	0.36 (0.14 to 0.89)	0.03	0.64 (0.29 to 1.42)	0.30	**0.39 (0.18 to 0.85)**	**0.02**	0.21 (0.08 to 0.54)	0.00
Quality assurance activities								
Not performed	Ref		Ref		Ref		Ref	
Performed	1.03 (0.56 to 1.88)	0.93	0.81 (0.44 to 1.49)	0.50	**2.18 (1.08 to 4.42)**	**0.03**	0.56 (0.20 to 1.57)	0.30
External supervision								
No	Ref		Ref		Ref		Ref	
Yes	**2.68 (1.43 to 5.04)**	**0.00**	1.57 (0.76 to 3.22)	0.22	**2.25 (1.23 to 4.10)**	**0.01**	0.83 (0.23 to 2.96)	0.80
Frequency of health facility meeting								
None	Ref		Ref		Ref		Ref	
Sometimes	**0.29 (0.10 to 0.85)**	**0.02**	0.84 (0.17 to 4.10)	0.83	**3.53 (1.13 to 11.03)**	**0.03**	0.94 (0.17 to 5.21)	0.94
Monthly	0.45 (0.16 to 1.25)	0.13	2.01 (0.54 to 7.44)	0.30	**3.55 (1.40 to 9.04)**	**0.01**	2.25 (0.43 to 11.87)	0.34
Review of client's opinion								
Not reviewed	Ref		Ref		Ref		Ref	
Reviewed	**5.05 (1.79 to 14.28)**	**0.002**	**4.87 (2.14 to 11.06)**	**<0.001**	**4.84 (2.09 to 11.21)**	**<0.001**	2.88 (0.92 to 9.02)	0.07

COR: Crude Odds ratio; CI: Confidence Interval; Ref: Reference group
Peripheral health facilities include local hospital, health posts and primary health care centers

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Table-4: Factors associated with readiness of health facilities to provide NCDs-related services (adjusted)

Characteristics	Chronic Respiratory Disease related services		Cardiovascular Disease related services		Diabetes Mellitus related services		Mental Health related services	
	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p
Location								
Urban	Ref		Ref		Ref		Ref	
Rural	1.55 (0.74 to 3.21)	0.24	**2.04 (1.02 to 4.09)**	**0.045**	1.28 (0.50 to 3.27)	0.61	1.66 (0.12 to 23.80)	0.71
Ecological region								
Hill	Ref		Ref		Ref		Ref	
Mountain	1.45 (0.39 to 5.47)	0.58	**0.24 (0.09 to 0.65)**	**0.005**	0.82 (0.34 to 1.99)	0.65	1.11 (0.08 to 15.24)	0.94
Terai	1.15 (0.39 to 3.37)	0.80	1.18 (0.38 to 3.70)	0.78	2.74 (0.91 to 8.22)	0.072	1.45 (0.47 to 4.46)	0.52
Province								
Province-1	Ref		Ref		Ref		Ref	
Madhesh	0.63 (0.19 to 2.09)	0.45	**0.24 (0.07 to 0.78)**	**0.018**	0.43 (0.16 to 1.18)	0.10	0.71 (0.10 to 5.20)	0.74
Bagmati	1.58 (0.59 to 4.21)	0.36	0.9 (0.23 to 3.45)	0.87	2.39 (0.71 to 8.08)	0.16	2.94 (0.41 to 20.95)	0.28
Gandaki	2.81 (0.83 to 9.53)	0.10	1.28 (0.36 to 4.54)	0.70	2.75 (0.82 to 9.17)	0.10	0.57 (0.10 to 3.23)	0.52
Lumbini	1.66 (0.44 to 6.17)	0.45	0.89 (0.27 to 2.99)	0.86	1.22 (0.43 to 3.44)	0.71	0.43 (0.07 to 2.70)	0.36
Karnali	0.32 (0.07 to 1.51)	0.15	0.76 (0.13 to 4.46)	0.76	0.89 (0.21 to 3.82)	0.87	0.78 (0.11 to 5.38)	0.80
Sudurpaschim	2.25 (0.97 to 5.20)	0.06	1.05 (0.32 to 3.42)	0.94	**3.31 (1.23 to 8.87)**	**0.02**	3.71 (0.80 to 17.08)	0.093
Type of facility								
Federal/Provincial hospital	Ref		Ref		Ref		Ref	

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Peripheral health facilities	**0.04 (0.02 to 0.09)**	**<0.001**	**0.12 (0.05 to 0.28)**	**<0.001**	**0.08 (0.04 to 0.18)**	**<0.001**	**0.17 (0.03 to 0.95)**	**0.04**
Private hospitals	**0.37 (0.16 to 0.87)**	**0.02**	0.56 (0.24 to 1.31)	0.18	0.42 (0.16 to 1.1)	0.079	**0.14 (0.04 to 0.55)**	**0.01**
Quality assurance activities								
Not Performed	Ref		Ref		Ref		Ref	
Performed	0.86 (0.45 to 1.64)	0.66	0.64 (0.33 to 1.25)	0.19	2.06 (0.98 to 4.32)	0.06	0.45 (0.16 to 1.29)	0.14
External supervision								
No	Ref		Ref		Ref		Ref	
Yes	**3.43 (1.64 to 7.20)**	**0.00**	1.59 (0.69 to 3.66)	0.27	**2.56 (1.29 to 5.08)**	**0.01**	0.85 (0.19 to 3.87)	0.83
Frequency of health facility meeting								
None	Ref		Ref		Ref		Ref	
Sometimes	**0.27 (0.10 to 0.76)**	**0.01**	0.78 (0.15 to 3.99)	0.76	2.77 (0.76 to 10.01)	0.12	0.76 (0.13 to 4.54)	0.76
Monthly	**0.25 (0.09 to 0.65)**	**0.00**	1.51 (0.38 to 5.90)	0.56	1.85 (0.69 to 4.92)	0.22	1.84 (0.29 to 11.83)	0.52
Review of client's opinion								
Not Reviewed	Ref		Ref		Ref		Ref	
Reviewed	2.60 (0.91 to 7.44)	0.07	**2.68 (1.26 to 5.70)**	**0.01**	1.99 (0.77 to 5.17)	0.16	3.15 (0.97 to 10.19)	0.06

AOR: Adjusted Odds ratio; CI: Confidence Interval; Ref: reference group
Peripheral health facilities include local hospital, health posts and primary health care centers.

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Discussion

This study aimed to determine the readiness of the health facilities to provide services related to NCDs including cardiovascular diseases, chronic respiratory disease, diabetes mellitus, and mental health in Nepal from a nationally representative sample of health facilities from the Nepal Health Facility Survey 2021. The overall median readiness score of the health facilities to provide CRDs, CVDs, diabetes, and mental health-related services were 26.7, 35.0, 35.4 and 18.8 respectively with the readiness score for guidelines and training domain being the lowest and the readiness score for essential equipment and supplies being the highest in each disease. Very few of the facilities offering respective NCDs-related services have readiness scores greater than 70 accounting for 3.8% for CVDs, 3.7% for diabetes, 3.3% for mental health, and 2.3% for chronic respiratory disease-related services. Peripheral public health facilities were more likely to be ready to offer all NCD-related services, compared to federal and provincial facilities. Facilities that received external supervision in the past 4 months were less likely to be ready to provide CRD and DM services, while facilities that considered client feedback were more likely to be ready to offer CRD, CVD, and DM services. The results of the study identified areas for improvement in the management of NCDs as well as strengths and shortcomings in the current healthcare system of Nepal.

A similar analysis from 2015 health facility survey showed the median readiness score of facilities to provide CVDs, CRDs, and DM to be 18.8, 11.3, and 26.4 respectively.[16] This finding from 2015 was comparatively lower compared to the present study. One of the factors for the increase in the readiness score of health facilities from 2015 to 2021 could be due to the roll out and expansion of the Package of Essential NCDs (PEN). PEN aims to detect, diagnose, treat, and refer individuals with CVDs, Chronic Obstructive Pulmonary diseases, cancer, DM, and MH issues at health posts, primary health care centers, and district hospitals in order to promote early detection and management of chronic diseases within the community. [3] In October 2016, PEN was introduced in two pilot districts, Illam and Kailali which was later expanded to all 77 districts in Nepal[4]. In addition, the National mental health strategy and action plan was launched in 2021 which can further improve the preparedness of health system to deliver mental health services in future. [4 17]

In our study, the availability of guidelines and staff training was one of the most problematic areas that needs intervention. A prior study on CVDs highlighted a lack of national guidelines and protocols for treating CVDs as a significant obstacle to providing evidence-based treatment. [18] The other study on DM suggested that there is a significant shortfall in the implementation of existing policies, plans, strategies, and programs aimed at addressing diabetes, with a lack of clarity on how they should be implemented. [19] This evidence suggests not only the need for formulation of evidence-informed guidelines and policies but also the appropriate communication and supply so facilities under all tiers of government have a clear understanding of the policy documents. These areas should be improved and addressed concurrently as they have been demonstrated to be cost-efficient in terms of healthcare delivery.[20]

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In tune with our findings, previous studies have also shown disparities in the availability of healthcare resources for the prevention and control of NCDs between different levels of healthcare, types of facilities, and regional settings.[21] Our study found that there was a significant lack of essential medicines and commodities for NCDs in public and rural facilities which was also reported in other studies [22 23]. The shortages of essential medicines and commodities were often accompanied by shortages/lack of training of staff, which further hindered access to proper medical care for patients; which has also been the case for a study done in Nepal using the 2015 health facility survey data.[16] This is a cause for concern as it can negatively impact the health outcomes of individuals suffering from NCDs.[24] It is crucial to stress the relationship between the availability of drugs and supplies, and the training of health care professionals. For instance, even if trained personnel were available to provide services, a lack of drugs and supplies will prevent the health professional from providing quality healthcare, and the other way around.[25] Therefore, there is an urgent need to address the scarcity of both trained personnel and medicines, since doing so might assist to enhance management, which in turn would lead to an increase in the supply and availability of medications. Our study revealed that facilities with external supervision had significantly higher preparedness scores for diabetes mellitus and chronic respiratory diseases. According to a study, external supervision mechanisms in healthcare facilities are essential in facilitating the overall management process and improving the effectiveness of the facility. Such supervision enables information sharing and performance review which is pivotal in streamlining the facility's management process and enhancing its efficiency. [26]

Within South Asian regions, differences regarding the lack of trained personnel, availability of essential medicines and commodities and guidelines in service-specific readiness have also been documented. [27] The region's progress in the management and prevention of NCDs has been hampered by the widespread absence of key resources. According to a recent report by the WHO, most countries, particularly low- and middle-income countries (LMICs), failed to achieve the global targets set for noncommunicable disease (NCD) progress in 2020. This report, which evaluated data from 194 countries, highlights the pressing need for increased global efforts in NCD prevention and control.[28]

Alongside the issues discussed, Nepal's health system has the potential to effectively address NCDs. Nepal has implemented policies and strategies, developed treatment guidelines and protocols, an essential drug list, a multisectoral plan for NCD prevention, surveillance and prevention strategic planning, and an action plan for NCDs. These findings suggest that Nepal should strengthen and orient health systems for the prevention and control of NCDs and strengthen supervision and monitoring as aligned with the action plan for the prevention and control of NCDs. [17] The disparities identified across various diseases and healthcare types and levels, as well as the noticeable differences in availability between urban and rural areas, along with a lack of basic medicines and supplies, underline the importance of an all-inclusive approach to upgrading healthcare facilities' ability to deliver successful NCD interventions. Also, the findings point to enhancing the management of NCDs by increasing the capacity of the healthcare workforce, which

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is crucial. This can be achieved by providing more training opportunities for healthcare professionals and expanding the number of clinicians skilled in managing NCDs. It will be impossible to achieve global NCD targets by 2025, as part of the Sustainable Development Goals (SDGs) by 2030, without significant efforts in both policies and programs. Therefore, it is imperative to take immediate action to enhance the provision of NCD services in both public and private healthcare facilities in Nepal.

Conclusions

The overall readiness of the facilities to provide NCDs related services in Nepal is sub-optimal. The peripheral facilities are less likely to be ready to provide NCDs related services compared to provincial and federal level hospitals. It is essential to enhance service delivery platforms and enhance the overall readiness of the health system to provide NCDs related services by increasing the number of qualified health staff, providing training, and supplying equipment and medicines.

Competing interests

We authors have no competing interest associated with this paper.

Data availability statement

The dataset is publicly available in the official website of "The Demographic and Health Surveys" program (https://dhsprogram.com/)

Ethical statements

Patient consent for publication: *Not applicable*

Ethical approval: The original 2021 NHFS survey was approved by the Institutional Review Board of ICF International, USA, and by the Nepal Health Research Council (NHRC), Nepal.[9]

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Contribution

- ***Conceptualization:*** *Bikram Adhikari, Achyut Raj Pandey*
- ***Formal analysis:*** *Bikram Adhikari, Achyut Raj Pandey*
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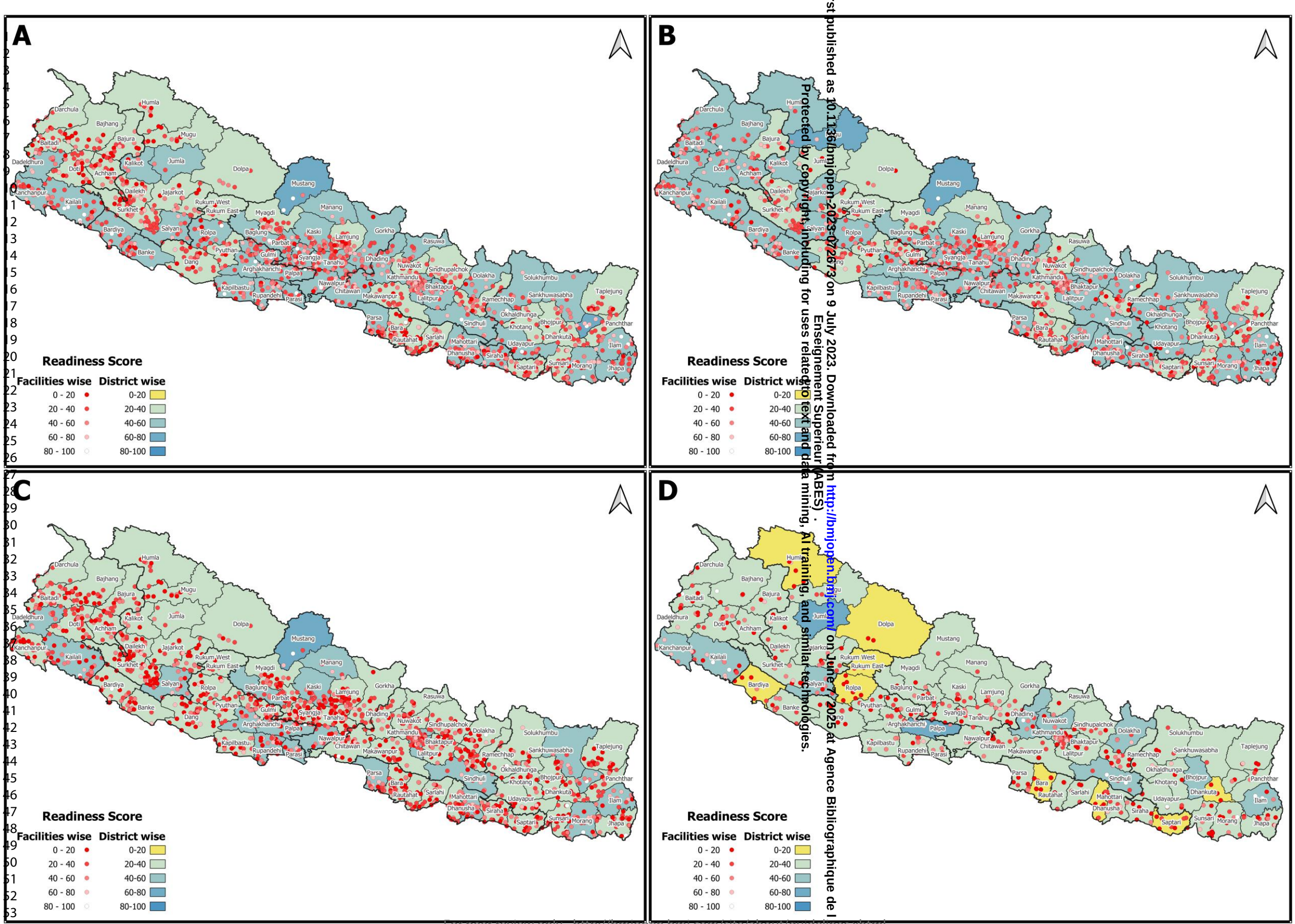

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Table 1: Summary of items of each domain and measurement procedure of readiness of health facilities with cardiovascular diseases related services

Domain	Indicators	Measure	Recode	Calculation of score	
				Domain wise score	Total score
Guidelines and training	Guidelines (a1)	Yes	1	A=(a1+b1)/2*100	(A+B+C)/3
		No	0		
	Staff training (b1)	Yes	1		
		No	0		
Equipment	Stethoscope (c1)	Yes	1	B=(c1+d1+e1+f1+g1)/5*100	
		No	0		
	Blood pressure (d1)	Yes	1		
		No	0		
	Adult weighing scale (e1)	Yes	1		
		No	0		
	Oxygen (f1)	Yes	1		
		No	0		
	Pulse oximeter (g1)	Yes	1		
		No	0		
Medicines	Amlodipine/nifedipine (h1)	Yes	1	C=(h1+i1+j1+k1)/4*100	
		No	0		
	Beta-blockers (atenolol) (i1)	Yes	1		
		No	0		
	Aspirin (j1)	Yes	1		
		No	0		
	Thiazide (k1)	Yes	1		
		No	0		

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Table 2: Summary of items of each domain and measurement procedure of readiness of health facilities with diabetes related services

Domain	Indicators	Measurement	Recode	Calculation of score	
				Domain wise score	Total score
Guidelines and training	Guidelines (a2)	Yes	1	A=(a2+b2)/3*100	(A+B+C)/3
		No	0		
	Staff training (b2)	Yes	1		
		No	0		
Equipment	Blood pressure (c2)	Yes	1	B=(c2+d2+e2)/3*100	
		No	0		
	Adult weighing scale (d2)	Yes	1		
		No	0		
	Height board/stadiometer (e2)	Yes	1		
		No	0		
Medicines	Metformin (f2)	Yes	1	C=(f2+g2+h2+j2)/4*100	
		No	0		
	Glibenclamide (g2)	Yes	1		
		No	0		
	Injectable insulin (h2)	Yes	1		
		No	0		
	D. Injectable glucose solution (j2)	Yes	1		
		No	0		
Diagnostics	Blood glucose (k2)	Yes	1	D=(k2+I2+m2)/3*100	
		No	0		
	Urine Glucose (l2)	Yes	1		
		No	0		
	Urine Protein (m2)	Yes	1		
		No	0		

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Table 3: Summary of items of each domain and measurement procedure of readiness of health facilities with COPD-related services

Domain	Indicators	Measurement	Recode	Calculation of score	
				Domain wise score	Domain wise score
Guidelines and training	Guidelines (a3)	Yes	1	A=(a3+b3)/2*100	Score=(A+B+C)/3
		No	0		
	Staff training (b3)	Yes	1		
		No	0		
Equipment	Stethoscope (c3)	Yes	1	B=(c3+d3+e3+f3)/4*100	
		No	0		
	Oxygen Flowmeter (d3)	Yes	1		
		No	0		
	Spacer for inhalers (e3)	Yes	1		
		No	0		
	Oxygen (f3)	Yes	1		
		No	0		
Medicines	Salbutamol inhaler (g3)	Yes	1	C=(g3+h3+i3+j3+k3+l3+m3)/7*100	
		No	0		
	Beclomethasone inhaler (h3)	Yes	1		
		No	0		
	Prednisolone cap/tabs (i3)	Yes	1		
		No	0		
	Hydrocortisone injection (j3)	Yes	1		
		No	0		
	Epinephrine injectable (k3)	Yes	1		
		No	0		
	Salbutamol inhaler (l3)	Yes	1		
		No	0		
	Beclomethasone inhaler (m3)	Yes	1		
		No	0		

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Table 4: Summary of items of each domain and measurement procedure of readiness of health facilities with Mental health-related services

Domain	Indicators	Measurement	Recode	Calculation of score	
				Domain wise score	Total Score
	Guidelines (a4)	Yes	1	A= (a4+b4)/2*100	(A+B)/2
		No	0		
	Staff training (b4)	Yes	1		
		No	0		
Medicines	Amitriptyline (c4)	Yes	1	B= (c4+d4+e4+f4+g4+h4+i4+j4)/8*100	
		No	0		
	Fluoxetine (d4)	Yes	1		
		No	0		
	Carbamazepine (e4)	Yes	1		
		No	0		
	Phenobarbitone (f4)	Yes	1		
		No	0		
	Sodium valproate (g4)	Yes	1		
		No	0		
	Respiridone (h4)	Yes	1		
		No	0		
	Alprazolam (i4)	Yes	1		
		No	0		
	Diazepam (j4)	Yes	1		
		No	0		

