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Factors Associated with Adherence to the Package of Essential Non- Communicable Disease Protocol Among Service Providers in Primary Healthcare Facilities of Chitwan District, Nepal: A Cross-Sectional Study

Nabin Parajuli

parajulinabin97@gmail.com

Pokhara University

Bimala Bhatta

Pokhara University

Nisha Lamichhane

Pokhara University

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Abstract

Background

Non-communicable diseases (NCDs) are responsible for significant proportion of deaths worldwide. World Health Organization Package of Essential Non-communicable Disease (PEN) interventions was designed to strengthen NCD care at the primary health care level. Nepal adopted the PEN protocol in 2016, yet evidence on provider adherence and its determinants remains limited, particularly at the district level. This study assessed the level of adherence to the PEN protocol and identified factors associated with adherence among service providers in primary health care facilities of Chitwan district, Nepal.

Methods

A cross-sectional quantitative study was conducted among 176 PEN-trained NCD service providers selected through proportionate stratified random sampling across 91 primary health care facilities in Chitwan district. Adherence was assessed using an eight-item observation-based checklist and dichotomized into good and poor adherence using the median score. Cabana framework was employed to assess perceived barriers across seven domains (familiarity, awareness, motivation, self-efficacy, outcome expectancy, agreement, and external environment). Bivariate chi-square tests and multivariable binary logistic regression were used to identify independent predictors of adherence, with variance inflation factor used to screen for multicollinearity.

Results

Of 176 participants, 99 (56.2%) demonstrated good adherence to the PEN protocol. In bivariate analysis, work experience duration, training duration, health facility type, local government type, type of service available, resource availability (medicine, equipment, diagnostic services), and several domains were significantly associated with adherence. After adjusting for confounders, four factors remained independently associated with good adherence: working in a referral-level facility (adjusted odds ratio [AOR] = 6.06, 95% confidence interval [CI]: 1.65–22.33, p = 0.007), adequate familiarity with the protocol (AOR = 2.68, 95% CI: 1.11–6.46, p = 0.028), agreement with protocol recommendations (AOR = 2.36, 95% CI: 1.04–5.36, p = 0.041), and a favourable external work environment (AOR = 3.12, 95% CI: 1.43–6.82, p = 0.040).

Conclusions

Adherence to the PEN protocol among trained providers in Chitwan district remains moderate. Facility-level conditions and providers' understanding of and trust in the protocol, rather than individual sociodemographic characteristics, were the dominant predictors of adherence. Strengthening first-

contact facility readiness, reinforcing familiarity through structured refresher training, and reducing organizational barriers are recommended to improve PEN protocol adherence and NCD service delivery.

Trial Registration

Clinical trial number: not applicable

Background

Non-communicable diseases (NCDs) are often long-lasting conditions arising from the interaction of behavioral, physiological, environmental, and genetic factors, and their rising prevalence is among the central challenges facing health systems worldwide[1]. The proportion of deaths attributable to NCDs is projected to increase from 59% in 2002 to 69% by 2030[2]. NCDs account for approximately 75% of all non-pandemic-related mortality globally, and in Nepal they are estimated to account for 65% of all deaths, with cardiovascular disease responsible for 25%, chronic respiratory illness for 16%, cancer for 9%, and diabetes for 3%[3]. Many of these conditions are preventable through early identification of risk factors and timely primary intervention.

To address this burden, the World Health Organization (WHO) developed the Package of Essential Non-communicable Disease (PEN) interventions — a set of cost-effective, evidence-based interventions designed for delivery through primary health care, particularly in resource-constrained settings[4]. WHO PEN provides standardized protocols and tools to strengthen country capacity to integrate, expand, and sustain NCD care at the primary level, supporting reform across core health system building blocks[5]. Effective implementation that ensures quality, equity, and impact depends on trained providers, opportunistic screening, systematic clinical documentation, delivery of evidence-based interventions, monitoring of complications, and clear referral pathways[6]. PEN is recognized as a proven intervention package with the potential to reduce premature NCD mortality by 25% globally[7] .

Nepal adopted the WHO PEN package in 2016 to support essential NCD services at the primary level, incorporating validated, simple algorithms for clinical diagnosis and management that can be delivered by doctors, public health professionals, nurses, and paramedics[8]. NCDs have been incorporated into Nepal's Basic Health Service Package (BHSP), which under the constitution must be provided free of cost to all citizens[9]. Protocol 1 of the four WHO PEN protocols, which addresses the prevention of heart attack, stroke, and kidney disease through the management of diabetes and hypertension, has been the primary focus of national rollout, supported by health worker training, trainer guides, and efforts to ensure equipment and medicine availability [5].

Protocol implementation, however, is a multifaceted process shaped by provider behavior, the characteristics of the protocol itself, and the strategies used to support its use[10]. Poor adherence can compromise patient safety, waste health system resources, and lead to suboptimal outcomes. Evidence from low- and middle-income countries (LMICs) suggests that only 40–60% of patients receive care

consistent with established chronic disease guidelines[11], with barriers including time constraints, patient load, inflexible protocols, limited resources, and insufficient incentives [12–14].

Chitwan district carries a substantial NCD burden, with 26,495 diagnosed patients recorded in fiscal year 2080/81, including 12,000 cardiovascular disease cases and 6,512 diabetes cases[15]. A recent nationwide study examined PEN protocol adoption across Nepal's provinces but explicitly noted that its findings could not be generalized to all PEN-trained providers or facilities, given variation in structural readiness and provider-level behavioral factors across settings[16]. The Nepal Health Research Council has similarly noted that the PEN program has not been systematically evaluated, and that information on the factors influencing its success or failure remains limited[17]. Despite implementation of protocol Chitwan district since 2019, no district-level assessment has examined the determinants of provider adherence. This study therefor aimed to examine the level of PEN protocol adherence and identify the factors associated with adherence among service providers in primary health care facilities of Chitwan district, in order to generate specific evidence to inform targeted training, resource allocation, and system approach.

Methods

Study design and setting

This was a cross-sectional, quantitative study conducted among service providers in primary health care facilities of Chitwan district, Nepal. The PEN protocol was implemented in Chitwan district during the third phase of national rollout in fiscal year 2018/2019, with health workers trained for its delivery[8]. Despite multisectoral efforts by local governments to address NCDs, challenges persist across prevention, screening, diagnosis, and treatment at the primary care level, motivating a district-level assessment of adherence and its determinants.

Study population and sampling

The study population comprised PEN-trained health workers in primary health care facilities (primary hospitals, Health Posts, Urban Health Centres, Basic Health Service Centres, and Community Health Units) across all seven local-level governments of Chitwan district (one metropolitan city, five municipalities, and one rural municipality).

The sample size was calculated using Cochran's formula, assuming 50% expected adherence to the protocol, 95% confidence level, and 5% margin of error, applied to a finite population of N = 267 PEN-trained health workers. This yielded a base sample of 158, which was adjusted for an anticipated 10% non-response rate, giving a final sample size of 176.

A multistage sampling procedure was used. First, all seven local-level governments were included. Second, a list of health facilities was obtained from each local government. Third, the sample was

proportionately allocated to each local government based on the number of health facilities it contained (111 facilities in total across the selected local governments). Fourth, representation was ensured across all facility types (hospitals, Primary Health Centres, Health Posts, Basic Health Service Centres, and Community Health Units). Finally, PEN-trained health workers were listed at each facility during data collection, and participants were selected using simple random sampling.

Inclusion criteria

Health workers who had received PEN training and were directly involved in NCD prevention or treatment.

Exclusion criteria

Health workers not directly involved in NCD prevention or treatment, and providers at Ayurvedic health centres.

Variables and measurement

Outcome variable. Adherence to the PEN protocol was assessed through an eight-item checklist covering assessment practices during NCD-related consultations: use of the cardiovascular disease (CVD) risk assessment chart, body mass index (BMI) assessment, blood pressure measurement, blood sugar measurement, tobacco cessation counselling, referral for foot examination among diabetes patients, referral to a higher centre for hypertension patients, and use of the PEN program record-keeping register. Each item was scored 1 (performed) or 0 (not performed), yielding a total score of 0–8. As adherence scores were not normally distributed and no universally validated cut-off exists, the median score was used to dichotomize participants into good adherence (score ≥ 7) and poor adherence (score ≤ 6).

Independent variables. Sociodemographic characteristics (age, gender, ethnicity, education), professional characteristics (professional position, years of service, training duration received), health facility characteristics (facility type, type of local government, availability of outpatient/inpatient/laboratory services), and resource availability (essential medicines, diagnostic services, and essential equipment) were assessed. Resource availability was scored against PEN-recommended lists of eight essential medicines, ten diagnostic/laboratory services, and nine essential equipment items, each dichotomized as adequate or inadequate using the facility-level median score.