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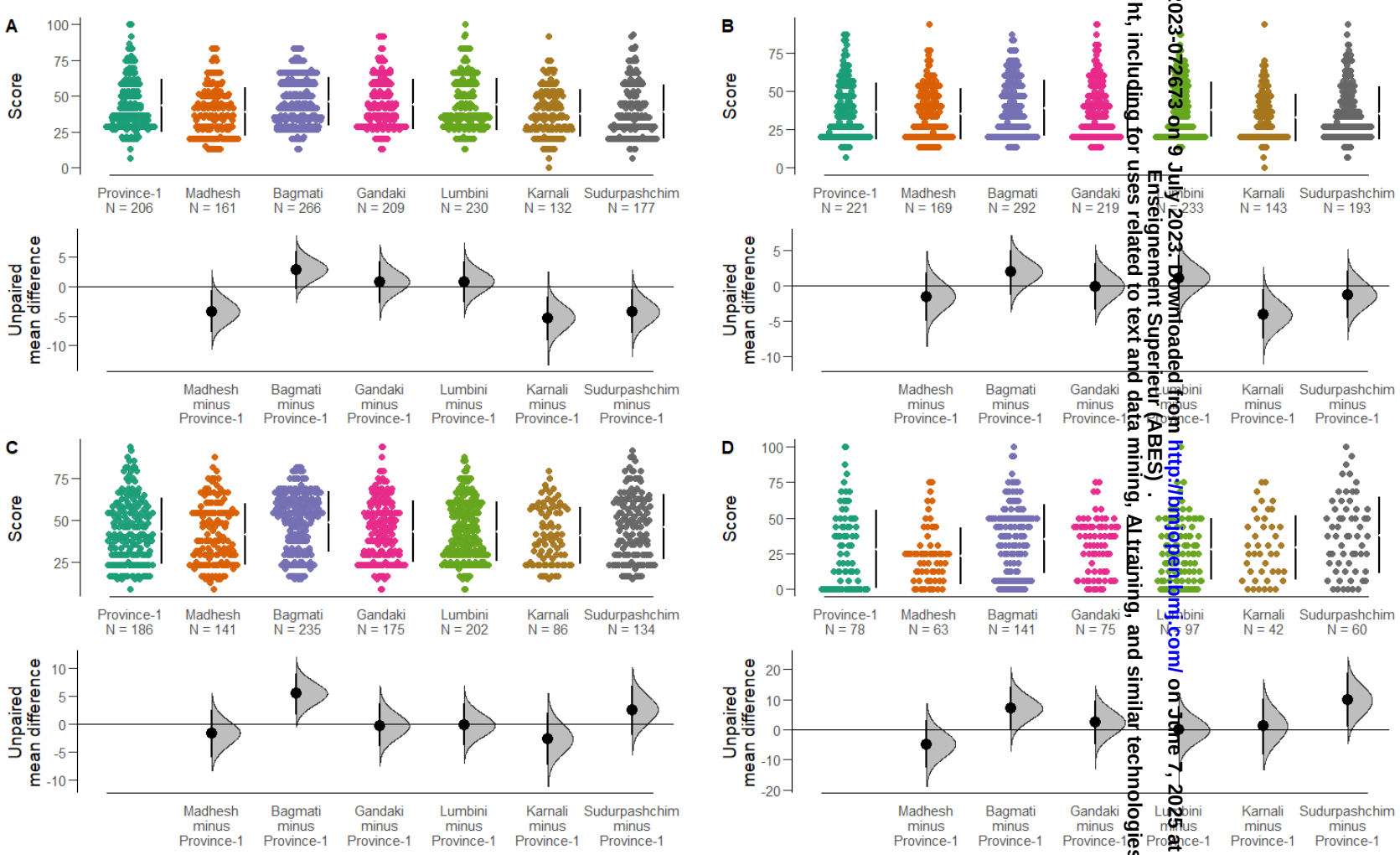

Figure: Gardner-Altman estimation plots for comparing mean service readiness scores of facilities offering A) CVDs services, B) CRDs services, C)DM services and D) MH services, by province

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	4-5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*6-7*
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	10-18

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Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-18
		(*b*) Report category boundaries when continuous variables were categorized	10-18
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	No
Discussion			
Key results	18	Summarise key results with reference to study objectives	19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	3
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19-20
Generalisability	21	Discuss the generalisability (external validity) of the study results	3
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	21

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Readiness of Health Facilities to Provide Non-Communicable Diseases Related Services in Nepal: A Further Analysis of Nepal Health Facility Survey- 2021

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Abstract

Objective: To assess the readiness of public and private health facilities(HFs) in delivering non-communicable diseases (NCDs)-related services in Nepal.

Methods: We analyzed data from nationally representative Nepal Health Facility Survey 2021 to determine readiness of HFs for four NCDs: Cardiovascular Diseases (CVDs), Diabetes Mellitus (DM), Chronic Respiratory Diseases (CRDs), and Mental Health(MH) related services using Service Availability and Readiness Assessment Manual from the World Health Organization. Readiness score was measured as the average availability of tracer items in percent, and HFs were considered "ready" for NCDs management if they scored ≥70 (out of 100). We performed weighted descriptive analysis, univariate and multivariable logistic regression to determine association of readiness of HFs with province, type of HFs, ecological region, quality assurance activities, external supervision, client's opinion review system, and frequency of HFs meetings.

Results: Of 1516 HFs offering at least one of four NCDs-related services, 93.1%, 75.8%, 99.3, and 26.0% provide CVDs, DM, CRDs and MH-related services respectively. The overall mean readiness score of HFs with CVDs, DM, CRDs, and MH-related services were 38.1, 38.5, 32.6 and 24.0 respectively. Guidelines and staff training domain had the lowest readiness score, whereas essential equipment and supplies domain has the highest score for each of the NCDs-related services. Local HFs were less likely to be ready to provide all NCDs-related services compared to federal/provincial hospitals. HFs with external supervision were more likely to be ready to provide CRDs and DM-related services and HFs reviewing client's opinions were more likely to be ready to provide CRDs, CVDs, and DM-related services.

Conclusion: Readiness of the local HFs and private hospitals to provide CVDs, DM, CRDs, and MH-related services were relatively poor compared to the federal/provincial. Prioritization of policies to reduce the gaps in readiness and capacity strengthening of the local HFs is tantamount to improving the overall readiness for NCDs.

Keywords: *cardiovascular; chronic respiratory disease; diabetes mellitus; health facilities; mental health; readiness*

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Strengths and limitations of this study

- Nationally representative sample of health facilities in Nepal, with coverage of all seven provinces and 77 districts
- The survey has adopted a highly standardized survey tool with the globally accepted research protocol.
- Variables for readiness analysis are based on standardized WHO's SARA guideline and thus, findings are comparable to findings from other countries.
- Weighted analysis has been performed to account for the complex sampling procedures and adjusts for non-response and disproportionate sampling.
- Since the survey was conducted during the COVID-19 pandemic, there could be some impact on service availability due to uncertainties and fear of COVID-19 transmission thus affecting the study results.

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Introduction:

Non-Communicable Diseases (NCDs) are one of the major public health and development challenge facing humankind globally. According to World Health Organization (WHO), NCDs are the leading cause of death worldwide killing 41 million people each year equivalent to 71% of all deaths globally. Approximately, 80% of NCD related deaths occur in low- and middle-income countries (L12MICs).[1] Every year, approximately 41 million people die from non-communicable diseases (NCDs), and it's projected that by 2030, this number will increase to 52 million.[2] In Southeast Asia, NCDs accounts for 9 million deaths (62% of all deaths) each year.[3] NCDs have emerged as the leading cause of premature mortality and Disability Adjusted Life Years (DALYs) in Nepal. Of the total 193,331 fatalities estimated in 2019, NCDs were responsible for 71.1% of deaths.[4] In 2040, NCDs are projected to attribute 78.64% of total deaths in Nepal.[4] In 2019, Cardiovascular Diseases (CVDs), Chronic Respiratory Diseases (CRDs) and neoplasm were the top three leading causes of death in Nepal, attributing to approximately 24%, 21.1% and 11.2% of total deaths, respectively. Together, these three conditions are responsible for more than half of the total deaths in Nepal.[5]

Recognizing the gravity of the situation, Nepal adopted, contextualized and implemented the Package of Essential Non-Communicable Diseases (PEN) to screen, diagnose, treat, and refer major NCDs such as CVDs, Diabetes Mellitus (DM), chronic obstructive pulmonary disease, cancer, and mental health at health posts, primary health care centers (PHCCs), and district hospitals.[6] The PEN package has now been expanded to all 77 districts of Nepal.[7] Moving a step further, the PEN Implementation Plan (2016-2020) was developed in accordance with the Multi-sectoral Action Plan for NCDs Prevention and Control (2014-2020).[7] Nepal Multi-Sectoral Action Plan for NCDs (2021-2025) focuses on creating high-impact, politically and socially acceptable, and potentially implementable interventions. The plan aims to reduce the burden of NCDs through the whole-of-government and whole-of-society approach. The action plan has an overarching target of reducing premature mortality from NCDs by 25% by 2025 and by one third by 2030.[7,8] The NCD action plan envisions to achieve 80% availability of cheap basic technologies and necessary medications, including generics, needed to treat major NCDs in both public and private institutions. The multi-sectoral action plan involves medication therapy and counseling (including glycemic management) for 50% of eligible persons (defined as those aged 40 and older with a 10-year cardiovascular risk of more than 30%, including those with established CVDs).[8]

NCDs services have been included in basic health care in Nepal although the service availability and preparedness remain very limited.[9] Apart from disease-specific interventions, Nepal Lancet NCDI poverty commission has pointed out the need for improving governance, strengthening health systems, and monitoring this extended group of priority NCDs.[10] The commission also recommended that structured capacity-building programs for health service providers; promoting care packages, such as the PEN interventions for primary health care; increasing the availability of specialty services and personnel; and expanding progressive vertical programs providing free

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care for disease-specific areas could be useful in improving service availability and preparedness for NCDs.[10]

The increasing burden of NCDs in Nepal is often not matched with the availability of resources and appropriate healthcare response. There is a need to generate evidence to uncover gaps in NCDs service readiness to facilitate evidence informed policy making to improve the service availability and uptake.[9,11] Thus, we aim to determine services availability and readiness of health facilities (HFs) in Nepal to provide services related to NCDs including CVDs, CRDs, DM, and Mental Health (MH) using nationally representative data from Nepal Health Facility Survey (NHFS), 2021.

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Methods:

Study Design

We analyzed secondary data[12] from the nationally representative cross-sectional survey, NHFS 2021, carried out by New Era with technical support of ICF International, to assess the availability and readiness of HFs to provide services related to NCDs namely, CVDs, CRDs, DM and MH. The detailed information on objectives and methodology of NHFS 2021 is published elsewhere.[13] NHFS 2021 was carried out among both public HFs and private hospitals of Nepal. In Nepal health services are delivered by public HFs, private HFs and other community based or NGO-run clinics, medical centers, mission hospitals, teaching hospitals. The public HFs deliver health services in three levels: federal, provincial, and local level. The local health system includes primary hospitals, PHCCs, health post, basic health care centers, urban health clinics, community health units and community level HFs (community health clinics, outreach primary health and immunization clinics). Health posts are the first institutional contact point for basic health services. The federal and provincial level health system includes central and provincial level hospitals providing tertiary care. Each level above health post is a referral point in network ranging from PHCC to primary and secondary level hospitals. The private HFs including private hospitals, clinics, medical hall pharmacies deliver basic health services to tertiary care.[13–15]

Sample and Sampling

A stratified random sample of 1,633 HFs out of 5,681 eligible HFs were selected in 2021 NHFS. The process of sample size estimation and sampling procedures are explained in detail elsewhere.[13] We analyzed data of 1480 HFs offering any NCDs services out of which 1381 HFs were offering CVDs services, 1470 were offering CRDs services, 1159 were offering DM services and 556 HFs were offering MH services. The flowchart showing details of sample and sampling is present in **Supplementary figure 1**.

Data collection

Data collection for 2021 NHFS took place between January 27, 2021, and September 28, 2021, with a break for three months from May through July, due to the COVID-19 imposed lockdowns beginning on April 29, 2021. The 2021 NHFS included the use of four types of survey instruments: a) Facility Inventory Questionnaire, b) Health Provider Questionnaire, c) Exit Interview Questionnaires, and d) Observation protocols for antenatal care, family planning services, care for sick children, and labor and delivery. For this study, we have used the data from "Facility Inventory Questionnaire", and "Health Provider Questionnaire".

Patient and public involvement

This article is prepared analyzing secondary data sources. There was no patient and public involvement in the design, conduct and reporting of our research.

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Outcome variables and measurement

The variables for services availability and readiness of HFs to provide NCDs-related facilities were selected based on the WHO Service Availability and Readiness (SARA) manual. [8]

Services Readiness: The service readiness of HFs was measured based on the availability and functioning of items categorized under three domains- staff and guidelines, essential equipment, and supplies, medicine and commodities and diagnostics. The list of tracer items of each domain for CVDs, CRDs, DM and MH and process of calculation of readiness score are presented in the **supplementary table 1**. The readiness score of HFs to provide services on CVDs, CRDs DM and MH were calculated using the Service Availability and Readiness Assessment manual of the World Health Organization.[16] The availability of tracer items is measured based observation of each tracer items by interviewer. The items in each domain were re-coded as binary variables, taking "1" for the presence of the item and "0" for the absence of the item in the facility. The mean score for each domain was computed by adding items followed by dividing by the number of items and multiplying by 100. Each domain included in score calculation contributes equally to the overall readiness score. The average score from the three domains was the readiness score. A cutoff of 70 was considered on the overall score to classify the readiness of the facilities towards NCDs-related services. A facility with an overall score of more than or equal to 70 was considered as "ready" to manage NCDs.[17–19]

Independent variables: The independent variables included setting (rural/urban), ecological region (Hill/Mountain / Terai), province (Koshi/ Madhesh / Bagmati / Gandaki /Lumbini / Karnali /Sudurpaschim), type of facility (federal or provincial hospital/local HFs/private hospital), presence of external supervision in past four months (present/absent), quality assurance activities (performed /not performed) and frequency of health facility meeting (none/sometimes/monthly).

The classification of setting into rural and urban was based on the type of municipalities in which HFs are located.[13] The type of HFs were classified into federal or provincial hospital, local HFs and private hospitals where local HFs comprised of local hospitals, health posts and PHCCs. The facility was considered to have external supervision if facility staff or members reported receiving of any external supervision/monitoring from the federal, provincial or municipal level in the past four months prior to survey and interviewer observed associated documentation.[13] Facility were considered to have performed quality assurance activities if staff or members from health facility reported carrying out quality assurance activities routinely and interviewer observed documentation of a recent quality assurance activity including report or minutes of a quality assurance meeting, a supervisory checklist, a mortality review, or an audit of records or registers.[13] For frequency of HFs meeting, the health facilities stating "no" for routine management/administrative meetings were classified as "None", those stating "monthly or more often" were classified as "Monthly" and those stating "irregular or every 2-6 months" were classified as "Sometimes".[13] HFs were considered to have performed review of client's opinion if staff or members of health facility reported presence of the system for determining client opinion,

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procedure for reviewing client opinion, and interviewer observed report of a recent review of client opinion.[13]

Statistical Analysis: We used R version 4.2.0 and RStudio [20,21] for statistical analysis. We used "survey" package [22] and performed weighted analysis to account for the complex survey design of NHFS 2021. We summarized continuous variables with mean, standard deviation (SD), median and interquartile range (IQR) whereas categorical variables were summarized with frequency, percent, and 95% confidence interval (95% CI) around percent. We plotted map QGIS 3.22.7-Białowieża [23], publicly available district-wise shape file taken from official website of Survey department of Ministry of Land Management, Cooperatives and Poverty Alleviation, Government of Nepal, and Global Positioning system (GPS) dataset of the HFs. We employed univariate and multivariate weighted logistic regression analysis to determine the association of the readiness of HFs to CVDs, CRDs, DM and MH-related services with independent variables including setting, ecological region, province, type of facility, external supervision, quality assurance activities, review of client opinion, and HFs meeting. The results of regression analysis are presented as crude odds ratio (COR) and adjusted odds ratio (AOR) with 95% confidence interval (CI) and p-value. A p-value of less than 0.05 is considered statistically significant.

Results

Of the total facilities offering any NCDs (CVDs, CRDs, DM or MH) related services, 46.7% were from rural areas. Half of the HFs with any NCDs-related services were from hill region (52.7%) followed by terai region (34.4%;). HFs providing NCDs services were highest in Bagmati accounting for 20.5% followed by Madhesh (16.1%), Koshi (15.7%) and Lumbini (15.7%). The quality assurance activities were performed in 23.9%, external supervision in past 4 months was present in 66.4%, review of client's opinion in 3.8% and monthly health facility meeting was carried out in 65.0% of HFs offering any NCDs related services. (*Table-1*)

Table 1: Characteristics of the facilities offering anyone of four NCDs related services.

Characteristics	Unweighted (n=1480)	Weighted (n=1516)	
	n (%)	n	% (95%CI)
Location			
Urban	946 (63.9)	808	53.3 (49.5 to 57.1)
Rural	534 (36.1)	708	46.7 (42.9 to 50.4)
Ecological Region			
Hill	794 (53.6)	800	52.7 (48.9 to 56.5)
Mountain	178 (12.0)	196	12.9 (10.7 to 15.5)
Terai	508 (34.4)	521	34.4 (30.8 to 38.2)

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Province			
Koshi	227 (15.3)	238	15.7 (13.0 to 18.8)
Madhesh	169 (11.4)	245	16.1 (13.1 to 19.7)
Bagmati	294 (19.9)	311	20.5 (17.6 to 23.7)
Gandaki	219 (14.8)	197	13.0 (10.8 to 15.5)
Lumbini	235 (15.9)	238	15.7 (13.2 to 18.5)
Karnali	143 (9.7)	119	7.9 (6.4 to 9.7)
Sudurpaschim	193 (13.0)	169	11.1 (9.3 to 13.2)
Type of facility			
Federal/Provincial hospital	97 (6.6)	27	1.8 (1.5 to 2.2)
Local HFs	1,128 (76.2)	1,376	90.7 (89.2 to 92.0)
Private Hospital	255 (17.2)	113	7.5 (6.3 to 8.9)
Quality assurance activities			
Not Performed	1,182 (79.9)	1,153	76.1 (72.6 to 79.2)
Performed	298 (20.1)	363	23.9 (20.8 to 27.4)
External Supervision			
No	561 (37.9)	509	33.6 (30.2 to 37.2)
Yes	919 (62.1)	1007	66.4 (62.8 to 69.8)
Review client's opinion			
Not reviewed	1,394 (94.2)	1459	96.2 (94.7 to 97.3)
Reviewed	86 (5.8)	58	3.8 (2.7 to 5.3)
Frequency of health facility meeting			
None	264 (17.8)	225	14.8 (12.5 to 17.5)
Sometimes	302 (20.4)	306	20.2 (17.4 to 23.3)
Monthly	914 (61.8)	985	65.0 (61.4 to 68.4)
Total Health workforce [1]	41.0 (123.1); 7.0 (3.0,20.2)	18.7±73.5; 6.0 (5.0, 9.0)	
Services availability			
CVDs	1381 (93.3)	1411	93.1 (90.9 to 94.7)
DM	1159 (78.3)	1149	75.8 (72.4 to 78.8)
CRDs	1470 (99.3)	1507	99.3 (98.3 to 99.7)

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MH	556 (37.6)	394	26.0 (23.0 to 29.2)

[1] Mean±SD; Median (IQR)
CVD: Cardiovascular Diseases; DM: Diabetes Mellitus; CRDs: Chronic Respiratory Diseases; MH: Mental Health; %: Percent; n: frequency; SD: standard deviation; IQR: interquartile range (1st quartile,3rd quartile); CI: Confidence Interval;

Table 2 presents the overall readiness score of HFs offering CVDs, CRDs, DM, and MH-related services (Mean±SD) which were 38.1±15.4, 32.6±14.7, 38.5±16.7, and 24.0±23.1 respectively. The overall readiness score for each NCDs related service was higher in federal or provincial hospitals followed by private hospital and lowest in the local HFs.

The median readiness score for guidelines and staff training domain was zero for all NCDs related services. The mean readiness score for essential equipment and supplies domain for CVDs, CRDs and DM-related services were 72.6±17.5, 49.1±17.8 and 76.4±18.8 respectively and was highest in three sets of facilities offering CVDs, DM and CRDs related services. Similarly, the median readiness score for medicine and supplies domain among facilities offering CVDs, DM and CRDs related services were 25.0(IQR: 0.0, 50.0), 40.0(IQR: 20.0, 40.0) and 25.0 (IQR: 25.0, 50.0). The median readiness score for diagnostic domain among facilities offering DM related services was zero (IQR: 0.0, 66.7).

HFs offering NCDs related services were 3.8% (95% CI: 5.3 to 2.8), 2.3% (95% CI: 1.6 to 3.3), 3.7% (95% CI: 2.6 to 5.1) and 3.3% (95% CI: 1.8 to 6.1) ready to deliver CVDs, CRDs, DM and MH-related services respectively. Among federal or provincial hospitals, 16.4%, 19.5%, 22.6% and 13.4% were ready to provide CVDs, CRDs, DM and MH-related services respectively.

Among private hospitals, 11.1%, 7.9%, 10.2% and 3.2% were ready to deliver CVDs, CRDs, DM and MH-related services respectively. Among local HFs, 2.9%, 1.5%, 2.4% and 2.5% were ready to provide CVDs, CRDs, DM and MH-related services respectively which was relatively lower compared to federal or provincial hospitals.

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Table-2: Readiness of facilities for services related to NCDs.