Perceived barriers. The Cabana framework [10] was used to assess perceived barriers to adherence across seven domains: familiarity, awareness, motivation, self-efficacy, outcome expectancy, agreement with the protocol, and external environmental factors. Each domain was measured using five-point Likert-scale items (1 = strongly disagree to 5 = strongly agree), with negatively worded items reverse-coded so that higher scores indicated lower perceived barriers. Domain scores were dichotomized using the domain-specific mean or median cut-off (detailed operational definitions are provided in Additional

file 1). Self-efficacy and outcome expectancy showed near-zero variance in responses (93.8% and 100% of providers reporting low self-efficacy and low expected outcome, respectively) and were therefore excluded from inferential analysis and reported descriptively only.

Data collection

Data were collected through face-to-face interviews using a structured questionnaire comprising three sections: sociodemographic information, PEN protocol adherence assessment[5], and the Cabana framework for perceived barriers [10]. Availability of medicines, equipment, and services was independently verified through a facility observation checklist. The questionnaire was adapted from a tool developed by earlier study [16], which was developed based on the Cabana framework, the WHO PEN protocol, and literature review; modification were to align it with objectives of the current study, it was further refined in consultation with was refined in consultation with expert.

The questionnaire was pretested in 10% (17) of health facilities in Pokhara Metropolitan City;

Cronbach's alpha for the resource availability and perceived barrier domains was 0.72, indicating acceptable internal consistency. Following pretesting, the questionnaire was translated into Nepali and back-translated into English to ensure semantic equivalence.

Data were collected via the Kobo Toolbox platform with automatic synchronization to secure servers and manual backup as CSV files; data were subsequently transferred to SPSS for analysis. The principal investigator collected all data directly, with no external enumerators. Skip logic and validation constraints built into Kobo Toolbox minimized missing or inconsistent entries, and submitted data were reviewed by the supervisor for completeness and credibility.

Statistical analysis

Data downloaded from Kobo Toolbox were checked for duplicates and outliers prior to analysis in IBM SPSS Statistics version 21. Descriptive statistics (frequencies, percentages, medians, interquartile ranges, and standard deviations) were used to summarize sociodemographic, professional, facility, and resource-related characteristics. Bivariate associations between independent variables and adherence status were assessed using the chi-square test. Variables significant at $p < 0.05$ in bivariate analysis were screened for multicollinearity using the variance inflation factor (VIF), with variables retained for multivariable modelling if $VIF \leq 5$. Multivariable binary logistic regression was then performed to identify independent predictors of good adherence, with results expressed as adjusted odds ratios (AOR) with 95% confidence intervals. A p-value < 0.05 was considered statistically significant throughout.

Ethical considerations

Ethical approval

was obtained from the Institutional Review Committee (IRC) of Pokhara University (Reference No. 78/2082/83) prior to data collection. Additional approval was obtained from the District Health Office, Chitwan, and from all participating municipalities.

Written and verbal informed consent was obtained from all participants after the purpose and objectives of the study were explained; participants were informed of their right to withdraw at any time without justification. No direct benefit or risk to participants was anticipated, and participants were informed of this prior to data collection. Privacy and confidentiality were maintained throughout.

Results

Sociodemographic, professional, and health facility characteristics

Table 1
Sociodemographic, professional, and health facility characteristics of participants (N = 176)

Characteristic	Frequency n = 176	Percentage (%)
Age (median = 35 years, IQR = 13)		
≤35 years	81	46.0
>35 years	95	54.0
Gender		
Female	91	51.7
Male	85	48.3
Ethnicity		
Brahmin	98	55.7
Janjati	43	24.4
Dalit	13	7.4
Madhesi	11	6.3
Chhetri	9	5.1
Muslim	2	1.1
Educational qualification		
Pre-diploma	46	26.1
Diploma	70	39.8
Bachelor's degree	46	26.1
Master's degree or higher	14	8.0
Professional position		
Senior/Auxiliary Health Worker	80	45.4
Public Health Inspector	46	26.1
Senior/Auxiliary Nursing Midwife	36	20.5
Health Assistant	8	4.5
Staff Nurse	4	2.3
Doctor	1	0.6
Public Health Officer	1	0.6

Characteristic	Frequency n = 176	Percentage (%)
Age (median = 35 years, IQR = 13)		
Work experience (median = 9 years)		
≤9 years	95	54.0
>9 years	81	46.0
Training duration received		
≤2 years	53	30.1
>2 years	123	69.9
Health facility type		
Health Post	70	39.8
Basic Health Service Center	63	35.8
Basic Hospital	34	19.3
Community Health Unit	4	2.3
Urban Health Center	3	1.7
Primary Health Care Center	2	1.1
Type of local government		
Rural municipality	19	10.8
Municipality	105	59.7
Metropolitan city	52	29.5
Type of service available		
OPD only	94	53.4
OPD and IPD	8	4.5
Other combinations	74	42.1

IQR, interquartile range; OPD, outpatient department; IPD, inpatient department.

A total of 176 PEN-trained health workers across 91 primary health care facilities participated in the study. The median age of participants was 35 years (interquartile range [IQR] = 13), with 54% above 35 years. The sample was almost evenly split by gender (51.7% female, n = 91; 48.3% male, n = 85). The majority of participants identified as Brahmin (55.7%) or Janjati (24.4%), with smaller proportions identifying as Dalit (7.4%), Madhesi (6.3%), Chhetri (5.1%), and Muslim (1.1%). Regarding educational

qualification, 39.8% held a Diploma, 26.1% a Pre-diploma, 26.1% a Bachelor's degree, and 8% a Master's degree or higher.

Professionally, the sample was dominated by Senior/Auxiliary Health Workers (45.5%), Public Health Inspectors (26.1%), and Senior/Auxiliary Nursing Midwives (20.5%), with smaller proportions of Health Assistants (4.5%), Staff Nurses (2.3%), Doctors (0.6%), and Public Health Officers (0.6%). Approximately 70% of participants had received PEN training more than two years prior to the survey. Using the median work experience as a cut-off, 54% of providers had ≤ 9 years of service.

Regarding facility characteristics, the largest proportion of PEN-trained providers worked in Health Posts (39.8%); only two providers worked in the district's single Primary Health Centre. By local government type, 10.8% of providers worked in the rural municipality, 59.7% in municipalities, and 29.5% in the metropolitan city. Just over half (53.4%) of providers worked at facilities offering outpatient (OPD) services only, while 4.5% worked at facilities with both outpatient and inpatient (IPD) services available. (See Table 1.)

Resource availability and assessment practices

Table 2
Resources availability

Domains	Items	Frequency (n = 89)	Percentage (%)
Availability of Medicine	Amoxicillin	89	100
	Amlodipine	88	98.9
	Metformin	86	96.6
	Furosemide	45	50.6
	Dextrose infusion	44	4.4
	Aspirin	42	47.2
	Statin Atorvastatin	13	14.6
	Epinephrine	7	7.9
Availability of Services	Blood glucose test	51	57.3
	Urine protein test	43	48.3
	Glucose urine test	43	48.3
	Laboratory	24	27
	Serum creatinine analyzer	21	23.6
	Blood cholesterol assay	20	22.5
	Lipid profile analyzer	20	22.5
	Urine microalbuminuria test	19	21.3
	ECG	7	7.9
	Ophthalmoscopy	5	5.6
Availability of Equipment	Sphygmomanometer	89	100
	Stethoscope	89	100
	weighing machine	89	100
	Health education materials for HTN & DM	74	83.1
	Stadiometer	70	78.7
	Glucometer	61	68.5
	Blood glucose test strips	61	68.5
	Lancets	61	68.5

Domains	Items	Frequency (n = 89)	Percentage (%)
	Oxygen cylinder	43	48.3

Among eight PEN-recommended essential medicines, amoxicillin was available at all 89 facilities (100%), with high availability of amlodipine (98.7%) and metformin (96.6%); furosemide (50.6%), dextrose infusion (49.4%), and aspirin (47.2%) showed moderate availability, while atorvastatin (14.6%) and epinephrine (7.9%) were the least available. Among diagnostic services, blood glucose testing was most widely available (57.3%), followed by urine protein testing (48.3%) and urine glucose testing (48.3%); specialized services such as ophthalmoscopy (5.6%), electrocardiography (7.9%), lipid profile analysis (22.5%), cholesterol assay (22.5%), creatinine testing (23.6%), and microalbuminuria testing (21.3%) were considerably less available. Blood pressure apparatus, stethoscopes, and weighing machines were available at all facilities (100%), with high availability of stadiometers (78.7%) and NCD-related health education materials (83.1%); oxygen cylinder availability was also high(48.3) even in first contact level health facilities, likely reflecting residual COVID-19 pandemic-era supply. (See Table 2.)