Tracer items	Total facilities		Federal or provincial hospitals		Local HFs		Private hospitals	
	% (95% CI)	Score[1]	95% CI	Score[1]	95% CI	Score[1]	95% CI	Score[1]
Chronic Respiratory Disease (CRDs)								
Guidelines and Training								
Guidelines	11.0 (8.9 to 13.6)	12.4±26.4; 0.0 (0.0, 0.0)	15.3 (9.4 to 24.1)	20.1±31.1; 0.0 (0.0, 50.0)	11.1 (8.8 to 13.8)	12.7±26.8; 0.0 (0.0, 0.0)	9.7 (5.3 to 17.2)	6.7±17.9; 0.0 (0.0, 0.0)
Staff Training	13.7 (11.3 to 16.5)		24.8 (17.1 to 34.6)		14.3 (11.7 to 17.4)		3.7 (2.0 to 6.6)	
Essential Equipment and Supplies								
BP apparatus	97.6 (95.9 to 98.6)	49.1±17.8; 40.0 (40.0, 60.0)	97.9 (91.8 to 99.5)	72.4±22.8; 80.0 (45.5, 80.0)	97.5 (95.6 to 98.5)	46.4±14.8; 40.0 (40.0, 40.0)	98.8 (97.0 to 99.5)	76.7±21.0; 80.0 (60.0, 100.0)
Stethoscope	98.4 (97.1 to 99.2)		98 (92.0 to 99.5)		98.5 (96.9 to 99.2)		98.8 (96.0 to 99.2)	
Oxygen Flow meter	16.7 (14.3 to 19.4)		59.9 (49.7 to 69.3)		11.7 (9.4 to 14.5)		66.5 (58.5 to 73.9)	
Oxygen	26.2 (23.1 to 29.5)		74.2 (64.4 to 82.1)		20.8 (17.6 to 24.3)		79.3 (72.8 to 85.8)	
Spacers	6.8 (5.3 to 8.6)		32 (23.3 to 42.1)		3.5 (2.3 to 5.3)		39.1 (31.2 to 48.8)	
Essential Medicines								
Salbutamol	90.8 (88.6 to 92.7)	36.5±22.3; 40.0 (20.0, 40.0)	90.7 (83.0 to 95.2)	75.4±21.3; 80.0 (60.0, 80.0)	92.3 (89.8 to 94.2)	33.3±18.5; 20.0 (20.0, 40.0)	73.6 (65.5 to 80.2)	65.4±32.3; 80.0 (40.0, 100.0)
Beclomethasone	3.9 (3.0 to 5.1)		27.8 (19.7 to 37.7)		1.1 (0.6 to 2.1)		33.1 (25.1 to 41.5)	
Prednisolone	13.1 (11.2 to 15.3)		80.3 (71.0 to 87.2)		7.3 (5.6 to 9.5)		67.3 (58.7 to 75.2)	
Hydrocortisone	36.6 (33.1 to 40.2)		92.6 (85.2 to 96.5)		31.6 (27.9 to 35.5)		83.3 (76.3 to 89.0)	
Epinephrine	37.9 (34.3 to 41.6)		85.5 (76.8 to 91.3)		34.3 (30.5 to 38.3)		71.9 (61.7 to 76.9)	
Overall Readiness Score[1]	32.6±14.7; 26.7 (20.0, 40.0)		56.0±14.3; 53.3 (46.7 to 65.6)		30.8±13.2; 26.7 (20.0, 36.7)		49.6±15.9; 46.7 (40.0, 60.0)	
HFs with readiness score >70, % (95%CI)	2.3 (1.6 to 3.3)	-	19.5 (12.7 to 28.7)		1.5 (0.9 to 2.4)		7.9 (3.8 to 15.7)	
Cardiovascular Disease (CVDs)								
Guidelines and Training								
Guidelines	11.2 (9.1 to 13.8)	12.1±25.6; 0.0 (0.0, 0.0)	17.4 (11.0 to 26.40)	19.0±30.9; 0.0 (0.0, 50.0)	11.2 (8.9 to 14.1)	12.3±26.0; 0.0 (0.0, 0.0)	9.8 (5.3 to 17.4)	7.7±18.8; 0.0 (0.0, 0.0)
Staff Training	12.9 (10.5 to 15.8)		20.7 (13.6 to 30.10)		13.4 (10.8 to 16.5)		5.0 (3.5 to 8.9)	
Essential Equipment and Supplies								
BP apparatus	97.4 (95.6 to 98.5)	72.6±17.5; 60.0 (60.0, 80.0)	97.9 (91.8 to 99.50)	90.3±17.6; 100.0 (80.0, 100.0)	97.3 (95.3 to 98.5)	70.5±16.4; 60.0 (60.0, 80.0)	98 (97.0 to 99.5)	92.8±14.0; 100.0 (80.0, 100.0)
Stethoscope	98.4 (96.9 to 99.2)		98 (92.0 to 99.50)		98.4 (96.8 to 99.2)		98 (95.9 to 99.2)	
Weighing scale	95.1 (93.2 to 96.5)		95.9 (89.3 to 98.50)		95.2 (93.0 to 96.7)		94 (90.7 to 96.3)	
Pulse Oximeter	44.5 (40.7 to 48.4)		85.6 (76.9 to 91.30)		39.4 (35.4 to 43.7)		92 (86.6 to 96.0)	
Oxygen	27.6 (24.4 to 31.1)		74.2 (64.4 to 82.10		22 (18.6 to 25.7)		80 (73.2 to 86.2)	
Essential Medicines								
Thiazide	6.7 (5.5 to 8.3)	29.6±26.2; 25.0 (0.0, 50.0)	45.2 (35.5 to 55.40)	71.1±28.1; 75.0 (50.0, 100.0)	2.9 (1.9 to 4.2)	25.9±21.8; 25.0 (0.0, 45.0)	41.5 (33.0 to 50.1)	62.3±37.8; 75.0 (25.0, 100.0)
Atenolol	32.4 (28.9 to 36.1)		68 (57.9 to 76.60)		29.3 (25.5 to 33.4)		58.1 (49.9 to 67.1)	
Aspirin	17.7 (15.3 to 20.4)		80.3 (71.0 to 87.20)		11.7 (9.4 to 14.5)		69.1 (61.3 to 77.2)	
Amlodipin	61.6 (57.7 to 65.4)		90.7 (83.0 to 95.20)		59.5 (55.2 to 63.6)		79.1 (71.7 to 85.0)	
Overall Readiness Score[1]	38.1±15.4; 35.0 (28.3, 45.0)		60.1±14.5; 60.0 (50.0, 66.7)		36.2±14.1; 35.0 (28.3, 43.3)		54.3±16.1; 58.3 (41.7, 66.7)	
HFs with readiness score >70, % (95%CI)	3.8 (5.3 to 2.8)	-	16.4 (10.2 to 25.30)		2.9 (1.9 to 4.4)		11 (6.4 to 18.5)	
Diabetes Mellitus (DM)								
Guidelines and Training								
Guidelines	14.1 (11.4 to 17.3)	14.2±27.5; 0.0 (0.0, 0.0)	19.4 (12.7 to 28.7)	20.1±31.1; 0.0 (0.0, 50.0)	14.4 (11.5 to 18.0)	14.9±28.1; 0.0 (0.0, 0.0)	9.4 (5.1 to 17.0)	6.8±18.1; 0.0 (0.0, 0.0)
Staff Training	14.3 (11.6 to 17.5)		20.7 (13.6 to 30.1)		15.3 (12.2 to 18.9)		4.2 (2.4 to 7.0)	
Essential Equipment and supplies								
BP apparatus	97.9 (96.0 to 98.9)	76.4±18.8;	97.9 (91.8 to 99.5)	82.5±20.0;	97.8 (95.6 to 98.9)	76.0±18.7;	98 (97.0 to 99.5)	78.4±19.3; 66.7

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Tracer items	Total facilities		Federal or provincial hospitals		Local HFs		Private hospitals	
	% (95% CI)	Score[1]	95% CI	Score[1]	95% CI	Score[1]	95% CI	Score[1]
Height Board	36.2 (32.2 to 40.5)	66.7 (66.7, 100.0)	53.6 (43.5 to 63.5)	100.0 (66.7, 100.0)	35 (30.5 to 39.8)	66.7 (66.7, 100.0)	42.3 (34.0 to 51.7)	(66.7, 100.0)
Weighing Scale	95 (92.6 to 96.6)		95.9 (89.3 to 98.5)		95.1 (92.3 to 96.8)		93.1 (90.5 to 96.2)	
Essential Medicines								
Metformin	65.6 (61.2 to 69.7)	34.1±22.6; 25.0 (25.0, 50.0)	91.8 (84.2 to 95.9)	65.9±23.1; 75.0 (50.0, 75.0)	63.8 (58.9 to 68.4)	30.8±19.2; 25.0 (25.0, 50.0)	75.1 (67.3 to 81.9)	56.7±30.1; 50.0 (50.0, 75.0)
Glibenclamide	4.4 (3.2 to 5.8)		26.7 (18.7 to 36.5)		2.2 (1.2 to 3.8)		18.1 (13.0 to 25.7)	
Injectable Insulin	7.5 (6.1 to 9.1)		49.4 (39.4 to 59.4)		1.5 (0.8 to 2.6)		32.1 (42.2 to 59.5)	
Injectable Glucose	59.2 (54.8 to 63.4)		95.9 (89.4 to 98.5)		55.6 (50.7 to 60.3)		81.1 (74.9 to 87.8)	
Diagnostics								
Test: Blood: Glucose	23.3 (20.0 to 27.0)	29.2±37.8; 0.0 (0.0, 66.7)	43.2 (33.6 to 53.4)	76.6±24.1; 66.7 (66.7, 100.0)	20.3 (16.7 to 24.3)	23.2±34.7; 0.0 (0.0, 33.3)	46.1 (37.2 to 54.4)	71.8±31.1; 66.7 (66.7, 100.0)
Test: Urine Glucose	32.6 (28.9 to 36.6)		92.8 (85.5 to 96.6)		25.1 (21.2 to 29.4)		84.2 (78.6 to 89.5)	
Test: Urine Glucose	31.8 (28.1 to 35.7)		93.8 (86.7 to 97.2)		24.2 (20.4 to 28.4)		84.2 (78.6 to 89.5)	
Overall Readiness Score[1]	38.5±16.7; 35.4 (22.9, 52.1)		61.3±13.3; 60.4 (52.1, 68.8)		36.2±15.5; 33.3 (22.9, 45.8)		53.4±15.7; 54.2 (45.8, 66.7)	
HFs with readiness score >70, % (95%CI)	3.7 (2.6 to 5.1)		22.6 (15.3 to 32.2)		2.4 (1.5 to 3.9)		11.1 (5.7 to 17.6)	
Mental Health (MH)								
Guidelines and Training								
Guidelines	11.9 (8.0 to 17.4)	17.6±28.3; 0.0 (0.0, 50.0)	10 (5.2 to 18.4)	23.0±30.2; 0.0 (0.0, 50.0)	12.6 (7.8 to 19.9)	20.1±29.8; 0.0 (0.0, 50.0)	14.3 to 20.6)	7.1±18.0; 0.0 (0.0, 0.0)
Staff Training	23.4 (18.2 to 29.7)		35.9 (26.5 to 46.5)		27.5 (20.5 to 35.8)		12.5 to 8.2)	
Essential Medicines								
Amitriptyline	49.5 (42.8 to 56.3)	30.3±32.2; 12.5 (0.0, 62.5)	80.8 (71.1 to 87.8)	66.2±29.9; 62.5 (37.5, 96.2)	41.6 (33.4 to 50.2)	20.8±25.8; 12.5 (0.0, 25.0)	68.2 (57.6 to 77.6)	53.4±34.0; 55.3 (25.0, 87.5)
Fluoxetine	23.6 (18.9 to 29.0)		58.4 (47.8 to 68.4)		15.6 (10.5 to 22.5)		41.2 (32.1 to 51.8)	
Carbamazepine	26.7 (21.5 to 32.6)		55 (44.4 to 65.1)		20 (14.0 to 27.7)		42.2 (32.3 to 52.4)	
Phenobarbitone	22.1 (17.7 to 27.2)		57.1 (46.5 to 67.2)		14.2 (9.6 to 20.6)		39.2 (30.4 to 49.9)	
Sodium Valproate	32.1 (26.5 to 38.2)		65.2 (54.5 to 74.5)		21.4 (15.3 to 29.0)		60.1 (50.3 to 69.9)	
Risperidone	20.9 (16.4 to 26.2)		55 (44.4 to 65.1)		13.6 (8.9 to 20.3)		36.1 (27.3 to 47.2)	
Alprazolam	29.4 (24.3 to 35.0)		68.5 (57.9 to 77.4)		16.3 (11.5 to 22.7)		64.1 (54.3 to 73.6)	
Diazepam	37.9 (32.0 to 44.1)		90 (81.6 to 94.8)		23.5 (17.4 to 30.9)		73.6 (63.9 to 81.4)	
Overall Readiness Score[1]	24.0±23.1; 18.8 (0.0, 37.5)		44.6±23.0; 43.8 (25.0 to 56.2)		20.4±22.3; 12.5 (0.0 to 37.5)		30.3±21.3; 31.2 (12.5 to 43.8)	
HFs with readiness score >70, % (95%CI)	3.3 (1.8 to 6.1)		13.4 (7.7 to 22.3)		2.5 (0.9 to 7.1)	0.9, 7.1	3.1 (1.5 to 6.3)	

[1] *Mean±SD; Median (IQR)*

%: percent; n: frequency; SD: standard deviation; IQR: interquartile range (1st quartile,3rd quartile); CI: Confidence Interval; Local HFs include local hospital, health posts and PHCCs

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[Figure 1 is here]

Figure 1: Facility and district-wise readiness score to provide services related to NCDs (A: Readiness of facilities to provide CVD-related services; B: Readiness of facilities to provide DM related services; C. Readiness of facilities to provide CRDs related services; D: Readiness of facilities to provide MH related services)

Figure 1 shows the readiness of facilities to provide services related to different NCDs grouped by district. Facilities are represented by red points for readiness scores ranging from 0 to 20 and white points for readiness scores ranging from 80 to 100, while districts with readiness scores from 0 to 20 are represented by yellow color and with readiness scores from 80 to 100 in blue. These legends are consistent across all the sub-figures A through D.

Gardner-Altman estimation plot to compare the readiness score of HFs for providing different NCDs-related services by province showed the readiness score of facilities vary by province. (**supplementary figure 2**)

Table 3 and 4 present the factors associated with services readiness of health facilities to provide NCDs-related services. In univariate analysis, service readiness of health facilities to provide CRDs-related services was significantly associated with the type of facility and presence of external supervision and revision of client opinion. Similarly, the readiness of HFs for CVDs-related services was significantly associated with the revision of client opinion and type of health facility. The readiness of HFs for DM was significantly associated with the type of facility, presence of quality assurance activities performed at least once a year, presence of external supervision, and revision of client opinion. The readiness of HFs for MH-related services was associated with the type of facility.

In the adjusted multivariable analysis, the odds of being ready for CRDs-related services were 0.04 (95% CI: 0.02 to 0.09) times in the local HFs and 0.37 (95% CI: 0.16 to 0.87) times in private hospitals compared to federal/provincial hospitals, and 3.43 (1.64 to 7.20) times in HFs with external supervision compared to HFs without external supervision in past 4 months after adjusting for other variables. The odds of being ready for CVDs-related services were 2.04 (95% CI: 1.02 to 4.09) times in rural areas compared to urban, 0.24 (95% CI: 0.09 to 0.65) times in mountain compared to the hill, 0.24 (95% CI: 0.07 to 0.78) in Madhesh compared to Koshi, 0.12 (95% CI: 0.05 to 0.28) times in local HFs compared to federal/provincial hospital and 2.68 (95% CI: 1.26 to 5.70) times in HFs reviewing client's opinions compared those HFs that did not review client's opinions. The odds of being ready towards DM-related services were 3.31 (95% CI: 1.23 to 8.87) times in Sudurpaschim compared to Koshi, 0.08 (95% CI: 0.04 to 0.18)] times in local HFs compared to federal/provincial hospitals, and 2.56 (95% CI: 1.29 to 5.08) times in HFs with

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external supervision. Similarly, the odds of being ready for MH-related services were 83% less in local HFs [AOR=0.17 (95% CI: 0.03 to 0.95)] and 84% less in private hospitals [AOR=0.14 (95% CI: 0.04 to 0.55)] compared to federal/provincial hospitals.

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Table 3: Factors associated with readiness of HFs to provide NCDs related services (unadjusted)

Characteristics	CRDs related services		CVDs related services		DM related services		MH related services	
	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p
Location								
Urban	Ref		Ref		Ref		Ref	
Rural	0.70 (0.31 to 1.57)	0.39	1.03 (0.52 to 2.03)	0.93	0.49 (0.21 to 1.11)	0.09	0.83 (0.16 to 4.17)	0.80
Ecological region								
Hill	Ref		Ref		Ref		Ref	
Mountain	0.99 (0.29 to 3.33)	0.98	**0.22 (0.09 to 0.57)**	**0.00**	0.74 (0.32 to 1.74)	0.50	1.18 (0.13 to 10.78)	0.90
Terai	0.78 (0.37 to 1.64)	0.51	0.80 (0.40 to 1.60)	0.52	1.42 (0.68 to 2.96)	0.40	0.79 (0.26 to 2.41)	0.70
Province								
Koshi	Ref		Ref		Ref		Ref	
Madhesh	0.50 (0.19 to 1.33)	0.17	**0.25 (0.09 to 0.73)**	**0.01**	0.56 (0.23 to 1.37)	0.20	0.61 (0.11 to 3.53)	0.60
Bagmati	1.65 (0.64 to 4.26)	0.30	0.97 (0.33 to 2.89)	0.96	2.09 (0.81 to 5.39)	0.13	2.24 (0.46 to 10.76)	0.30
Gandaki	2.46 (0.84 to 7.16)	0.10	1.15 (0.38 to 3.43)	0.80	1.50 (0.51 to 4.37)	0.50	0.48 (0.09 to 2.72)	0.40
Lumbini	1.51 (0.47 to 4.79)	0.49	1.04 (0.34 to 3.15)	0.95	1.36 (0.48 to 3.87)	0.60	0.43 (0.09 to 2.00)	0.30
Karnali	0.26 (0.06 to 1.19)	0.08	0.49 (0.10 to 2.42)	0.38	0.46 (0.13 to 1.64)	0.20	0.59 (0.10 to 3.38)	0.60
Sudurpaschim	1.50 (0.68 to 3.31)	0.31	0.79 (0.27 to 2.36)	0.68	**2.49 (0.97 to 6.38)**	**0.06**	2.98 (0.61 to 14.59)	0.20
Type of facility								
Federal/Provincial hospitals	Ref		Ref		Ref		Ref	

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Characteristics	CRDs related services		CVDs related services		DM related services		MH related services	
	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p
Local HFs	**0.06 (0.03 to 0.13)**	**<0.001**	**0.15 (0.08 to 0.31)**	**<0.001**	**0.08 (0.04 to 0.17)**	**<0.001**	**0.17 (0.05 to 0.58)**	**0.01**
Private hospital	0.36 (0.14 to 0.89)	0.03	0.64 (0.29 to 1.42)	0.30	**0.39 (0.18 to 0.85)**	**0.02**	0.21 (0.08 to 0.54)	0.00
Quality assurance activities								
Not performed	Ref		Ref		Ref		Ref	
Performed	1.03 (0.56 to 1.88)	0.93	0.81 (0.44 to 1.49)	0.50	**2.18 (1.08 to 4.42)**	**0.03**	0.56 (0.20 to 1.57)	0.30
External supervision								
No	Ref		Ref		Ref		Ref	
Yes	**2.68 (1.43 to 5.04)**	**0.00**	1.57 (0.76 to 3.22)	0.22	**2.25 (1.23 to 4.10)**	**0.01**	0.83 (0.23 to 2.96)	0.80
Frequency of health facility meeting								
None	Ref		Ref		Ref		Ref	
Sometimes	**0.29 (0.10 to 0.85)**	**0.02**	0.84 (0.17 to 4.10)	0.83	**3.53 (1.13 to 11.03)**	**0.03**	0.94 (0.17 to 5.21)	0.94
Monthly	0.45 (0.16 to 1.25)	0.13	2.01 (0.54 to 7.44)	0.30	**3.55 (1.40 to 9.04)**	**0.01**	2.25 (0.43 to 11.87)	0.34
Review of client's opinion								
Not reviewed	Ref		Ref		Ref		Ref	
Reviewed	**5.05 (1.79 to 14.28)**	**0.002**	**4.87 (2.14 to 11.06)**	**<0.001**	**4.84 (2.09 to 11.22)**	**<0.001**	2.88 (0.92 to 9.02)	0.07

COR: crude odds ratio; CI: confidence interval; Ref: reference group
CVDs: Cardiovascular Diseases; DM: Diabetes Mellitus; CRDs: Chronic Respiratory Diseases; MH: Mental Health
Local HFs include local hospital, health posts and PHCCs

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Table-4: Factors associated with readiness of HFs to provide NCDs-related services (adjusted)