Assessment Practice

Table 3
Assessment Practice Recommended by The Protocol

Assessment Practices	Frequency (n = 176)	Percentage (%)
Measurement of BP	176	100
Referred to a higher center for hypertensive patients	166	94.3
Counselling for tobacco cessation	165	93.8
Blood sugar measurement	134	76.1
BMI assessment	120	68.2
Referral for foot examination of DM patients	115	65.3
Record-keeping Register of the PEN program	102	58
CVD Risk chart use	81	46

Regarding assessment practices, all providers (100%) reported performing blood pressure measurement, while use of the CVD risk chart (46%) and the PEN program record-keeping register (58%) were comparatively low, consistent with the limited availability of these specific tools across facilities (See Table 3).

Adherence to the PEN protocol and perceived barriers

Table 4
Service provider adherence to the PEN protocol (N = 176)

Adherence category	n	%
Good adherence (score ≥ 7)	99	56.2
Poor adherence (score ≤ 6)	77	43.8
Total	**176**	**100.0**

Adherence was assessed using an eight-item checklist (range 0–8); the median score was used as the dichotomization cut-off.

Using the median-based dichotomization, 99 of 176 providers (56.2%) demonstrated good adherence to the PEN protocol, while 77 (43.8%) demonstrated poor adherence. (See Table 3.)

Barrier assessment

Assessment of barriers for guideline implementation was assessed through the Cabana framework. It outlines perceived barriers into seven domains: Familiarity, awareness, motivation/inertia, self-efficacy, lack of outcome expectancy, lack of agreement, and external factors. Each domain was assessed using a set of Likert-scale items. Domain scores were computed by summing the individual item score, and mean score was calculated for each domain. Participants scoring below the mean were considered to have inadequate level of the factor, while those scoring above the mean were classified as having adequate level, which indicates lower barrier.

Table 5
Perceived Barriers of the participants.

Domains	Frequency	Percentages
Familiarity		
Inadequate familiarity	58	33
Adequate Familiarity	118	67
Awareness		
Inadequate Awareness	46	26.1
Adequate Awareness	130	73.9
Motivation		
Low motivation	74	42
High motivation	102	58
Self-Efficacy		
Low self-efficacy	165	93.8
High self-efficacy	11	6.3
Expected outcome		
Low expected outcome	176	100
High expected outcome	0	0
Agreement with protocol		
Inadequate agreement	64	36.4
Adequate Agreement	112	63.6
External factors		
Unfavorable External factors	80	45.5
Favorable external factor	96	54.5

The distribution of perceived barrier domain showed that 67% of providers had adequate familiarity with the PEN protocol and 74% had adequate awareness. More than half (58%) said there is high motivation to use protocol, while 63.6% agreed with the content of the protocol. However self-efficacy was notably low, 93.8% of providers reporting to low self-efficacy and all providers were categorized as perceiving low expected outcome from the protocol. Regarding contextual influences, 54.5% perceived external factors as favorable where as 45.5% reported unfavorable external factors affecting protocol adherence. (See Table 5.)

Bivariate analysis

Bivariate analysis was carried out for association of variables with adherence to protocol. Similarly, result was presented in narrative forms and the data was presented in tabular forms.

No statistically significant association was observed between adherence and age group ($p = 0.124$), gender ($p = 0.178$), ethnicity ($p = 0.134$), education level ($p = 0.311$), or professional position ($p = 0.204$). However, both work experience duration ($\chi^2 = 8.278$, $p = 0.004$) and training duration received ($\chi^2 = 8.520$, $p = 0.004$) were significantly associated with adherence.

All health facility characteristics examined were significantly associated with adherence: facility type, i.e., referral level versus first-contact level ($\chi^2 = 52.66$, $p < 0.001$); type of service available, i.e., facilities with versus without laboratory services ($\chi^2 = 48.55$, $p < 0.001$); and type of local government, i.e., rural municipality, municipality, or metropolitan city ($\chi^2 = 21.05$, $p < 0.001$).

All three resource availability domains were significantly associated with adherence: medicine availability ($\chi^2 = 45.419$, $p < 0.001$), service availability ($\chi^2 = 64.542$, $p < 0.001$), and equipment availability ($\chi^2 = 72.464$, $p < 0.001$), with higher adherence observed among providers at facilities with adequate resources.

Among the Cabana framework domains, familiarity ($\chi^2 = 19.399$, $p < 0.001$), awareness ($\chi^2 = 7.417$, $p = 0.006$), motivation ($\chi^2 = 23.132$, $p < 0.001$), agreement with the protocol ($\chi^2 = 22.449$, $p < 0.001$), and external environmental factors ($\chi^2 = 30.171$, $p < 0.001$) were all significantly associated with adherence status. Self-efficacy was not significantly associated with adherence ($\chi^2 = 0.556$, $p = 0.456$).

(For Bivariate analysis output table, see supplementary file 1)

Multivariable analysis

All variables significant in bivariate analysis — work experience duration, training duration, health facility type, type of service available, type of local government, medicine availability, service availability, equipment availability, familiarity, awareness, motivation, agreement with the protocol, and external environmental factors — were screened for multicollinearity using VIF (all VIF ≤ 5) and entered into the multivariable binary logistic regression model.

Table 6
Multivariable binary logistic regression of factors associated with adherence to the PEN protocol

Variables	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Work duration				
≤ 9 years (Ref)	1		1	
> 9 years	2.45(1.32–4.54)	**.004**	0.82(0.32–2.10)	.677
Training received				
Less than 2 years (Ref)	1		1	
More than 2 years	1.64(1.03–3.82)	**.004**	1.40(0.45–4.39)	.565
HF type				
First contact point level (Ref)	1		1	
Referral level	12.18(5.91–25.12)	**< 0.001**	6.06(1.65–22.33)	**.007**
Type of service				
HF without Lab (Ref)	1		1	
HF with Lab	11.323(5.43–23.56)	**< 0.001**	1.53(0.36–6.59)	.565
Type of Municipality				
Rural (Ref)	1		1	
municipality	1.158(0.43–3.11)	.771	0.44(0.11–1.88)	.270
Metropolitan	6.57(2.059–20.95)	**.001**	1.88(0.31–11.65)	.497
Familiarity with protocol				
Inadequate familiarity (Ref)	1		1	
adequate Familiarity	4.32(2.21–8.45)	**< 0.001**	2.68(1.11–6.46)	**.028**
Awareness				
Inadequate Awareness(ref)	1		1	
adequate Awareness	2.57(1.29–5.13)	**0.007**	0.68(0.26–1.75)	.421
Motivation				
Low motivation (Ref)	1		1	
High motivation	4.65(2.44–8.83)	**< 0.001**	1.42(0.59–3.37)	.428
Agreement with protocol				

Variables	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Work duration				
Inadequate agreement (Ref)	1		1	
adequate Agreement	4.69(2.43–9.08)	**< 0.001**	2.36(1.04–5.36)	**.041**
External factors				
Unfavorable external factors (Ref)	1		1	
favorable external factors	5.89(3.06–11.33)	**< 0.001**	3.12(1.43–6.82)	**0.04**

After adjustment, four variables remained independently and significantly associated with good adherence. Providers working at referral-level facilities had approximately six times higher odds of good adherence than those at first-contact facilities (AOR = 6.06, 95% CI: 1.65–22.33, p = 0.007). Providers with adequate familiarity with the protocol had significantly higher odds of good adherence compared to those with inadequate familiarity (AOR = 2.68, 95% CI: 1.11–6.46, p = 0.028). Providers who agreed with the protocol's recommendations had 2.36 times higher odds of good adherence than those with inadequate agreement (AOR = 2.36, 95% CI: 1.04–5.36, p = 0.041). Providers reporting a favourable external environment had 3.12 times higher odds of good adherence than those in an unfavourable environment (AOR = 3.12, 95% CI: 1.43–6.82, p = 0.040).

Work experience duration, training duration, all three resource availability domains, and the motivation and awareness barrier domains, despite showing significant bivariate associations, were not independently significant predictors after adjustment for the other variables in the model (see Table 6).