Characteristics	CRDs related services		CVDs related services		DM related services		MH related services	
	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p
Location								
Urban	Ref		Ref		Ref		Ref	
Rural	1.55 (0.74 to 3.21)	0.24	**2.04 (1.02 to 4.09)**	**0.045**	1.28 (0.50 to 3.2	0.61	1.66 (0.12 to 23.80)	0.71
Ecological region								
Hill	Ref		Ref		Ref		Ref	
Mountain	1.45 (0.39 to 5.47)	0.58	**0.24 (0.09 to 0.65)**	**0.005**	0.82 (0.34 to 1.9	0.65	1.11 (0.08 to 15.24)	0.94
Terai	1.15 (0.39 to 3.37)	0.80	1.18 (0.38 to 3.70)	0.78	2.74 (0.91 to 8.2	0.072	1.45 (0.47 to 4.46)	0.52
Province								
Koshi	Ref		Ref		Ref		Ref	
Madhesh	0.63 (0.19 to 2.09)	0.45	**0.24 (0.07 to 0.78)**	**0.018**	0.43 (0.16 to 1.1	0.10	0.71 (0.10 to 5.20)	0.74
Bagmati	1.58 (0.59 to 4.21)	0.36	0.9 (0.23 to 3.45)	0.87	2.39 (0.71 to 8.0	0.16	2.94 (0.41 to 20.95)	0.28
Gandaki	2.81 (0.83 to 9.53)	0.10	1.28 (0.36 to 4.54)	0.70	2.75 (0.82 to 9.1	0.10	0.57 (0.10 to 3.23)	0.52
Lumbini	1.66 (0.44 to 6.17)	0.45	0.89 (0.27 to 2.99)	0.86	1.22 (0.43 to 3.4	0.71	0.43 (0.07 to 2.70)	0.36
Karnali	0.32 (0.07 to 1.51)	0.15	0.76 (0.13 to 4.46)	0.76	0.89 (0.21 to 3.8	0.87	0.78 (0.11 to 5.38)	0.80
Sudurpaschim	2.25 (0.97 to 5.20)	0.06	1.05 (0.32 to 3.42)	0.94	**3.31 (1.23 to 8.87)**	**0.02**	3.71 (0.80 to 17.08)	0.093
Type of facility								
Federal/Provincial hospital	Ref		Ref		Ref		Ref	

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Characteristics	CRDs related services		CVDs related services		DM related services		MH related services	
	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p
Local HFs	**0.04 (0.02 to 0.09)**	**<0.001**	**0.12 (0.05 to 0.28)**	**<0.001**	**0.08 (0.04 to 0.18)**	**<0.001**	**0.17 (0.03 to 0.95)**	**0.04**
Private hospitals	**0.37 (0.16 to 0.87)**	**0.02**	0.56 (0.24 to 1.31)	0.18	0.42 (0.16 to 1.1[illegible])	0.079	**0.14 (0.04 to 0.55)**	**0.01**
Quality assurance activities								
Not Performed	Ref		Ref		Ref		Ref	
Performed	0.86 (0.45 to 1.64)	0.66	0.64 (0.33 to 1.25)	0.19	2.06 (0.98 to 4.3[illegible])	0.06	0.45 (0.16 to 1.29)	0.14
External supervision								
No	Ref		Ref		Ref		Ref	
Yes	**3.43 (1.64 to 7.20)**	**0.00**	1.59 (0.69 to 3.66)	0.27	**2.56 (1.29 to 5.08)**	**0.01**	0.85 (0.19 to 3.87)	0.83
Frequency of health facility meeting								
None	Ref		Ref		Ref		Ref	
Sometimes	**0.27 (0.10 to 0.76)**	**0.01**	0.78 (0.15 to 3.99)	0.76	2.77 (0.76 to 10.01)	0.12	0.76 (0.13 to 4.54)	0.76
Monthly	**0.25 (0.09 to 0.65)**	**0.00**	1.51 (0.38 to 5.90)	0.56	1.85 (0.69 to 4.9[illegible])	0.22	1.84 (0.29 to 11.83)	0.52
Review of client's opinion								
Not Reviewed	Ref		Ref		Ref		Ref	
Reviewed	2.60 (0.91 to 7.44)	0.07	**2.68 (1.26 to 5.70)**	**0.01**	1.99 (0.77 to 5.14)	0.16	3.15 (0.97 to 10.19)	0.06

AOR: adjusted odds ratio; CI: confidence interval; Ref: reference group
CVD: Cardiovascular Diseases; DM: Diabetes Mellitus; CRDs: Chronic Respiratory Diseases; MH: Mental Health
Local HFs include local hospitals, health posts and PHCCs.

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Discussion

This study aimed to determine the readiness of the HFs to provide services related to NCDs including CVDs, CRDs, DM, MH in Nepal from a nationally representative sample of HFs from the NHFS 2021. The overall median HFs readiness score to provide CRDs, CVDs, DM, and MH-related services were 26.7, 35.0, 35.4 and 18.8 respectively with the readiness score for guidelines and training domain being the lowest and the readiness score for essential equipment and supplies being the highest for each disease. The proportion of HFs with more than 70% readiness score was 3.8% for CVDs, 3.7% for DM, 3.3% for MH, and 2.3% for CRDs related services. Federal or provincial hospitals are more likely to be ready to provide NCDs-related services compared to Local HFs.

A similar analysis from NHFS 2015 showed the median readiness score of HFs to provide CVDs, CRDs, and DM to be 18.8, 11.3, and 26.4 respectively.[24] Compared to NHFS 2015, the readiness score has improved in 2021 as demonstrated in our study. One of the factors for the increase in the readiness score of HFs from 2015 to 2021 could be due to the roll out and expansion of the PEN. PEN aims to detect, diagnose, treat, and refer individuals with CVDs, CRDs, cancer, DM, and MH issues at health posts, PHCCs, and district hospitals in order to promote early detection and management of chronic diseases within the community.[6] In October 2016, PEN was introduced in two pilot districts, Illam and Kailali which was later expanded to all 77 districts in Nepal.[7] In addition, the National mental health strategy and action plan was launched in 2021 which can further improve the preparedness of health system to deliver mental health services in future.[7,25]

In our study, the availability of guidelines and staff training was one area with lowest readiness score. A study conducted in Bangladesh also aligns with our findings, where the shortage of guidelines was commonly reported across HFs.[26] A prior study on CVDs highlighted a lack of national guidelines and protocols for treating CVDs as a significant obstacle to providing evidence-based treatment.[27] The other study on DM suggested that there is a significant shortfall in the implementation of existing policies, plans, strategies, and programs aimed at addressing DM, with a lack of clarity on how they should be implemented.[28] This evidence suggests not only the need for the formulation of evidence-informed guidelines and policies but also ensuring the availability of guidelines in HFs together with appropriate communication at all tiers of governments to ensure that they have a clear understanding of the policy documents. These areas should be improved and addressed concurrently as they have been demonstrated to be cost-efficient in terms of healthcare delivery.[29]

Our study revealed that HFs with external supervision had significantly higher preparedness scores for DM and CRDs. External supervision mechanisms in HFs are essential in facilitating the overall management process and improving the effectiveness of the facility. Such supervision enables information sharing and performance review which is pivotal in streamlining the facility's management process and enhancing its efficiency.[30]

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In tune with our findings, previous studies have also shown disparities in the availability of healthcare resources for the prevention and control of NCDs between different levels of healthcare, types of HFs, and regional settings.[31] Our study found that there was a notable lack of essential medicines and commodities for NCDs in local HFs, similar to findings reported by other studies.[32,33] Several other studies have shown that the essential medicines, especially those for NCDs, are less available in LMICs compared to medicines for acute illnesses. Furthermore, the availability of these drugs is lower in the local HFs compared to the private hospitals. This disparity in availability can be attributed to various factors such as inadequate financial resources for purchasing medicines, inaccurate forecasting of drug requirements, ineffective procurement processes, and inefficient distribution systems in the public sector.[34–36] The shortages of essential medicines and commodities were often accompanied by the shortages/lack of training of the staff, which further hindered access to proper medical care for patients; which has also been the case for a study done in Nepal using the 2015 health facility survey data.[24] This is a cause for concern as it can negatively impact the health outcomes of individuals suffering from NCDs.[37] It is crucial to stress the relationship between the availability of drugs and supplies, and the training of health care professionals. For instance, even if trained personnel were available to provide services, a lack of drugs and supplies will prevent the health professional from providing quality healthcare, and the other way around.[38] Therefore, there is an urgent need to address the scarcity of both trained personnel and medicines, since doing so might assist to enhance management to improve the processes and strategies used to manage and distribute healthcare resources effectively and efficiently.

Within South Asian regions, differences regarding the lack of trained personnel, availability of essential medicines and commodities and guidelines in service-specific readiness have also been documented.[39] A systematic review carried out with studies from resource poor setting demonstrated that healthcare systems have been negatively impacted by insufficient supply of medication, equipment, and trained healthcare personnel.[40] The region's progress in the management and prevention of NCDs has been hampered by the widespread absence of key resources. According to a recent report by the WHO, most countries, particularly LMICs, failed to achieve the global targets set for NCDs progress in 2020. This report, which evaluated data from 194 countries, highlights the pressing need for increased global efforts in NCDs prevention and control.[41]

Alongside the issues discussed, Nepal's health system does have the potential to effectively address NCDs. Nepal has implemented policies and strategies, developed treatment guidelines and protocols, an essential drug list, a multisectoral plan for NCDs prevention, surveillance and prevention strategic planning, and an action plan for NCDs. These findings suggest that Nepal should strengthen and orient health systems for the prevention and control of NCDs and strengthen supervision and monitoring as aligned with the action plan for the prevention and control of NCDs. [25] The disparities identified across various diseases and healthcare types and levels, as well as the noticeable differences in availability between urban and rural areas, along with a lack of basic

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medicines and supplies, underline the importance of an all-inclusive approach to upgrading healthcare facilities' ability to deliver successful NCDs interventions. Also, the findings point to enhancing the management of NCDs by increasing the capacity of the healthcare workforce, which is crucial. This can be achieved by providing more training opportunities for healthcare professionals and expanding the number of clinicians skilled in managing NCDs. It will be impossible to achieve global NCDs targets by 2025, as part of the Sustainable Development Goals (SDGs) by 2030, without significant efforts in both policies and programs. Therefore, it is imperative to take immediate action to enhance the provision of NCD services in both public and private HFs in Nepal.

This study has several strengths such as a) use of a nationally representative sample that enables us to generalize the study findings throughout Nepal, b) use of a validated survey tool and presence of adequate quality control and implementation strategies including recruitment strategies, data collection and data analysis) in the survey ensures the internal validity of the study findings, and c) use of appropriate statistical procedures to account for complex sampling procedures and non-responses. There are some potential limitations to consider in this study. Firstly, as the survey was carried out during the time of COVID-19 pandemic, there could be some level of impact due to pandemic on the availability of tracer items and readiness of the HFs. Secondly, this study lacks readiness of HFs for cancer and chronic kidney diseases. Finally, this study lacks an important variable i.e., the number of CVDs, CRDs, DM and MH patients seeking care each month from the HFs which is important to understand the patient burden in HFs which impacts the readiness of HFs.

Implication for managers or decision makers

The study has important implications for managers and decision-makers in the health sector in Nepal. First, decision-makers should prioritize improving the readiness of HFs to provide NCDs related services, particularly at the peripheral level. This can be achieved through increased investment in health infrastructure, equipment, and essential medicines. Second, there is a need to increase the number of qualified health staff and provide training on NCDs prevention, screening, and management. Managers should explore innovative approaches such as telemedicine and task-shifting to enhance access to NCDs related services in remote areas. Third, strengthening the supply chain system and improving the forecasting of drug requirements would ensure the availability of essential medicines for NCDs management. Finally, policymakers and managers should promote public-private partnerships to improve the quality of care provided in the private sector, which was found to have higher readiness for NCDs related services than the public sector. These measures would help to enhance the overall readiness of the health system to provide NCDs related services and improve the health outcomes of the population.

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Conclusions

Readiness of local HFs to provide NCDs related services in Nepal is relatively poor compared to federal/provincial hospitals with the guidelines and staff training being the weakest domain. HFs that are ready are very low among federal/provincial hospital, local HFs and private hospitals. The readiness of HFs to provide different NCDs related services are associated with presence of external supervision, quality assurance activities, review of client opinion. This highlights the need for improving service delivery platforms and enhancing the overall readiness of the health system to provide NCDs related services. To address this issue, increasing the number of qualified health staff, providing training on NCDs prevention, screening, and management, and supplying essential equipment and medicines are essential steps that should be taken. Policymakers and health system stakeholders should prioritize addressing the gaps in readiness and strengthening the capacity of local HFs to provide NCDs related services. Such efforts would help to improve the overall health outcomes of the population and promote health equity in Nepal.

Acknowledgement

We would like to acknowledge DHS program for providing us data for further analysis and we are grateful to those who directly or indirectly contributed us and motivated us to conduct this study.

Contributors

BA and ARP were responsible for conceptualization, data acquisition, formal analysis, methodology, validation, writing-original draft, and writing review & editing. SCB, DJ, and SR were responsible for supervision and validation, writing-original the draft, and writing-review & editing. BL, SPKC, and SG were responsible for formal analysis, writing-original draft, and writing review & editing.

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Competing interests

We authors have no competing interest associated with this paper.

Patient consent for publication: Not required as this study involves secondary data analysis.

Ethical approval: The original 2021 NHFS survey was approved by the Institutional Review Board of ICF International, USA, and by the Ethical Review Board of Nepal Health Research Council (NHRC), Nepal (Reference number: 733/2020).[13]

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Data availability statement

The data is available publicly in the open-access repository. The data can be downloaded from the official website of "The Demographic and Health Surveys" program (https://dhsprogram.com/data/dataset/Nepal_SPA_2021.cfm?flag=0).[12]

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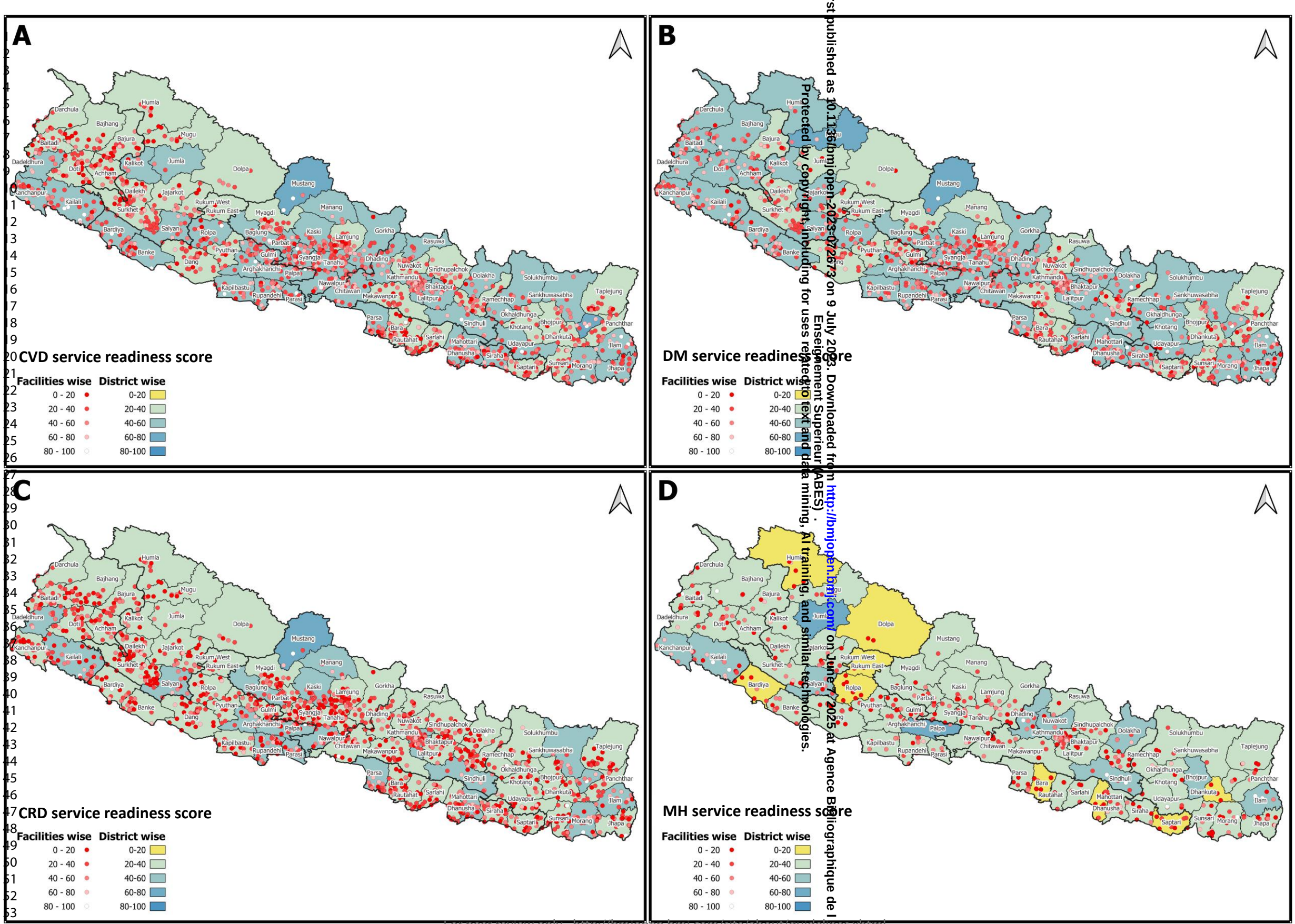

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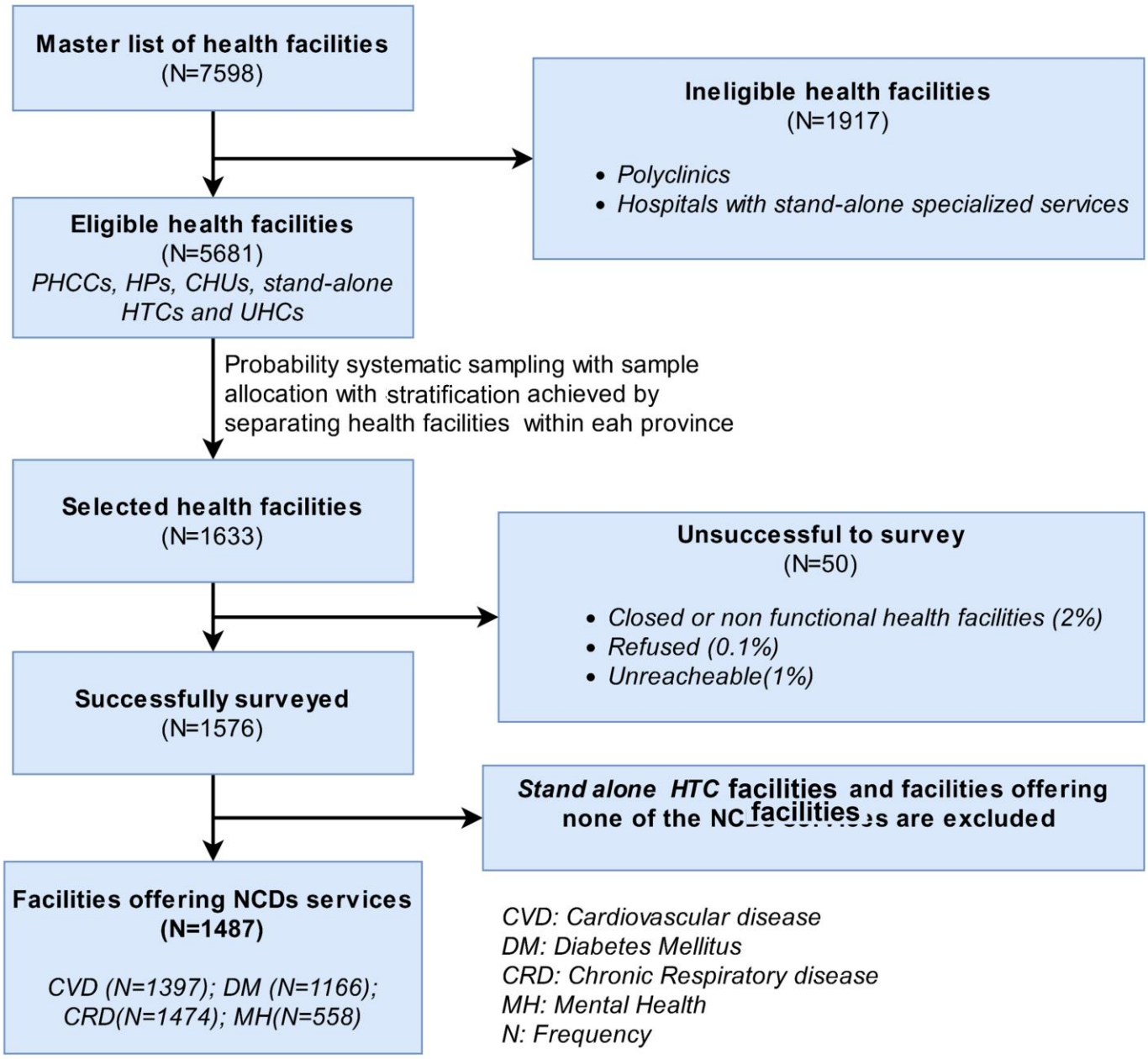

Supplementary Figure 1: Flowchart showing sample and sampling process

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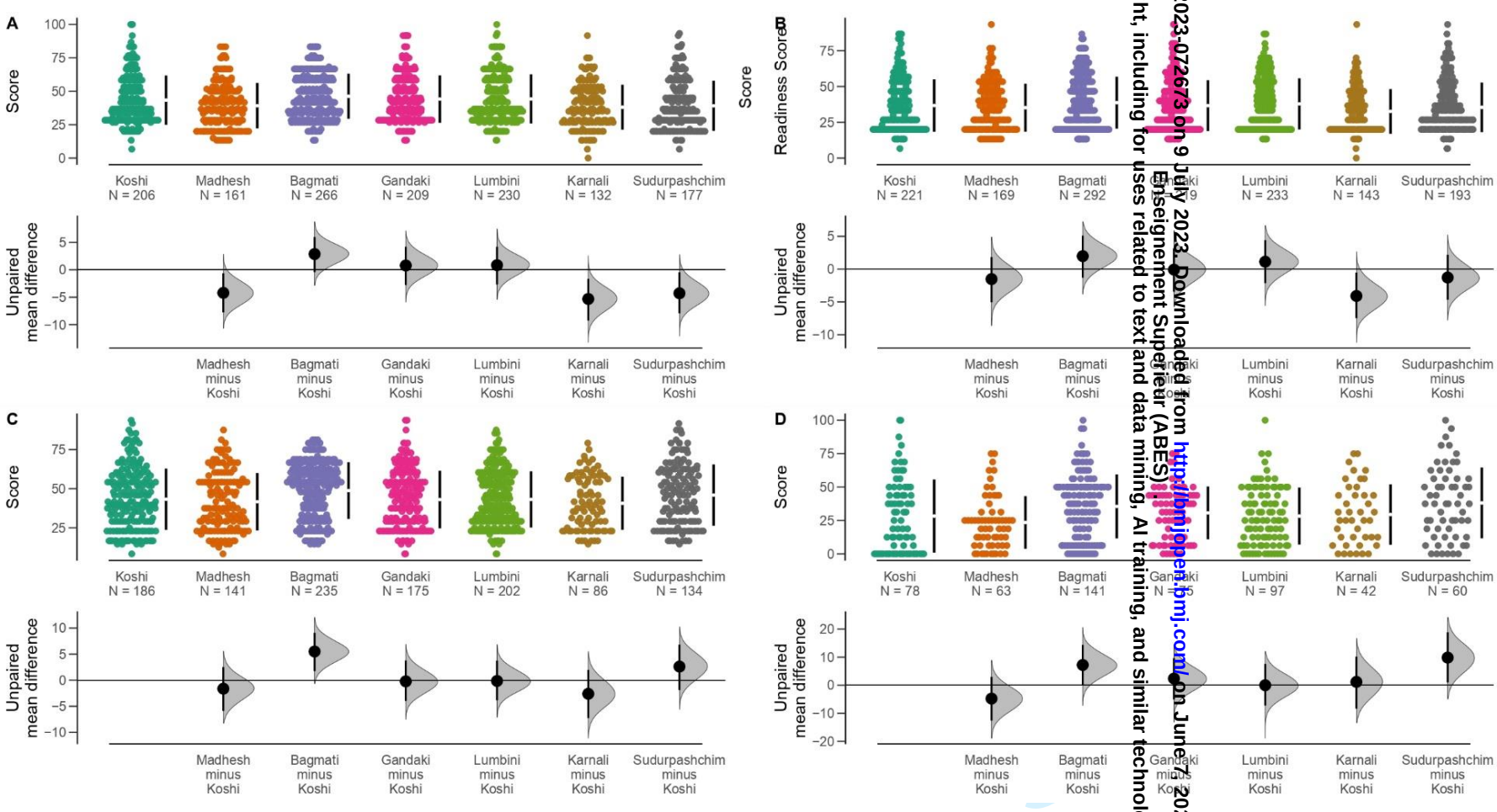

Supplementary Figure 2: Gardner-Altman estimation plots for comparing mean readiness scores of health facilities offering A) CVD-related services, B) CRD-related services, C) DM-related services, and D) MH-related services by province.