Discussion

This study assessed the level of PEN protocol adherence and its associated factors among service providers in primary health care settings of Chitwan district, Nepal. More than half of participants (56.2%) demonstrated good adherence, while 43.8% demonstrated poor adherence. This is, to our knowledge, the first study to assess provider-level adherence to the PEN protocol in Chitwan district since its implementation in 2019, and the findings suggest that adherence remains suboptimal despite nearly a decade of program rollout. The proportion of providers demonstrating good adherence in this study is broadly consistent with evidence from other LMIC settings, where adherence to chronic disease guidelines has been reported to range between 40% and 60%[11]. A nationwide cross-sectional study in Nepal examined PEN protocol adoption across four practice domains but did not calculate a composite adherence score for comparison[16]; a separate mixed-methods study evaluating PEN implementation fidelity in Nepal reported a low overall fidelity score (approximately 20 out of 100), a finding corroborated by accompanying qualitative data[18].

Adherence did not vary significantly by age, gender, ethnicity, education, or professional position in this study, consistent with both the national PEN adoption study in Nepal[16] and a study from Saudi Arabia in which demographic and professional characteristics did not predict guideline adherence[19]. This contrasts with a national survey from China linking higher educational attainment to better guideline implementation[20]; the discrepancy may partly reflect the comparatively narrow educational range of the present sample, in which most providers held diploma- or pre-diploma-level qualifications.

Work experience and training duration were associated with adherence in unadjusted analysis — providers with more than nine years of service and more than two years since training showed higher unadjusted odds of good adherence — but neither association remained significant after adjustment. One plausible explanation is that more experienced providers tend to work in better-resourced referral facilities, such that their apparent advantage may reflect facility conditions rather than experience or training per se. This contrasts with evidence from Moldova showing that PEN-specific training was independently associated with improved consultation quality and protocol adherence[21], but aligns with the Nepal national PEN adoption study, in which training duration was not independently associated with protocol use[16].

Health facility type emerged as the strongest and most consistent predictor of adherence in this study, with providers at referral-level facilities showing markedly higher odds of good adherence even after adjustment for resources, training, and behavioral barriers (AOR = 6.06, 95% CI: 1.65–22.33). This is consistent with evidence that guideline-concordant care is not distributed evenly across the rural–urban and facility-level continuum[22], and with qualitative findings that continuity of care and follow-up are harder to sustain in smaller, first-contact facilities[23]. Notably, of the three facility-related variables examined, only facility type survived adjustment, suggesting that referral-level facilities carry structural advantages — mixed staffing patterns, more consistent resource availability, and more established clinical routines — that more directly support protocol adherence than local government type or service-availability category alone.

Resource availability variables (essential medicines, equipment, and diagnostic services) were each strongly associated with adherence in bivariate analysis but did not remain significant after adjustment, likely reflecting their close correlation with facility type, which limited the ability to isolate their independent effect. This pattern is broadly consistent with evidence from other LMIC settings, including Nepal, in which inadequate infrastructure, equipment, and services have been identified as barriers to guideline-concordant NCD care[24, 25]. A related study in Nepal reported that the odds of CVD risk-chart use were three times higher when amlodipine was available, and that blood glucose testing was significantly associated with metformin availability[16]; mixed-methods evidence from Ethiopia and India similarly links medicine, diagnostic, and equipment availability to NCD guideline-recommended care[26, 27], and a systematic review identified supply-side deficits as a key contributor to poor primary care readiness for guideline adherence[28].

Among the Cabana framework domains, familiarity, agreement with the protocol, and external environmental factors remained independently associated with adherence after adjustment, while motivation and awareness did not. Providers with adequate familiarity had 2.68 times higher odds of good adherence than those with inadequate familiarity, consistent with a regional systematic review identifying unfamiliarity with guideline content as a recurring barrier[29] and qualitative evidence that familiarity is central to whether a guideline is used in practice [30]. This suggests that familiarity operates closer to actual practice behavior than more distal constructs such as awareness or motivation: providers must first know the content and steps of a protocol before motivation or perceived value can translate into consistent clinical action.