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Supplementary Table 1: Summary of items of each domain and measurement procedure of readiness of health facilities offering different non-communicable diseases-related services

Cardiovascular diseases related services					
Domain	**Indicators**	**Measure**	**Recode**	**Calculation of score**	
				Domain wise score	**Total score**
Guidelines and training	Guidelines (a1)	Yes	1	A=(a1+b1)/2*100	(A+B+C)/3
		No	0		
	Staff training (b1)	Yes	1		
		No	0		
Equipment	Stethoscope (c1)	Yes	1	B=(c1+d1+e1+f1+g1)/5*100	
		No	0		
	Blood pressure (d1)	Yes	1		
		No	0		
	Adult weighing scale (e1)	Yes	1		
		No	0		
	Oxygen (f1)	Yes	1		
		No	0		
	Pulse oximeter (g1)	Yes	1		
		No	0		
Medicines	Amlodipine/nifedipine (h1)	Yes	1	C=(h1+i1+j1+k1)/4*100	
		No	0		
	Beta-blockers (atenolol) (i1)	Yes	1		
		No	0		
	Aspirin (j1)	Yes	1		
		No	0		
	Thiazide (k1)	Yes	1		
		No	0		

Diabetes-related services					
Domain	**Indicators**	**Measurement**	**Recode**	**Calculation of score**	
				Domain wise score	**Total score**
Guidelines and training	Guidelines (a2)	Yes	1	A=(a2+b2)/2*100	(A+B+C)/3
		No	0		
	Staff training (b2)	Yes	1		
		No	0		
Equipment	Blood pressure (c2)	Yes	1	B=(c2+d2+e2)/3*100	
		No	0		
	Adult weighing scale (d2)	Yes	1		
		No	0		
	Height board/stadiometer (e2)	Yes	1		
		No	0		
Medicines	Metformin (f2)	Yes	1	C=(f2+g2+h2+j2)/4*100	
		No	0		
	Glibenclamide (g2)	Yes	1		
		No	0		
	Injectable insulin (h2)	Yes	1		
		No	0		
	D. Injectable glucose solution (j2)	Yes	1		
		No	0		

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Diagnostics	Blood glucose (k2)	Yes	1	D=(k2+I2+m2)/3*100	
		No	0		
	Urine Glucose (l2)	Yes	1		
		No	0		
	Urine Protein (m2)	Yes	1		
		No	0		

Chronic Respiratory Diseases related services

Domain	Indicators	Measurement	Recode	Calculation of score	
				Domain wise score	Domain wise score
Guidelines and training	Guidelines (a3)	Yes	1	A=(a3+b3)/2*100	Score=(A+B+C)/3
		No	0		
	Staff training (b3)	Yes	1		
		No	0		
Equipment	Stethoscope (c3)	Yes	1	B=(c3+d3+e3+f3)/4*100	
		No	0		
	Oxygen Flowmeter (d3)	Yes	1		
		No	0		
	Spacer for inhalers (e3)	Yes	1		
		No	0		
	Oxygen (f3)	Yes	1		
		No	0		
Medicines	Salbutamol inhaler (g3)	Yes	1	C=(g3+h3+i3+j3+k3+l3+m3)/7*100	
		No	0		
	Beclomethasone inhaler (h3)	Yes	1		
		No	0		
	Prednisolone cap/tabs (i3)	Yes	1		
		No	0		
	Hydrocortisone injection (j3)	Yes	1		
		No	0		
	Epinephrine injectable (k3)	Yes	1		
		No	0		
	Salbutamol inhaler (l3)	Yes	1		
		No	0		
	Beclomethasone inhaler (m3)	Yes	1		
		No	0		

Mental Health related services

Domain	Indicators	Measurement	Recode	Calculation of score	
				Domain wise score	Total Score
	Guidelines (a4)	Yes	1	A= (a4+b4)/2*100	(A+B)/2
		No	0		
	Staff training (b4)	Yes	1		
		No	0		
Medicines	Amitriptyline (c4)	Yes	1	B= (c4+d4+e4+f4+g4+h4+i4+j4)/8*100	
		No	0		
	Fluoxetine (d4)	Yes	1		
		No	0		
	Carbamazepine (e4)	Yes	1		
		No	0		
		Yes	1		

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	Phenobarbitone (f4)	No	0		
	Sodium valproate (g4)	Yes	1		
		No	0		
	Respiridone (h4)	Yes	1		
		No	0		
	Alprazolam (i4)	Yes	1		
		No	0		
	Diazepam (j4)	Yes	1		
		No	0		

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	4-5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*7-8*
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8-9
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	10-18

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Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-18
		(*b*) Report category boundaries when continuous variables were categorized	10-18
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	No
Discussion			
Key results	18	Summarise key results with reference to study objectives	19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	21
Generalisability	21	Discuss the generalisability (external validity) of the study results	21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Readiness of health facilities to provide services related to non-communicable diseases in Nepal: Evidence from nationally representative Nepal Health Facility Survey 2021

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Readiness of health facilities to provide services related to non-communicable diseases in Nepal: Evidence from nationally representative Nepal Health Facility Survey 2021

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Abstract

Objective: To assess the readiness of public and private health facilities (HFs) in delivering Non-Communicable Diseases (NCDs) related services in Nepal.

Methods: We analyzed data from nationally representative Nepal Health Facility Survey 2021 to determine the readiness of HFs for Cardiovascular Diseases (CVDs), Diabetes Mellitus (DM), Chronic Respiratory Diseases (CRDs), and Mental Health (MH) related services using Service Availability and Readiness Assessment Manual of the World Health Organization. Readiness score was measured as the average availability of tracer items in percent, and HFs were considered "ready" for NCDs management if they scored ≥70 (out of 100). We performed weighted univariate and multivariable logistic regression to determine association of HFs readiness with province, type of HFs, ecological region, quality assurance activities, external supervision, client's opinion review, and frequency of meetings in HFs.

Results: The overall mean readiness score of HFs offering CRDs, CVDs, DM, and MH-related services were 32.6, 38.0, 38.4, and 24.0 respectively. Guidelines and staff training domain had the lowest readiness score, whereas essential equipment and supplies domain had the highest readiness score for each of the NCDs-related services. A total of 2.3%, 3.8%, 3.6%, and 3.3% HFs were ready to deliver CRDs, CVDs, DM, and MH-related services respectively. Local HFs were less likely to be ready to provide all NCDs-related services compared to federal/provincial hospitals. HFs with external supervision were more likely to be ready to provide CRDs and DM-related services and HFs reviewing client's opinions were more likely to be ready to provide CRDs, CVDs, and DM-related services.

Conclusion: Readiness of the local HFs and private hospitals to provide CVDs, DM, CRDs, and MH-related services were relatively poor compared to federal/provincial hospitals. Prioritization of policies to reduce the gaps in readiness and capacity strengthening of the local HFs is essential for improving their overall readiness to provide NCDs-related services.

Keywords: *cardiovascular; chronic respiratory disease; diabetes mellitus; health facilities; mental health; readiness; Nepal*

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Strengths and limitations of this study

- Nationally representative sample of health facilities in Nepal, with coverage of all seven provinces and 77 districts
- The survey has adopted a highly standardized survey tool with the globally accepted research protocol.
- Variables for readiness analysis are based on standardized WHO's SARA guidelines and thus, findings are comparable to findings from other countries.
- Weighted analysis has been performed to account for the complex sampling procedures and adjusts for non-response and disproportionate sampling.
- The limitations of the study is that this study doesn't determine the readiness of HFs for cancer and chronic kidney diseases and this study doesn't account flow rate of NCD patients in the HFs.

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Introduction:

Globally, Non-Communicable Diseases (NCDs) is one of the major public health and development challenges. According to World Health Organization (WHO), NCDs are the leading cause of death worldwide killing 41 million people each year equivalent to 71% of all deaths globally. By 2030, the projected number is expected to increase to 52 million.[1] Approximately, 80% of NCD-related deaths occur in low- and middle-income countries (LMICs).[2] In Southeast Asia, NCDs account for 9 million deaths (62% of all deaths) each year.[3]

In Nepal, NCDs have emerged as the leading cause of premature mortality and Disability Adjusted Life Years (DALYs). In 2019, NCDs were responsible for 71.1% of deaths,[4] and are projected to attribute for 78.6% of total deaths by 2040.[4] In 2019, Cardiovascular Diseases (CVDs), Chronic Respiratory Diseases (CRDs), and cancer were the top three leading causes of death, attributing to approximately 24.0%, 21.1%, and 11.2% of total deaths, respectively. Together, these three conditions are responsible for more than half of the total deaths in Nepal.[5]

Sustainable Development Goal (SDG) 3.4 targets to reduce the premature mortality from NCDs by two-third by 2030 through prevention and treatment.[6] To achieve SDG goal, Nepal adopted, contextualized, and implemented the Package of Essential Non-Communicable Diseases (PEN) to screen, diagnose, treat, and refer major NCDs such as CVDs, Diabetes Mellitus (DM), CRDs, cancer, and mental health (MH) at health posts, primary health care centers (PHCCs), and district hospitals.[7] The PEN package has now been expanded to all 77 districts of Nepal.[8] Moving a step further, the PEN Implementation Plan (2016-2020) was developed in accordance with the Multi-sectoral Action Plan for NCDs Prevention and Control (2014-2020).[8] Nepal Multi-Sectoral Action Plan for NCDs (2021-2025) focuses on creating high-impact, politically and socially acceptable, and potentially implementable interventions. The plan aims to reduce the burden of NCDs through the whole-of-government and whole-of-society approach. The action plan has an overarching target of reducing premature mortality from NCDs by 25% by 2025 and by one-third by 2030, aligning to global SDG goal.[8,9] The NCD action plan envisions to achieve 80% availability of cheap basic technologies and necessary medications, including generics, needed to treat major NCDs in both public and private health facilities. The multi-sectoral action plan involves medication therapy and counseling (including glycemic management) for 50% of eligible persons (defined as those aged 40 and older with a 10-year cardiovascular risk of more than 30%, including those with established CVDs).[9]

NCDs services have been included in basic health care in Nepal although the service availability and preparedness remain very limited.[10] Apart from disease-specific interventions, Nepal Lancet NCDI poverty commission has pointed out the need for improving governance, strengthening health systems, and monitoring of priority NCDs such as CVDs, CRDs, DM and cancer by provincial and local government.[11] The commission also recommended that structured capacity-building programs for health service providers; promoting care packages, such as the PEN

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interventions for primary health care; increasing the availability of specialty services and personnel; and expanding progressive vertical programs providing free care for disease-specific areas could be useful in improving service availability and preparedness for NCDs.[11]

The increasing burden of NCDs in Nepal is often not matched with the sufficient healthcare response. There is a need to generate evidence to uncover gaps in NCDs service readiness to facilitate evidence informed policy making to improve the service availability and uptake.[10,12] Thus, we aim to determine readiness of public and private health facilities (HFs) of Nepal to provide CRDs, CVDs, DM, and MH related services using nationally representative data from Nepal Health Facility Survey (NHFS) 2021.

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Methods:

Study Design

We analyzed secondary data[13] from the nationally representative cross-sectional survey, NHFS 2021, carried out by New Era with technical support of ICF International, to assess the availability and readiness of HFs to provide services related to NCDs namely, CVDs, CRDs, DM and MH. The detailed information on objectives and methodology of NHFS 2021 is published elsewhere.[14] NHFS 2021 was carried out among both public HFs and private hospitals of Nepal. In Nepal, health services are delivered by public HFs, private HFs and other community based or NGO-run clinics, medical centers, mission hospitals, teaching hospitals. The public HFs deliver health services in three levels: federal, provincial, and local level. The local health system includes primary hospitals, PHCCs, health post, basic health care centers, urban health clinics, community health units and community level HFs (Primary Health Care Outreach clinics and Expanded Program on Immunization (EPI) clinics). Health posts are the first institutional contact point for basic health services. The provincial and federal level health system includes provincial level and central level hospitals respectively providing secondary to tertiary level care. Each level above health post is a referral point in network ranging from PHCC to primary and secondary level hospitals and finally to tertiary level hospitals. The private HFs including private hospitals, clinics, and pharmacies, deliver basic health services to tertiary level care.[14–16]

Sample and Sampling

A stratified random sample of 1,633 HFs out of 5,681 eligible HFs were selected in 2021 NHFS. The flowchart showing details of sample and sampling is present in **Supplementary figure 1**. The process of sample size estimation and sampling procedures are explained in detail elsewhere.[14] We analyzed data of 1480 HFs offering any NCDs services out of which 1470 were offering CRDs services, 1381 HFs were offering CVDs services, 1159 were offering DM services and 556 HFs were offering MH services.

Data collection

Data collection for 2021 NHFS took place between January 27, 2021, and September 28, 2021, with a break for three months from May through July, due to the COVID-19 imposed lockdowns beginning on April 29, 2021. The 2021 NHFS included the use of four types of survey instruments: a) Facility Inventory Questionnaire, b) Health Provider Questionnaire, c) Exit Interview Questionnaires, and d) Observation protocols for antenatal care, family planning services, care for sick children, and labor and delivery. For this study, we have used the data from "Facility Inventory Questionnaire", and "Health Provider Questionnaire".

Patient and public involvement

This article is prepared analyzing secondary data sources. There was no patient and public involvement in the design, conduct and reporting of our research.

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Outcome variables and measurement

The variables for services availability and readiness of HFs to provide NCDs-related facilities were selected based on the WHO Service Availability and Readiness (SARA) manual.[17]

Services Readiness: The service readiness of HFs was measured based on the availability and functioning of items categorized under three domains- staff and guidelines, essential equipment, and supplies, medicine and commodities and diagnostics. The list of tracer items of each domain for CRDs, CVDs, DM and MH and process of calculation of readiness score are presented in the **Supplementary table 1**. The readiness score of HFs to provide services on CVDs, CRDs, DM, and MH were calculated using the SARA manual of the World Health Organization.[17] The availability of tracer items is measured based observation of each tracer items by interviewer. The items in each domain were re-coded as binary variables, taking the value "1" for the presence of the item and "0" for the absence of the item in the facility. To compute the mean score for each domain, the sum of the scores for each item was divided by the number of items, and the result was multiplied by 100. Each domain included in score calculation contributes equally to the overall readiness score. The average score from the three domains was the readiness score. A cutoff of 70 was considered on the overall score to classify the readiness of the facilities towards NCDs-related services. A facility with an overall score of more than or equal to 70 was considered "ready" to manage NCDs.[18–20]

Independent variables: The independent variables included setting (rural/urban), ecological region (Hill/Mountain / Terai), province (Koshi/ Madhesh / Bagmati / Gandaki /Lumbini / Karnali /Sudurpaschim), type of facility (federal or provincial hospital/local HFs/private hospital), presence of external supervision in the past four months (present/absent), quality assurance activities (performed /not performed) and the frequency of health facility meeting (none/sometimes/monthly).

The classification of setting into rural and urban was based on the type of municipalities in which HFs are located.[14] The type of HFs were classified into federal or provincial hospital, local HFs and private hospitals where local HFs comprised of local hospitals, health posts and PHCCs. The facility was considered to have external supervision if facility staff or members reported receiving of any external supervision/monitoring from the federal, provincial or municipal level in the past four months prior to survey and interviewer observed associated documentation.[14] Facility were considered to have performed quality assurance activities if staff or members from health facility reported carrying out quality assurance activities routinely and the interviewer observed documentation of a recent quality assurance activity including report or minutes of a quality assurance meeting, a supervisory checklist, a mortality review, or an audit of records or registers.[14] For the frequency of health facility meeting, the health facilities stating "no" for routine management/administrative meetings were classified as "None", those stating "monthly or more often" were classified as "Monthly" and those stating "irregular or every 2-6 months" were classified as "Sometimes".[14] HFs were considered to have reviewed client's opinion if staff or

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members of health facility reported presence of the system for determining client opinion, procedure for reviewing client opinion, and interviewer observed report of a recent review of client opinion.[14]

Statistical Analysis: We used R (version 4.2.0)[21] and RStudio (version 2023.03.1 build 446)[22] for statistical analysis. We used "survey" package[23] and performed weighted analysis to account for the complex survey design of NHFS 2021. We summarized continuous variables with mean, standard deviation (SD), median and interquartile range (IQR) whereas categorical variables were summarized with frequency, percent, and 95% confidence interval (95% CI) around the percent. We created the maps using Quantum Geographic Information System (QGIS) version 3.22.7-Białowieża [24], with publicly available district-wise shape file taken from official website of Survey department of Ministry of Land Management, Cooperatives and Poverty Alleviation, Government of Nepal, and Global Positioning system (GPS) dataset of the HFs. We employed univariate and multivariate weighted logistic regression analysis to determine the association of the readiness of HFs to CRDs, CVDs, DM and MH-related services with independent variables including setting, ecological region, province, type of facility, external supervision, quality assurance activities, review of client opinion, and HFs meeting. The results of regression analysis are presented as crude odds ratio (COR) and adjusted odds ratio (AOR) with 95% confidence interval (CI) and p-value. A p-value of less than 0.05 is considered statistically significant.

Results

Of the total facilities offering any NCDs (CRDs, CVDs, DM or MH) related services, 46.7% were from rural areas. Half of the HFs offering any NCDs-related services were from hill region (52.7%) followed by terai region (34.4%). HFs providing NCDs-related services were highest in Bagmati accounting for 20.5% followed by Madhesh (16.1%), Koshi (15.7%) and Lumbini (15.7%). The quality assurance activities were performed in 23.9%, external supervision in past 4 months was present in 66.4%, review of client's opinion in 3.8% and monthly health facility meeting was carried out in 65.0% of the HFs offering any NCDs related services. (*Table-1*)

Table 1: Characteristics of the facilities offering anyone of four NCDs related services.

Characteristics	Unweighted (n=1480)	Weighted (n=1516)	
	n (%)	n	% (95%CI)
Location			
Urban	946 (63.9)	808	53.3 (49.5 to 57.1)
Rural	534 (36.1)	708	46.7 (42.9 to 50.4)
Ecological Region			
Hill	794 (53.6)	800	52.7 (48.9 to 56.5)

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Mountain	178 (12.0)	196	12.9 (10.7 to 15.5)
Terai	508 (34.4)	521	34.4 (30.8 to 38.2)
Province			
Koshi	227 (15.3)	238	15.7 (13.0 to 18.8)
Madhesh	169 (11.4)	245	16.1 (13.1 to 19.7)
Bagmati	294 (19.9)	311	20.5 (17.6 to 23.7)
Gandaki	219 (14.8)	197	13.0 (10.8 to 15.5)
Lumbini	235 (15.9)	238	15.7 (13.2 to 18.5)
Karnali	143 (9.7)	119	7.9 (6.4 to 9.7)
Sudurpaschim	193 (13.0)	169	11.1 (9.3 to 13.2)
Type of facility			
Federal/Provincial hospital	97 (6.6)	27	1.8 (1.5 to 2.2)
Local HFs	1,128 (76.2)	1,376	90.7 (89.2 to 92.0)
Private Hospital	255 (17.2)	113	7.5 (6.3 to 8.9)
Quality assurance activities			
Not Performed	1,182 (79.9)	1,153	76.1 (72.6 to 79.2)
Performed	298 (20.1)	363	23.9 (20.8 to 27.4)
External Supervision			
No	561 (37.9)	509	33.6 (30.2 to 37.2)
Yes	919 (62.1)	1007	66.4 (62.8 to 69.8)
Review client's opinion			
Not reviewed	1,394 (94.2)	1459	96.2 (94.7 to 97.3)
Reviewed	86 (5.8)	58	3.8 (2.7 to 5.3)
Frequency of health facility meeting			
None	264 (17.8)	225	14.8 (12.5 to 17.5)
Sometimes	302 (20.4)	306	20.2 (17.4 to 23.3)
Monthly	914 (61.8)	985	65.0 (61.4 to 68.4)
Total Health workforce [1]	41.0 (123.1); 7.0 (3.0,20.2)	18.7±73.5; 6.0 (5.0, 9.0)	
Services availability			
CRDs	1470 (99.3)	1507	99.3 (98.3 to 99.7)

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CVDs	1381 (93.3)	1411	93.1 (90.9 to 94.7)
DM	1159 (78.3)	1149	75.8 (72.4 to 78.8)
MH	556 (37.6)	394	26.0 (23.0 to 29.2)

[1] Mean±SD; Median (IQR)
CVD: Cardiovascular Diseases; DM: Diabetes Mellitus; CRDs: Chronic Respiratory Diseases; MH: Mental Health; %: Percent; n: frequency; SD: standard deviation; IQR: interquartile range (1st quartile,3rd quartile); CI: Confidence Interval;

Table 2 presents the overall readiness score of HFs offering CRDs, CVDs, DM, and MH-related services (Mean±SD) which were 32.6±14.7, 38.0±15.5, 38.4±16.7, and 24.0±23.1 respectively. The overall readiness score for each NCDs related service was higher in federal or provincial hospitals followed by private hospital and lowest in the local HFs.

The median readiness score for guidelines and staff training domain was zero for all NCDs related services. The mean readiness score for essential equipment and supplies domain for CRDs, CVDs, and DM-related services were 49.1±17.8, 72.4±17.9, and 76.4±18.8 respectively and was highest in three sets of facilities offering CRDs, CVDs and DM related services. Similarly, the median readiness score for medicine and supplies domain among facilities offering CRDs, CVDs, DM and MH related services were 40.0 (IQR: 20.0, 40.0), 25.0 (IQR: 0.0, 50.0), 25.0 (IQR: 25.0, 50.0). and 12.5 (IQR: 0.0, 62.5) respectively. The median readiness score for diagnostic domain among facilities offering DM related services was zero (IQR: 0.0, 66.7).

Among HFs offering CRDs, CVDs, DM and MH related services, 2.3% (95% CI: 1.6 to 3.3), 3.8% (95% CI: 2.8 to 5.3), 3.6% (95% CI: 2.6 to 5.1) and 3.3% (95% CI: 1.8 to 6.1) were ready to deliver respective services. Among federal or provincial hospitals, 19.5%, 16.4%, 22.6% and 13.4% were ready to provide CRDs, CVDs, DM and MH related services respectively.

Among private hospitals, 7.9%, 11.1%, 10.2% and 3.1% were ready to deliver CRDs, CVDs, DM and MH-related services respectively. Among local HFs, 1.5%, 2.9%, 2.4% and 2.5% were ready to provide CRDs, CVDs, DM, and MH-related services respectively which was relatively lower compared to federal or provincial hospitals.

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Table-2: Readiness of facilities for services related to NCDs.

Tracer items	Total facilities		Federal or provincial hospitals		Local HFs		Private hospitals	
	% (95% CI)	Score[1]	95% CI	Score[1]	95% CI	Score[1]	95% CI	Score[1]
Chronic Respiratory Disease (CRDs)								
Guidelines and Training								
Guidelines	11.0 (8.9 to 13.6)	12.4±26.4; 0.0 (0.0, 0.0)	15.3 (9.4 to 24.1)	20.1±31.1; 0.0 (0.0, 50.0)	11.1 (8.8 to 13.8)	12.7±26.8; 0.0 (0.0, 0.0)	9.7 (5.3 to 17.2)	6.7±17.9; 0.0 (0.0, 0.0)
Staff Training	13.7 (11.3 to 16.5)		24.8 (17.1 to 34.6)		14.3 (11.7 to 17.4)		3.2 (2.0 to 6.6)	
Essential Equipment and Supplies								
Stethoscope	98.4 (97.1 to 99.2)	49.1±17.8; 40.0 (40.0, 60.0)	98.0 (92.0 to 99.5)	72.4±22.8; 80.0 (45.5, 80.0)	98.5 (96.9 to 99.2)	46.4±14.8; 40.0 (40.0, 40.0)	98.8 (96.0 to 99.2)	76.7±21.0; 80.0 (60.0, 100.0)
Oxygen Flow meter	16.7 (14.3 to 19.4)		59.9 (49.7 to 69.3)		11.7 (9.4 to 14.5)		56.5 (58.5 to 73.9)	
Oxygen	26.2 (23.1 to 29.5)		74.2 (64.4 to 82.1)		20.8 (17.6 to 24.3)		78.2 (72.8 to 85.8)	
Spacers	6.8 (5.3 to 8.6)		32.0 (23.3 to 42.1)		3.5 (2.3 to 5.3)		39.1 (31.2 to 48.8)	
Essential Medicines								
Salbutamol	90.8 (88.6 to 92.7)	36.5±22.3; 40.0 (20.0, 40.0)	90.7 (83.0 to 95.2)	75.4±21.3; 80.0 (60.0, 80.0)	92.3 (89.8 to 94.2)	33.3±18.5; 20.0 (20.0, 40.0)	72.9 (65.5 to 80.2)	65.4±32.3; 80.0 (40.0, 100.0)
Beclomethasone	3.9 (3.0 to 5.1)		27.8 (19.7 to 37.7)		1.1 (0.6 to 2.1)		33.1 (25.1 to 41.5)	
Prednisolone	13.1 (11.2 to 15.3)		80.3 (71.0 to 87.2)		7.3 (5.6 to 9.5)		67.2 (58.7 to 75.2)	
Hydrocortisone	36.6 (33.1 to 40.2)		92.6 (85.2 to 96.5)		31.6 (27.9 to 35.5)		83.1 (76.3 to 89.0)	
Epinephrine	37.9 (34.3 to 41.6)		85.5 (76.8 to 91.3)		34.3 (30.5 to 38.3)		70.2 (61.7 to 76.9)	
Overall Readiness Score[1]	32.6±14.7; 26.7 (20.0, 40.0)		56.0±14.3; 53.3 (46.7 to 65.6)		30.8±13.2; 26.7 (20.0, 36.7)		49.6±15.9; 46.7 (40.0, 60.0)	
HFs with readiness score >70, % (95%CI)	2.3 (1.6 to 3.3)	-	19.5 (12.7 to 28.7)		1.5 (0.9 to 2.4)		11.1 (7.3 to 15.7)	
Cardiovascular Disease (CVDs)								
Guidelines and Training								
Guidelines	11.2 (9.1 to 13.8)	12.1±25.6; 0.0 (0.0, 0.0)	17.4 (11.0 to 26.4)	19.0±30.9; 0.0 (0.0, 50.0)	11.2 (8.9 to 14.1)	12.3±26.0; 0.0 (0.0, 0.0)	9.8 (5.3 to 17.4)	7.7±18.8; 0.0 (0.0, 0.0)
Staff Training	12.9 (10.5 to 15.8)		20.7 (13.6 to 30.1)		13.4 (10.8 to 16.5)		5.6 (3.5 to 8.9)	
Essential Equipment and Supplies								
BP apparatus	96.2 (94.2 to 97.5)	72.4±17.9; 60.0 (60.0, 80.0)	95.9 (89.3 to 98.5)	89.9±18.5; 100.0 (80.0, 100.0)	96.1 (93.8 to 97.5)	70.2±16.8; 60.0 (60.0, 80.0)	97.1 (94.7 to 98.5)	92.5±14.8; 100.0 (80.0, 100.0)
Stethoscope	98.4 (96.9 to 99.2)		98.0 (92.0 to 99.5)		98.4 (96.8 to 99.2)		98.1 (95.9 to 99.2)	
Weighing scale	95.1 (93.2 to 96.5)		95.9 (89.3 to 98.5)		95.2 (93.0 to 96.7)		94.1 (90.7 to 96.3)	
Pulse Oximeter	44.5 (40.7 to 48.4)		85.6 (76.9 to 91.3)		39.4 (35.4 to 43.7)		92.1 (86.6 to 96.0)	
Oxygen	27.6 (24.4 to 31.1)		74.2 (64.4 to 82.1)		22.0 (18.6 to 25.7)		80.7 (73.2 to 86.2)	
Essential Medicines								
Thiazide	6.7 (5.5 to 8.3)	29.6±26.2; 25.0 (0.0, 50.0)	45.2 (35.5 to 55.4)	71.1±28.1; 75.0 (50.0, 100.0)	2.9 (1.9 to 4.2)	25.9±21.8; 25.0 (0.0, 45.0)	41.9 (33.0 to 50.1)	62.3±37.8; 75.0 (25.0, 100.0)
Atenolol	32.4 (28.9 to 36.1)		68 (57.9 to 76.6)		29.3 (25.5 to 33.4)		58.7 (49.9 to 67.1)	
Aspirin	17.7 (15.3 to 20.4)		80.3 (71.0 to 87.2)		11.7 (9.4 to 14.5)		69.2 (61.3 to 77.2)	
Amlodipin	61.6 (57.7 to 65.4)		90.7 (83.0 to 95.2)		59.5 (55.2 to 63.6)		79.2 (71.7 to 85.0)	
Overall Readiness Score[1]	38.0±15.5; 35.0 (28.3, 45.0)		60.0±14.6; 59.1 (50.0, 66.7)		36.1±14.2; 35.0 (28.3, 43.3)		54.2±16.1; 58.3 (41.7, 66.7)	
HFs with readiness score >70, % (95%CI)	3.8 (2.8 to 5.3)	-	16.4 (10.2 to 25.3)		2.9 (1.9 to 4.4)		11.1 (6.4 to 18.5)	
Diabetes Mellitus (DM)								
Guidelines and Training								
Guidelines	14.1 (11.4 to 17.3)	14.2±27.5; 0.0 (0.0, 0.0)	19.4 (12.7 to 28.7)	20.1±31.1; 0.0 (0.0, 50.0)	14.4 (11.5 to 18.0)	14.9±28.1; 0.0 (0.0, 0.0)	9.4 (5.1 to 17.0)	6.8±18.1; 0.0 (0.0, 0.0)
Staff Training	14.3 (11.6 to 17.5)		20.7 (13.6 to 30.1)		15.3 (12.2 to 18.9)		4.2 (2.4 to 7.0)	
Essential Equipment and supplies								
BP apparatus	96.8 (94.7 to 98.1)	76.0±19.3; 66.7 (66.7,	95.9 (89.3 to 98.5)	81.8±21.0; 100.0 (66.7,	96.8 (94.3 to 98.2)	75.6±19.1; 66.7 (66.7,	97.4 (94.8 to 98.6)	77.9±20.1; 66.7 (66.7, 100.0)
Height Board	36.2 (32.2 to 40.5)		53.6 (43.5 to 63.5)		35 (30.5 to 39.8)		42.1 (34.0 to 51.7)	

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Tracer items	Total facilities		Federal or provincial hospitals		Local HFs		Private hospitals	
	% (95% CI)	Score[1]	95% CI	Score[1]	95% CI	Score[1]	95% CI	Score[1]
Weighing Scale	95.0 (92.6 to 96.6)	100.0)	95.9 (89.3 to 98.5)	100.0)	95.1 (92.3 to 96.8)	100.0)	93.2 (90.5 to 96.2)	
Essential Medicines								
Metformin	65.6 (61.2 to 69.7)	34.1±22.6; 25.0 (25.0, 50.0)	91.8 (84.2 to 95.9)	65.9±23.1; 75.0 (50.0, 75.0)	63.8 (58.9 to 68.4)	30.8±19.2; 25.0 (25.0, 50.0)	75.4 (67.3 to 81.9)	56.7±30.1; 50.0 (50.0, 75.0)
Glibenclamide	4.4 (3.2 to 5.8)		26.7 (18.7 to 36.5)		2.2 (1.2 to 3.8)		18.4 (13.0 to 25.7)	
Injectable Insulin	7.5 (6.1 to 9.1)		49.4 (39.4 to 59.4)		1.5 (0.8 to 2.6)		50.3 (42.2 to 59.5)	
Injectable Glucose	59.2 (54.8 to 63.4)		95.9 (89.4 to 98.5)		55.6 (50.7 to 60.3)		81.4 (74.9 to 87.8)	
Diagnostics								
Test: Blood: Glucose	23.3 (20.0 to 27.0)	29.2±37.8; 0.0 (0.0, 66.7)	43.2 (33.6 to 53.4)	76.6±24.1; 66.7 (66.7, 100.0)	20.3 (16.7 to 24.3)	23.2±34.7; 0.0 (0.0, 33.3)	45.4 (37.2 to 54.4)	71.8±31.1; 66.7 (66.7, 100.0)
Test: Urine Glucose	32.6 (28.9 to 36.6)		92.8 (85.5 to 96.6)		25.1 (21.2 to 29.4)		84.4 (78.6 to 89.5)	
Test: Urine Glucose	31.8 (28.1 to 35.7)		93.8 (86.7 to 97.2)		24.2 (20.4 to 28.4)		84.4 (78.6 to 89.5)	
Overall Readiness Score[1]	38.4±16.7; 35.4 (22.9, 52.1)		61.3±13.3; 60.4 (52.1, 68.8)		36.1±15.5; 33.3 (22.9, 45.8)		53.3±15.7; 54.2 (45.8, 66.7)	
HFs with readiness score >70, % (95%CI)	3.6 (2.6 to 5.1)		22.6 (15.3 to 32.2)		2.4 (1.5 to 3.9)		9.4 (5.5 to 17.4)	
Mental Health (MH)								
Guidelines and Training								
Guidelines	11.9 (8.0 to 17.4)	17.6±28.3; 0.0 (0.0, 50.0)	10.0 (5.2 to 18.4)	23.0±30.2; 0.0 (0.0, 50.0)	12.6 (7.8 to 19.9)	20.1±29.8; 0.0 (0.0, 50.0)	14.4 (10.3 to 20.6)	7.1±18.0; 0.0 (0.0, 0.0)
Staff Training	23.4 (18.2 to 29.7)		35.9 (26.5 to 46.5)		27.5 (20.5 to 35.8)		4.2 (2.5 to 8.2)	
Essential Medicines								
Amitriptyline	49.5 (42.8 to 56.3)	30.3±32.2; 12.5 (0.0, 62.5)	80.8 (71.1 to 87.8)	66.2±29.9; 62.5 (37.5, 96.2)	41.6 (33.4 to 50.2)	20.8±25.8; 12.5 (0.0, 25.0)	67.6 (57.6 to 77.6)	53.4±34.0; 55.3 (25.0, 87.5)
Fluoxetine	23.6 (18.9 to 29.0)		58.4 (47.8 to 68.4)		15.6 (10.5 to 22.5)		41.1 (32.1 to 51.8)	
Carbamazepine	26.7 (21.5 to 32.6)		55.0 (44.4 to 65.1)		20.0 (14.0 to 27.7)		42.1 (32.3 to 52.4)	
Phenobarbitone	22.1 (17.7 to 27.2)		57.1 (46.5 to 67.2)		14.2 (9.6 to 20.6)		39.1 (30.4 to 49.9)	
Sodium Valproate	32.1 (26.5 to 38.2)		65.2 (54.5 to 74.5)		21.4 (15.3 to 29.0)		60.1 (50.3 to 69.9)	
Risperidone	20.9 (16.4 to 26.2)		55.0 (44.4 to 65.1)		13.6 (8.9 to 20.3)		36.1 (27.3 to 47.2)	
Alprazolam	29.4 (24.3 to 35.0)		68.5 (57.9 to 77.4)		16.3 (11.5 to 22.7)		64.1 (54.3 to 73.6)	
Diazepam	37.9 (32.0 to 44.1)		90.0 (81.6 to 94.8)		23.5 (17.4 to 30.9)		73.1 (63.9 to 81.4)	
Overall Readiness Score[1]	24.0±23.1; 18.8 (0.0, 37.5)		44.6±23.0; 43.8 (25.0 to 56.2)		20.4±22.3; 12.5 (0.0 to 37.5)		30.3±21.3; 31.2 (12.5 to 43.8)	
HFs with readiness score >70, % (95%CI)	3.3 (1.8 to 6.1)		13.4 (7.7 to 22.3)		2.5 (0.9 to 7.1)	0.9, 7.1	3.1 (1.5 to 6.3)	

[1] *Mean±SD; Median (IQR)*

%: percent; n: frequency; SD: standard deviation; IQR: interquartile range (1st quartile,3rd quartile); CI: Confidence Interval.

Local HFs include local hospital, health posts and PHCCs

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[Figure 1 is here]

Figure 1: Facility and district-wise readiness score to provide services related to NCDs (A: Readiness of facilities to provide CRDs related services; B: Readiness of facilities to provide CVD-related services; C. Readiness of facilities to provide DM related services; D: Readiness of facilities to provide MH related services)

Figure 1 shows the readiness of facilities to provide services related to different NCDs grouped by district. Facilities are represented by red points for readiness scores ranging from 0 to 20 and white points for readiness scores ranging from 80 to 100, while districts with readiness scores from 0 to 20 are represented by yellow color and those with readiness scores from 80 to 100 in blue. These legends are consistent across all the sub-figures A through D.

Gardner-Altman estimation plot to compare the readiness score of HFs for providing different NCDs-related services by province showed the readiness score of HFs vary by province. (**Supplementary figure 2**)

Table 3 and 4 present the factors associated with services readiness of health facilities to provide NCDs-related services. In univariate analysis, service readiness of health facilities to provide CRDs-related services was significantly associated with the type of facility and presence of external supervision and revision of client opinion. Similarly, the readiness of HFs for CVDs-related services was significantly associated with the revision of client opinion and type of health facility. The readiness of HFs for DM was significantly associated with the type of facility, presence of quality assurance activities performed at least once a year, presence of external supervision, and revision of client opinion. The readiness of HFs for MH-related services was associated with the type of facility.

In the adjusted multivariable analysis, the odds of being ready for CRDs-related services were 0.04 (95% CI: 0.02 to 0.09) times in the local HFs and 0.37 (95% CI: 0.16 to 0.87) times in private hospitals compared to federal/provincial hospitals, and 3.43 (1.64 to 7.20) times in HFs with external supervision compared to HFs without external supervision in past 4 months after adjusting for other variables. The odds of being ready for CVDs-related services were 2.04 (95% CI: 1.02 to 4.09) times in rural areas compared to urban, 0.24 (95% CI: 0.09 to 0.65) times in mountain compared to the hill, 0.24 (95% CI: 0.07 to 0.78) in Madhesh compared to Koshi, 0.12 (95% CI: 0.05 to 0.28) times in local HFs compared to federal/provincial hospital and 2.68 (95% CI: 1.26 to 5.70) times in HFs reviewing client's opinions compared to those HFs that did not review client's opinions. The odds of being ready towards DM-related services were 3.29 (95% CI: 1.23 to 8.80) times in Sudurpaschim compared to Koshi, 0.08 (95% CI: 0.04 to 0.18)] times in local HFs compared to federal/provincial hospitals, and 2.51 (95% CI: 1.26 to 4.99) times in HFs with

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external supervision. Similarly, the odds of being ready for MH-related services were 83.0% lower in local HFs [AOR=0.17 (95% CI: 0.03 to 0.95)] and 86.0% lower in private hospitals [AOR=0.14 (95% CI: 0.04 to 0.55)] compared to federal/provincial hospitals.