Providers who agreed with the protocol's recommendations — reflecting trust in its evidence base, applicability, and clinical relevance — had 2.36 times higher odds of good adherence than those with inadequate agreement. This supports earlier evidence that belief in a guideline's clinical validity and practical importance is a necessary condition for its sustained adoption[31], and is consistent with a systematic review identifying protocol rigidity and complexity as recurring barriers to adherence in integrated NCD care[32]. Favorable external environmental conditions were also independently associated with adherence (AOR = 3.12), consistent with evidence that organizational constraints such as workload and time pressure lead providers to omit protocol components[33], and that underfunding and staffing shortages undermine protocol adherence at the health system level[5]. This is also broadly consistent with evidence that perceived barriers such as lack of incentives, patient-related factors, and organizational constraints are common contributors to external-factor-related non-adherence[34], although a study from Palestine reported that providers did not perceive a lack of incentives as a barrier to adherence[13].

Awareness and motivation each showed strong bivariate associations with adherence but were not independent predictors after adjustment, consistent with prior evidence on the role of intrinsic motivation in guideline use[35]. Self-efficacy and outcome expectancy could not be examined in relation to adherence due to near-absent variability — 93.8% of providers reported low self-efficacy, and virtually all participants reported low expected benefit from protocol use. This pattern contrasts with evidence from Bangladesh linking higher provider self-efficacy to better protocol adherence[36], and is itself a notable finding: it reveals a clear gap between what the PEN protocol recommends and what providers in this setting consider clinically important to their daily practice, independent of whether they ultimately follow the protocol's procedural steps.

Strengths and limitations

This study benefits from a sample drawn proportionately from each local-level government and the full range of facility types in Chitwan district, and from the use of an established theoretical framework (Cabana) for assessing perceived barriers. Several limitations should be noted. Adherence was assessed through self-report rather than direct clinical observation or audit, which may have led to overreporting due to recall bias or social desirability. The cross-sectional design also limits causal

inference, particularly for behavioral domains; for example, providers more familiar with the protocol may be more likely to adhere to it, but routine use of the protocol may also increase familiarity over time, making the direction of this relationship difficult to establish from a single time-point survey.

Conclusions

Adherence to the PEN protocol among trained service providers in Chitwan district remains moderate, with just over half of providers meeting the threshold for good adherence. Health facility type, familiarity with the protocol, agreement with the protocol, and the external environmental domain were the only factors that remained independently associated with adherence after adjustment, indicating that adherence is shaped more by workplace conditions and providers' understanding of and trust in the protocol than by individual characteristics such as age, sex, ethnicity, education, or professional position.

These findings suggest that efforts to improve adherence should prioritize strengthening first-contact facilities through uninterrupted medicine, equipment, and diagnostic service availability; reinforcing familiarity with the protocol through structured refresher sessions rather than relying on the durability of a single training event; and reducing organizational constraints such as excessive workload, limited supervisory feedback, and barriers related to patient preferences and ability to follow recommendations. Strengthening provider support systems through regular refresher training, supportive supervision, and routine performance feedback may help address both the familiarity and external-environment domains identified as independent predictors in this study. Future research incorporating both client and provider perspectives, and direct observation or clinical audit of practice rather than self-report alone, would help build on these findings.

Abbreviations

AOR: Adjusted odds ratio

BHSP: Basic Health Service Package

BMI: Body mass index

CI: Confidence interval

CVD: Cardiovascular disease

DALYs: Disability-adjusted life years

HP: Health Post

IPD: Inpatient Department

IQR: Interquartile range

IRC: Institutional Review Committee

LMICs: Low- and middle-income countries

NCDs: Non-communicable diseases

OPD: Outpatient Department

PEN: Package of Essential Non-communicable Diseases

PHC: Primary Health Care

SDG: Sustainable Development Goal

SPSS: Statistical Package for the Social Sciences

STP: Standard Treatment Protocol

UHC: Urban Health Centre

VIF: Variance inflation factor

WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Review Committee (IRC), Pokhara University (Reference No. 78/2082/83) prior to data collection. This study was conducted in accordance with the ethical principle of the declaration of Helsinki.Additional approval was obtained from the District Health Office, Chitwan, and from all participating municipalities of Chitwan district.

Written and verbal informed consent was obtained from all participants prior to data collection.Consent form both in Nepali (local language) and English language was prepared, and before taking data form was filled and compiled.

Participants were informed about that there will be “No Risk and No direct Benefit” for participating in the study, and were informed that privacy and confidentiality will be maintained.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

No competing interests.

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Authors' contributions

NP conceptualized and designed the study, collected and analyzed the data, and drafted the manuscript. BB supervised the study design, data analysis, and critically revised the manuscript for important intellectual content. Both authors read and approved the final manuscript.

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Authors' information

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