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Table 3: Factors associated with readiness of HFs to provide NCDs related services (unadjusted)

Characteristics	CRDs-related services		CVDs-related services		DM-related services		MH-related services	
	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p
Location								
Urban	Ref		Ref		Ref		Ref	
Rural	0.70 (0.31 to 1.57)	0.39	1.03 (0.52 to 2.03)	0.93	0.49 (0.22 to 1.12)	0.09	0.83 (0.16 to 4.17)	0.80
Ecological region								
Hill	Ref		Ref		Ref		Ref	
Mountain	0.99 (0.29 to 3.33)	0.98	**0.22 (0.09 to 0.57)**	**0.00**	0.75 (0.32 to 1.77)	0.52	1.18 (0.13 to 10.78)	0.90
Terai	0.78 (0.37 to 1.64)	0.51	0.80 (0.40 to 1.60)	0.52	1.44 (0.69 to 3.01)	0.33	0.79 (0.26 to 2.41)	0.70
Province								
Koshi	Ref		Ref		Ref		Ref	
Madhesh	0.50 (0.19 to 1.33)	0.17	**0.25 (0.09 to 0.73)**	**0.01**	0.56 (0.23 to 1.37)	0.21	0.61 (0.11 to 3.53)	0.60
Bagmati	1.65 (0.64 to 4.26)	0.30	0.97 (0.33 to 2.89)	0.96	2.09 (0.81 to 5.39)	0.13	2.24 (0.46 to 10.76)	0.30
Gandaki	2.46 (0.84 to 7.16)	0.10	1.15 (0.38 to 3.43)	0.80	1.42 (0.47 to 4.30)	0.53	0.48 (0.09 to 2.72)	0.40
Lumbini	1.51 (0.47 to 4.79)	0.49	1.04 (0.34 to 3.15)	0.95	1.36 (0.48 to 3.87)	0.56	0.43 (0.09 to 2.00)	0.30
Karnali	0.26 (0.06 to 1.19)	0.08	0.49 (0.10 to 2.42)	0.38	0.46 (0.13 to 1.64)	0.23	0.59 (0.10 to 3.38)	0.60
Sudurpaschim	1.50 (0.68 to 3.31)	0.31	0.79 (0.27 to 2.36)	0.68	**2.49 (0.97 to 6.38)**	**0.06**	2.98 (0.61 to 14.59)	0.20
Type of facility								
Federal/Provincial hospitals	Ref		Ref		Ref		Ref	

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Characteristics	CRDs-related services		CVDs-related services		DM-related services		MH-related services	
	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p	COR (95% CI)	p
Local HFs	**0.06 (0.03 to 0.13)**	**<0.001**	**0.15 (0.08 to 0.31)**	**<0.001**	**0.08 (0.04 to 0.17)**	**<0.001**	**0.17 (0.05 to 0.58)**	**0.01**
Private hospital	0.36 (0.14 to 0.89)	0.03	0.64 (0.29 to 1.42)	0.30	**0.38 (0.17 to 0.84)**	**0.02**	0.21 (0.08 to 0.54)	0.00
Quality assurance activities								
Not performed	Ref		Ref		Ref		Ref	
Performed	1.03 (0.56 to 1.88)	0.93	0.81 (0.44 to 1.49)	0.50	**2.21 (1.09 to 4.48)**	**0.03**	0.56 (0.20 to 1.57)	0.30
External supervision								
No	Ref		Ref		Ref		Ref	
Yes	**2.68 (1.43 to 5.04)**	**0.00**	1.57 (0.76 to 3.22)	0.22	**2.23 (1.22 to 4.07)**	**0.01**	0.83 (0.23 to 2.96)	0.80
Frequency of health facility meeting								
None	Ref		Ref		Ref		Ref	
Sometimes	**0.29 (0.10 to 0.85)**	**0.02**	0.84 (0.17 to 4.10)	0.83	**3.53 (1.13 to 11.03)**	**0.03**	0.94 (0.17 to 5.21)	0.94
Monthly	0.45 (0.16 to 1.25)	0.13	2.01 (0.54 to 7.44)	0.30	**3.52 (1.38 to 8.97)**	**0.01**	2.25 (0.43 to 11.87)	0.34
Review of client's opinion								
Not reviewed	Ref		Ref		Ref		Ref	
Reviewed	**5.05 (1.79 to 14.28)**	**0.002**	**4.87 (2.14 to 11.06)**	**<0.001**	**4.88 (2.11 to 11.32)**	**<0.001**	2.88 (0.92 to 9.02)	0.07

COR: crude odds ratio; CI: confidence interval; Ref: reference group; p: p-value
CVDs: Cardiovascular Diseases; DM: Diabetes Mellitus; CRDs: Chronic Respiratory Diseases; MH: Mental Health
Local HFs include local hospital, health posts and PHCCs

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Table-4: Factors associated with readiness of HFs to provide NCDs-related services (adjusted)

Characteristics	CRDs-related services		CVDs-related services		DM-related services		MH-related services	
	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p
Location								
Urban	Ref		Ref		Ref		Ref	
Rural	1.55 (0.74 to 3.21)	0.24	**2.04 (1.02 to 4.09)**	**0.045**	1.29 (0.51 to 3.2[illegible])	0.60	1.66 (0.12 to 23.80)	0.71
Ecological region								
Hill	Ref		Ref		Ref		Ref	
Mountain	1.45 (0.39 to 5.47)	0.58	**0.24 (0.09 to 0.65)**	**0.005**	0.82 (0.34 to 1.9[illegible])	0.66	1.11 (0.08 to 15.24)	0.94
Terai	1.15 (0.39 to 3.37)	0.80	1.18 (0.38 to 3.70)	0.78	2.79 (0.93 to 8.3[illegible])	0.07	1.45 (0.47 to 4.46)	0.52
Province								
Koshi	Ref		Ref		Ref		Ref	
Madhesh	0.63 (0.19 to 2.09)	0.45	**0.24 (0.07 to 0.78)**	**0.018**	0.43 (0.16 to 1.1[illegible])	0.10	0.71 (0.10 to 5.20)	0.74
Bagmati	1.58 (0.59 to 4.21)	0.36	0.9 (0.23 to 3.45)	0.87	2.42 (0.72 to 8.1[illegible])	0.15	2.94 (0.41 to 20.95)	0.28
Gandaki	2.81 (0.83 to 9.53)	0.10	1.28 (0.36 to 4.54)	0.70	2.61 (0.76 to 8.9[illegible])	0.13	0.57 (0.10 to 3.23)	0.52
Lumbini	1.66 (0.44 to 6.17)	0.45	0.89 (0.27 to 2.99)	0.86	1.21 (0.43 to 3.4[illegible])	0.71	0.43 (0.07 to 2.70)	0.36
Karnali	0.32 (0.07 to 1.51)	0.15	0.76 (0.13 to 4.46)	0.76	0.89 (0.21 to 3.8[illegible])	0.87	0.78 (0.11 to 5.38)	0.80
Sudurpaschim	2.25 (0.97 to 5.20)	0.06	1.05 (0.32 to 3.42)	0.94	**3.29 (1.23 to 8.80)**	**0.02**	3.71 (0.80 to 17.08)	0.093
Type of facility								
Federal/Provincial hospital	Ref		Ref		Ref		Ref	

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Characteristics	CRDs-related services		CVDs-related services		DM-related services		MH-related services	
	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p	AOR (95% CI)	p
Local HFs	**0.04 (0.02 to 0.09)**	**<0.001**	**0.12 (0.05 to 0.28)**	**<0.001**	**0.08 (0.04 to 0.18)**	**<0.001**	**0.17 (0.03 to 0.95)**	**0.04**
Private hospitals	**0.37 (0.16 to 0.87)**	**0.02**	0.56 (0.24 to 1.31)	0.18	0.41 (0.15 to 1.07)	0.08	**0.14 (0.04 to 0.55)**	**0.01**
Quality assurance activities								
Not Performed	Ref		Ref		Ref		Ref	
Performed	0.86 (0.45 to 1.64)	0.66	0.64 (0.33 to 1.25)	0.19	2.08 (0.99 to 4.37)	0.05	0.45 (0.16 to 1.29)	0.14
External supervision								
No	Ref		Ref		Ref		Ref	
Yes	**3.43 (1.64 to 7.20)**	**0.00**	1.59 (0.69 to 3.66)	0.27	**2.51 (1.26 to 4.99)**	**0.01**	0.85 (0.19 to 3.87)	0.83
Frequency of health facility meeting								
None	Ref		Ref		Ref		Ref	
Sometimes	**0.27 (0.10 to 0.76)**	**0.01**	0.78 (0.15 to 3.99)	0.76	2.72 (0.75 to 9.87)	0.13	0.76 (0.13 to 4.54)	0.76
Monthly	**0.25 (0.09 to 0.65)**	**0.00**	1.51 (0.38 to 5.90)	0.56	1.81 (0.68 to 4.82)	0.24	1.84 (0.29 to 11.83)	0.52
Review of client's opinion								
Not Reviewed	Ref		Ref		Ref		Ref	
Reviewed	2.60 (0.91 to 7.44)	0.07	**2.68 (1.26 to 5.70)**	**0.01**	2.03 (0.78 to 5.25)	0.15	3.15 (0.97 to 10.19)	0.06

AOR: adjusted odds ratio; CI: confidence interval; Ref: reference group; p: p-value
CVD: Cardiovascular Diseases; DM: Diabetes Mellitus; CRDs: Chronic Respiratory Diseases; MH: Mental Health
Local HFs include local hospitals, health posts and PHCCs.

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Discussion

This study aimed to determine the readiness of the HFs to provide services related to NCDs including CVDs, CRDs, DM, MH in Nepal from a nationally representative sample of HFs from the NHFS 2021. The overall median HFs readiness score to provide CRDs, CVDs, DM, and MH-related services were 26.7, 35.0, 35.4 and 18.8 respectively with the readiness score for guidelines and training domain being the lowest and the readiness score for essential equipment and supplies being the highest for each disease. The proportion of HFs with more than 70% readiness score was 2.3% for CRDs, 3.8% for CVDs, 3.6% for DM, and 3.3% for MH related services. Federal or provincial hospitals were more likely to be ready to provide NCDs-related services compared to Local HFs.

A similar analysis from NHFS 2015 showed the median readiness score of HFs to provide CVDs, CRDs, and DM to be 18.8, 11.3, and 26.4 respectively,[25] which indicate improvement in the readiness score of HFs in 2021. One of the factors for the increase in the readiness score of HFs from 2015 to 2021 could be attributed to the roll out and expansion of the PEN which has been rolled-out in majority of HFs throughout the country. [8] In addition, the National mental health strategy and action plan was launched in 2021 which can further improve the preparedness of health system to deliver mental health services in future.[8,26]

The availability of guidelines and staff training had lowest readiness score which is similar to the case in Bangladesh, where the shortage of guidelines was commonly reported across HFs.[27] This finding is also in congruence with a prior study in Nepal that highlighted a lack of national guidelines and protocols for treating CVDs as a significant obstacle to providing evidence-based treatment.[28] The other study on DM suggested that there is a significant shortfall in the implementation of existing policies, plans, strategies, and programs aimed at addressing DM, with a lack of clarity on how they should be implemented.[29] This evidence suggests that not only there is a need of formulating evidence-informed guidelines and policies but also ensuring the availability and implementation of guidelines in HFs through strengthened communication across all tiers of governments and developing a clear understanding of the policy documents. These areas should be improved and addressed concurrently as they have been demonstrated to be cost-efficient in terms of healthcare delivery.[30]

Our study revealed that HFs with external supervision had significantly higher preparedness scores for DM and CRDs. External supervision mechanisms in HFs are essential in facilitating the overall management process and improving the effectiveness of the facility. Such supervision enables information sharing and performance review which is pivotal in streamlining the facility's management process and enhancing its efficiency.[31]

In tune with our findings, previous studies have also shown disparities in the availability of healthcare resources for the prevention and control of NCDs between different levels of healthcare, types of HFs, and regional settings.[32] Our study found that there was a notable lack of essential

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medicines and commodities for NCDs in local HFs, similar to findings reported by other studies.[33,34] Several other studies have shown that the essential medicines, especially those for NCDs, are less available in LMICs compared to medicines for acute illnesses. Furthermore, the availability of these drugs is lower in the local HFs compared to the private hospitals. This disparity in availability can be attributed to various factors such as inadequate financial resources for purchasing medicines, inaccurate forecasting of drug requirements, ineffective procurement processes, and inefficient distribution systems in the public sector.[35–37] The shortages of essential medicines and commodities were often accompanied by the shortages/lack of training of the staff, which further hindered access to proper medical care for patients; which has also been the case for a study done in Nepal using the 2015 health facility survey data.[25] This is a cause for concern as it can negatively impact the health outcomes of individuals suffering from NCDs.[38] It is crucial to stress the relationship between the availability of drugs and supplies, and the training of health care professionals. For instance, even if trained personnel were available to provide services, a lack of drugs and supplies will prevent the health professional from providing quality healthcare, and the other way around.[39] Therefore, there is an urgent need to address the scarcity of both trained personnel and medicines.

Within South Asian regions, differences regarding the lack of trained personnel, availability of essential medicines and commodities and guidelines in service-specific readiness have also been documented.[40] A systematic review carried out with studies from resource poor setting demonstrated that healthcare systems have been negatively impacted by insufficient supply of medication, equipment, and trained healthcare personnel.[41] The region's progress in the management and prevention of NCDs has been hampered by the widespread absence of key resources. According to a recent report by the WHO, most countries, particularly LMICs, failed to achieve the global targets set for NCDs progress in 2020. This report, which evaluated data from 194 countries, highlights the pressing need for increased global efforts in NCDs prevention and control.[42]

Alongside the issues discussed, Nepal's health system does have the potential to effectively address NCDs. Nepal has implemented policies and strategies, developed treatment guidelines and protocols, an essential drug list, a multisectoral plan for NCDs prevention, surveillance and prevention strategic planning, and an action plan for NCDs. These findings suggest that Nepal should strengthen and orient health systems for the prevention and control of NCDs and strengthen supervision and monitoring as aligned with the action plan for the prevention and control of NCDs.[26] The disparities identified across various diseases and healthcare types and levels, as well as the noticeable differences in availability between urban and rural areas, along with a lack of basic medicines and supplies, underline the importance of an all-inclusive approach to upgrading healthcare facilities' ability to deliver successful NCDs interventions. Also, the findings point to enhancing the management of NCDs by increasing the capacity of the healthcare workforce, which is crucial. This can be achieved by providing more training opportunities for healthcare professionals and expanding the number of clinicians skilled in managing NCDs. It will be

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impossible to achieve global NCDs targets by 2025, as part of the SDGs by 2030, without significant efforts in both policies and programs. Therefore, it is imperative to take immediate action to enhance the provision of NCD services in both public and private HFs in Nepal.

This study has several strengths such as a) use of a nationally representative sample that enables us to generalize the study findings throughout Nepal, b) use of a validated survey tool and presence of adequate quality control and implementation strategies including recruitment strategies, data collection and data analysis) in the survey ensures the internal validity of the study findings, and c) use of appropriate statistical procedures to account for complex sampling procedures and non-responses. There are some potential limitations to consider in this study. Firstly, as the survey was carried out during the time of COVID-19 pandemic, there could be some level of impact due to pandemic on the availability of tracer items and readiness of the HFs. Secondly, this study lacks readiness of HFs for cancer and chronic kidney diseases. Finally, this study lacks an important variable i.e., the number of CVDs, CRDs, DM and MH patients seeking care each month from the HFs which is important to understand the patient burden in HFs which impacts the readiness of HFs.

Implication to managers or decision makers

The study has important implications to managers and decision-makers in the health sector in Nepal. First, decision-makers could prioritize improving the readiness of HFs to provide NCDs related services, particularly at the peripheral level. This can be achieved through increased investment in equipment, and essential medicines. Second, there is a need to increase the number of qualified health staff and provide training on NCDs prevention, screening, and management. Managers could explore innovative approaches such as telemedicine and task-shifting to enhance access to NCDs related services in remote areas. Third, strengthening the supply chain system and improving the forecasting of drug requirements would ensure the availability of essential medicines for NCDs management. Finally, policymakers and managers could promote public-private partnerships to improve the quality of care provided in the private sector, which was found to have higher readiness for NCDs related services than the Federal/Provincial hospitals. These measures would help to enhance the overall readiness of the health system to provide NCDs related services and improve the health outcomes of the population.

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Conclusions

Readiness of local HFs to provide NCDs related services in Nepal was relatively poor compared to federal/provincial hospitals with the guidelines and staff training being the weakest domain. HFs that were ready to deliver NCDs related services were very low in all categories of Health facilities- federal/provincial hospital, local HFs, and private hospitals. The readiness of HFs to provide different NCDs-related services are associated with presence of external supervision, quality assurance activities, review of client opinion.

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Contributors

BA and ARP were responsible for conceptualization, data acquisition, formal analysis, methodology, validation, writing-original draft, and writing review & editing. SCB, DJ, and SR were responsible for supervision and validation, writing-original the draft, and writing-review & editing. BL, SPKC, and SG were responsible for formal analysis, writing-original draft, and writing review & editing.

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Competing interests

We authors have no competing interest associated with this paper.

Patient consent for publication: Not required as this study involves secondary data analysis.

Ethical approval: The NHFS 2021 was approved by the Institutional Review Board of ICF International, USA (Reference number: 180657.0.001.NP.SPA.01), and by the Ethical Review Board of Nepal Health Research Council (NHRC), Nepal (Reference number: 733/2020).[14]

Data availability statement

The data is available publicly in the open-access repository. The data can be downloaded from the official website of "The Demographic and Health Surveys" program (https://dhsprogram.com/data/dataset/Nepal_SPA_2021.cfm?flag=0).[13]

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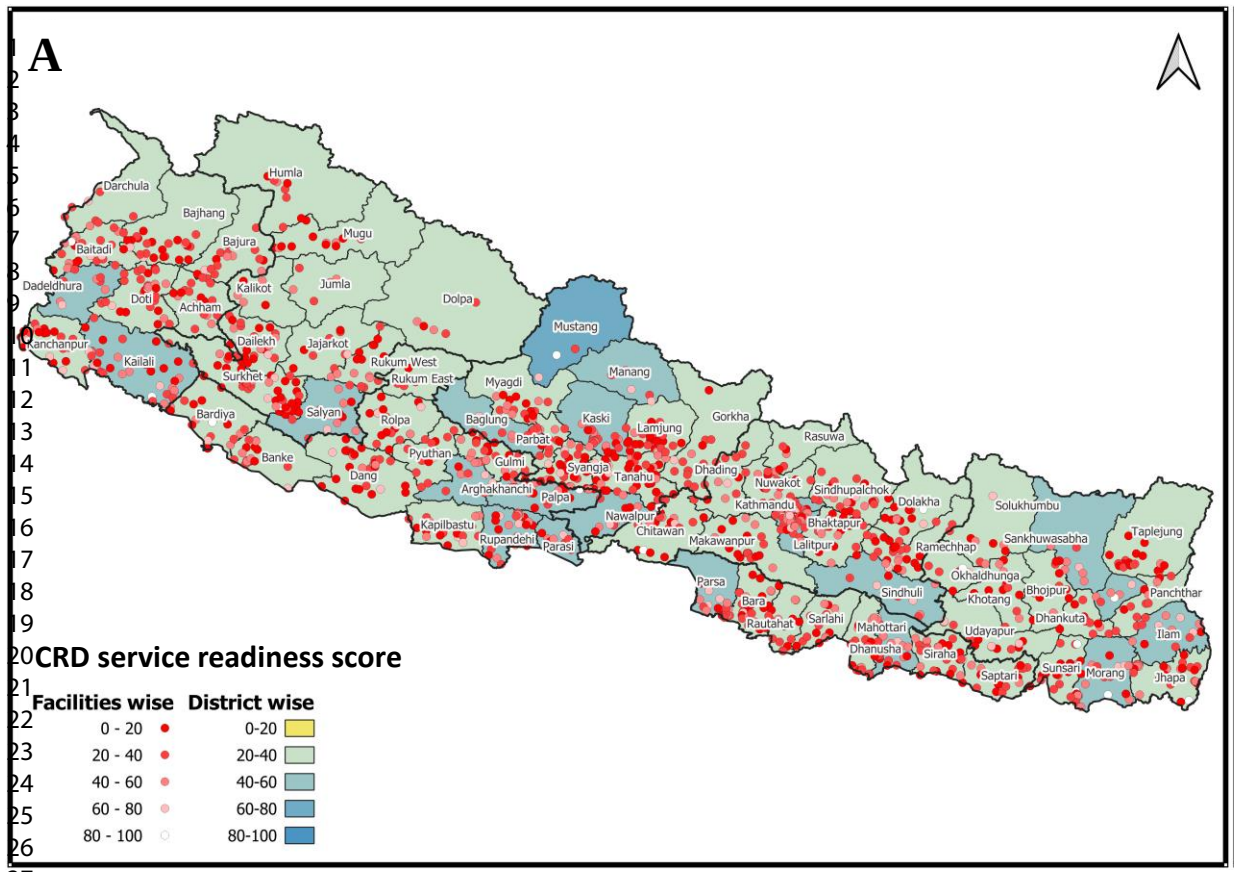

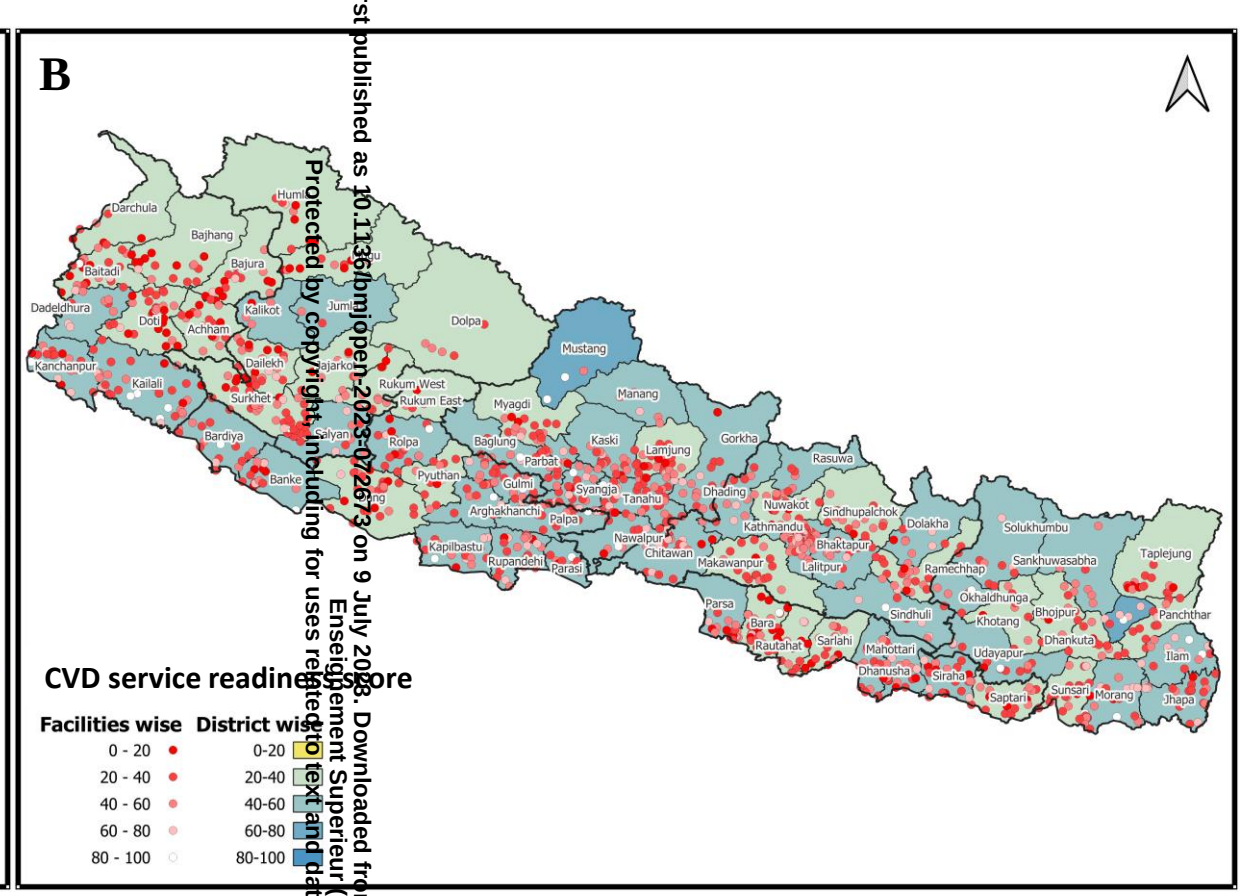

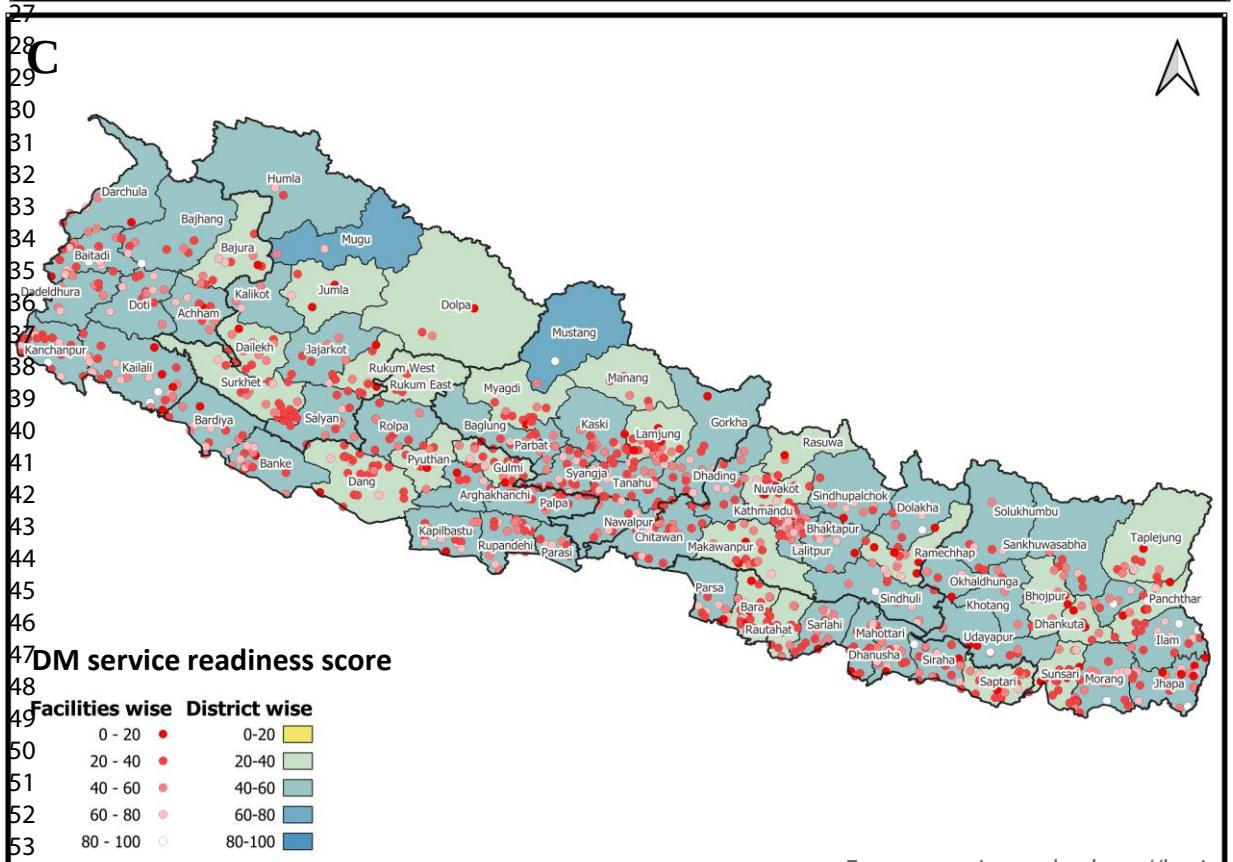

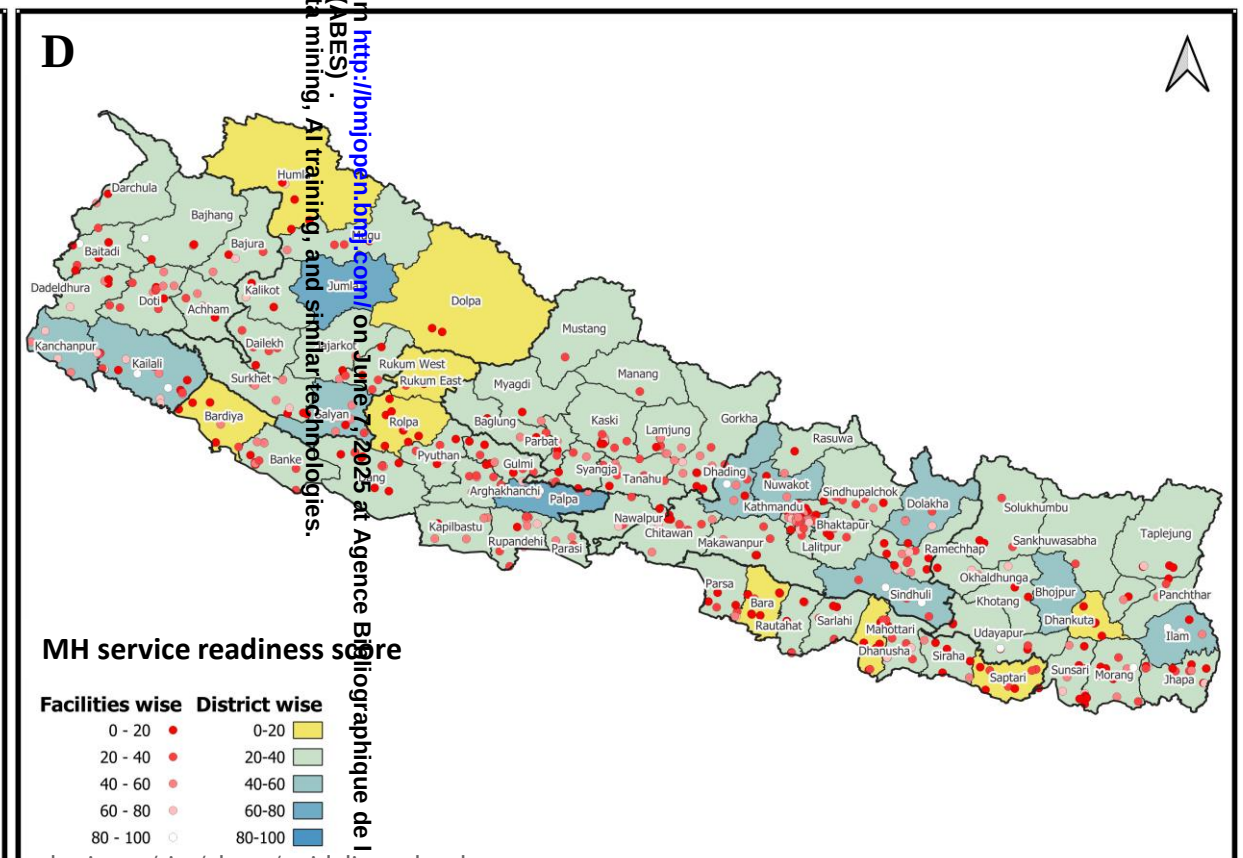

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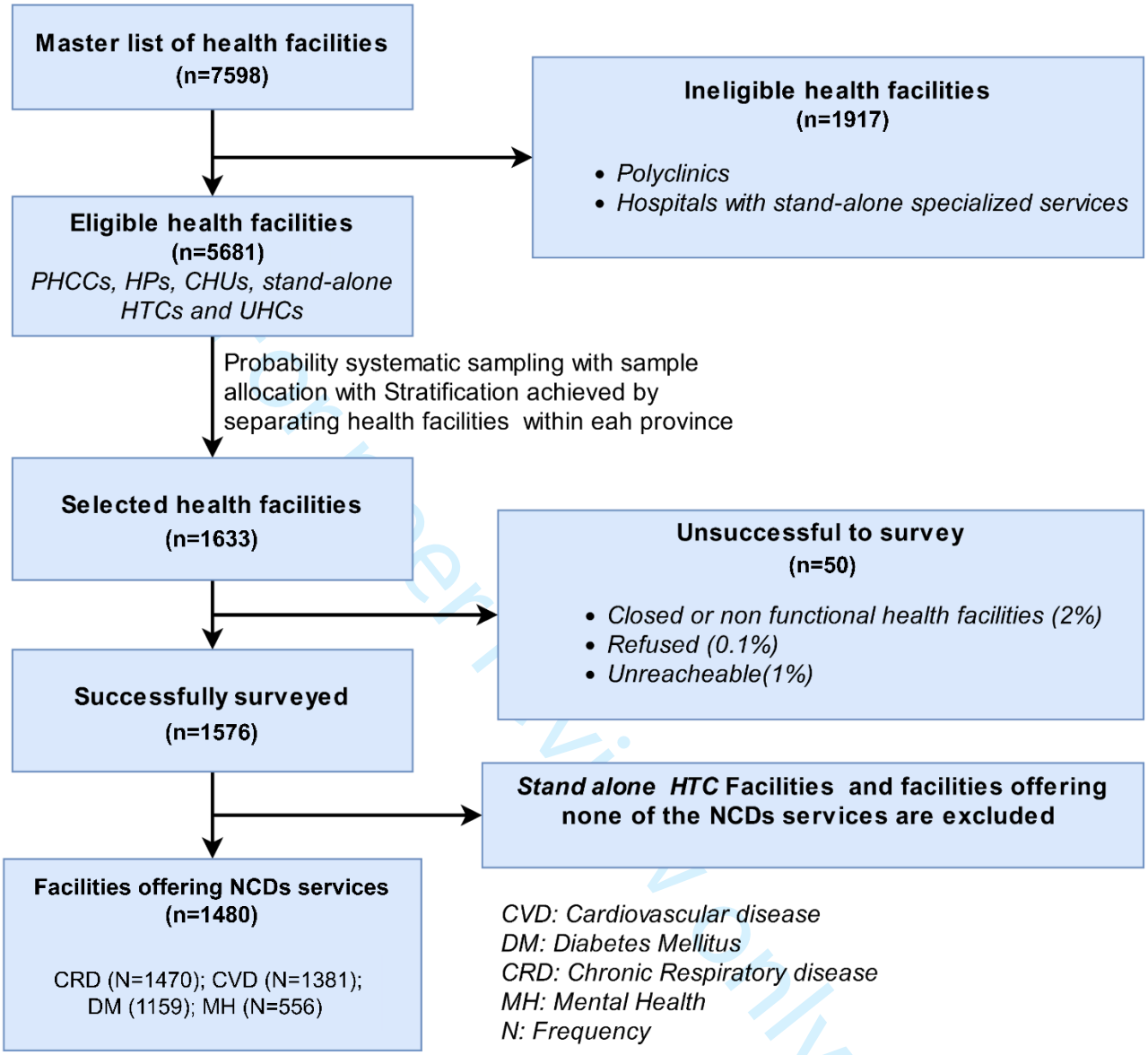

Supplementary Figure 1: Flowchart showing sample and sampling technique

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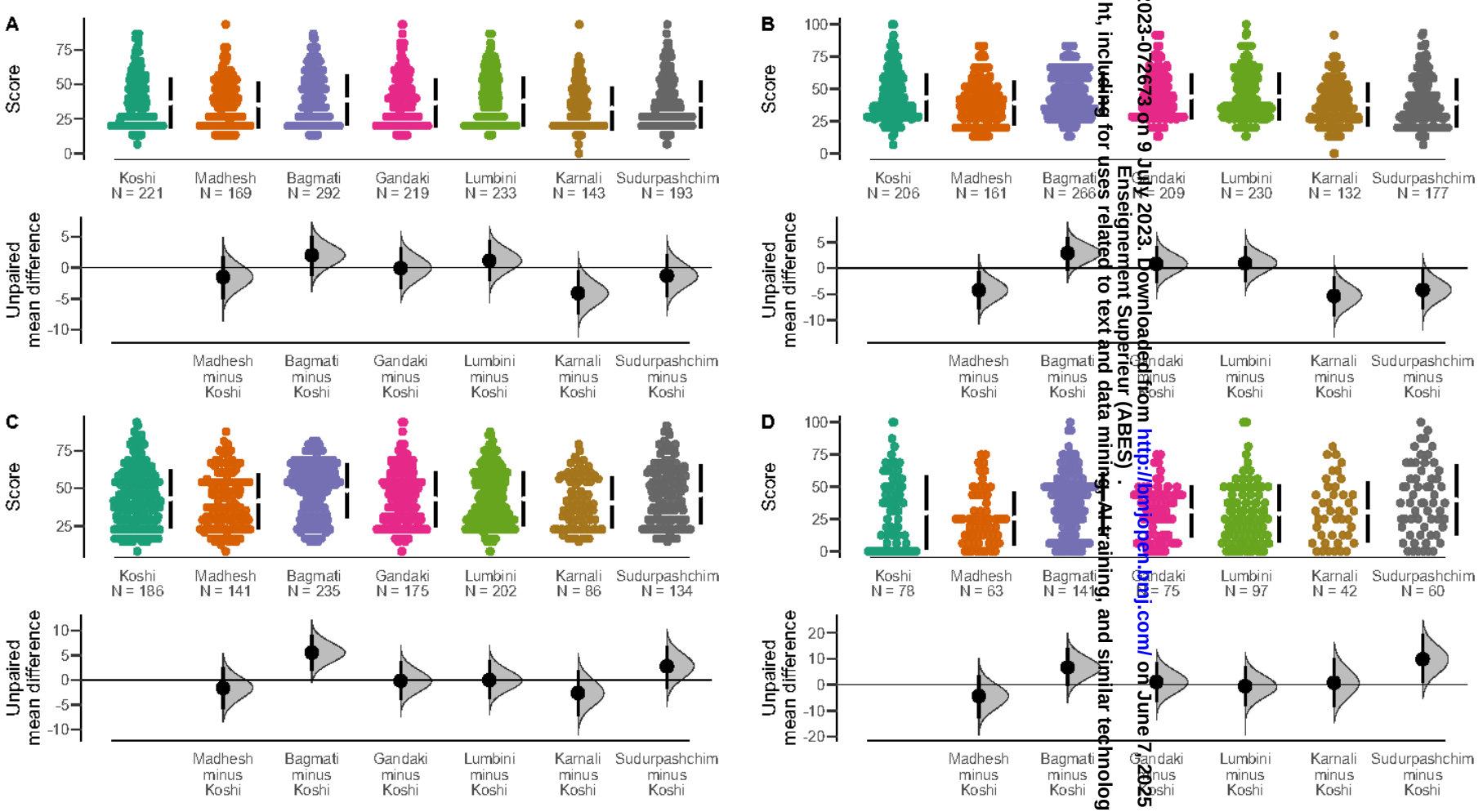

Supplementary Figure 2: Gardner-Altman estimation plots for comparing unweighted mean readiness scores of health facilities offering A) CRD-related services, B) CVD-related services, C) DM-related services, and D) MH- related services

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Supplementary Table 1: Summary of tracer items of each domain and measurement procedure of readiness score of health facilities offering different non-communicable diseases-related services

Cardiovascular diseases (CVDs) related services					
Domain	**Indicators**	**Measure**	**Recode**	**Calculation of score**	
				Domain wise score	**Total score**
Guidelines and training	Guidelines for diagnosis and management of CVDs (a1)	Yes	1	A=(a1+b1)/2*100	(A+B+C)/3
		No	0		
	Staff training * (b1)	Yes	1		
		No	0		
Equipment	Stethoscope (c1)	Yes	1	B=(c1+d1+e1+f1+g1)/5*100	
		No	0		
	Blood pressure (d1)	Yes	1		
		No	0		
	Adult weighing scale (e1)	Yes	1		
		No	0		
	Oxygen (f1)	Yes	1		
		No	0		
	Pulse oximeter (g1)	Yes	1		
		No	0		
Medicines	Amlodipine/nifedipine (h1)	Yes	1	C=(h1+i1+j1+k1)/4*100	
		No	0		
	Beta-blockers (atenolol) (i1)	Yes	1		
		No	0		
	Aspirin (j1)	Yes	1		
		No	0		
	Thiazide (k1)	Yes	1		
		No	0		

Diabetes Mellitus (DM) related services					
Domain	**Indicators**	**Measurement**	**Recode**	**Calculation of score**	
				Domain wise score	**Total score**
Guidelines and training	Guidelines for diagnosis and management of DM (a2)	Yes	1	A=(a2+b2)/2*100	(A+B+C)/3
		No	0		
	Staff training * (b2)	Yes	1		
		No	0		
Equipment	Blood pressure (c2)	Yes	1	B=(c2+d2+e2)/3*100	
		No	0		
	Adult weighing scale (d2)	Yes	1		
		No	0		
	Height board/stadiometer (e2)	Yes	1		
		No	0		
Medicines	Metformin (f2)	Yes	1	C=(f2+g2+h2+j2)/4*100	
		No	0		
	Glibenclamide (g2)	Yes	1		
		No	0		
	Injectable insulin (h2)	Yes	1		
		No	0		
		Yes	1		

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	D. Injectable glucose solution (j2)	No	0		
Diagnostics	Blood glucose (k2)	Yes	1	D=(k2+I2+m2)/3*100	
		No	0		
	Urine Glucose (l2)	Yes	1		
		No	0		
	Urine Protein (m2)	Yes	1		
		No	0		

Chronic Respiratory Diseases (CRDs) related services

Domain	Indicators	Measurement	Recode	Calculation of score: Domain wise score	Calculation of score: Domain wise score
Guidelines and training	Guidelines for diagnosis and management of CRDs (a3)	Yes	1	A=(a3+b3)/2*100	Score=(A+B+C)/3
		No	0		
	Staff training * (b3)	Yes	1		
		No	0		
Equipment	Stethoscope (c3)	Yes	1	B=(c3+d3+e3+f3)/4*100	
		No	0		
	Oxygen Flowmeter (d3)	Yes	1		
		No	0		
	Spacer for inhalers (e3)	Yes	1		
		No	0		
	Oxygen (f3)	Yes	1		
		No	0		
Medicines	Salbutamol inhaler (g3)	Yes	1	C=(g3+h3+i3+j3+k3+l3+m3)/7*100	
		No	0		
	Beclomethasone inhaler (h3)	Yes	1		
		No	0		
	Prednisolone cap/tabs (i3)	Yes	1		
		No	0		
	Hydrocortisone injection (j3)	Yes	1		
		No	0		
	Epinephrine injectable (k3)	Yes	1		
		No	0		
	Salbutamol inhaler (l3)	Yes	1		
		No	0		
	Beclomethasone inhaler (m3)	Yes	1		
		No	0		

Mental Health related services

Domain	Indicators	Measurement	Recode	Calculation of score: Domain wise score	Calculation of score: Total Score
Guidelines and training	Guidelines for diagnosis and management of MH (a4)	Yes	1	A= (a4+b4)/2*100	(A+B)/2
		No	0		
	Staff training * (b4)	Yes	1		
		No	0		
Medicines		Yes	1		

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	Amitriptyline (c4)	No	0	B= (c4+d4+e4+f4+g4+h4+i4+j4)/8* 100	
	Fluoxetine (d4)	Yes	1		
		No	0		
	Carbamazepine (e4)	Yes	1		
		No	0		
	Phenobarbitone (f4)	Yes	1		
		No	0		
	Sodium valproate (g4)	Yes	1		
		No	0		
	Respiridone (h4)	Yes	1		
		No	0		
	Alprazolam (i4)	Yes	1		
		No	0		
	Diazepam (j4)	Yes	1		
		No	0		

* *At least one interviewed provider of services for CRDs, CVDs, DM, and MH reported receiving in-service training (such as PEN) in CRDs, CVDs, DM, and MH during the 2 years preceding the survey. The training must have involved structured sessions; it does not include individual instruction that a provider might have received during routine supervision.*

Note: Tracer items were considered to be present in the health facility if enumerators observed them in the given health facility. We coded "1" for the presence of the item and "0" for the absence of the item in the facility.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	4-5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*7-8*
Bias	9	Describe any efforts to address potential sources of bias	NA
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8-9
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	NA
Outcome data	15*	Report numbers of outcome events or summary measures	10-18

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Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-18
		(*b*) Report category boundaries when continuous variables were categorized	10-18
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	No
Discussion			
Key results	18	Summarise key results with reference to study objectives	19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	21
Generalisability	21	Discuss the generalisability (external validity) of the study results	21
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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