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RESEARCH ARTICLE

READINESS OF PRIMARY HEALTH CARE FACILITIES TO DELIVER THE IRAN'S PACKAGE OF ESSENTIAL NON-COMMUNICABLE DISEASES (IRAPEN) PROGRAM: A DISTRICT-WIDE CROSS-SECTIONAL STUDY FROM IRAN

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ABSTRACT

BACKGROUND:

Non-communicable diseases (NCDs) are the leading cause of death in Iran, accounting for the vast majority of all fatalities. Strengthening primary health care (PHC) via Iran's adaptation of WHO-PEN (IraPEN) is central to earlier detection and continuity of NCD care. However, evidence regarding the readiness of PHC facilities to implement IraPEN at the district level remains limited. This study aims to assess facility-level readiness to deliver IraPEN in one district health network of Iran.

METHODS:

This study used a cross-sectional design and conducted a census of all PHC facilities in Kerman district health network. In total, 147 facilities, including comprehensive community health centers (CCHCs), health posts (HPs), and health houses (HHs), were assessed. Data were collected with a checklist adapted from WHO-PEN and IraPEN guidance that measured five domains: accessibility, human resources, medical equipment and supplies, information system, and the care system from November 2019 to January 2020. For each domain, scores were categorized using predefined thresholds as poor (≤50% of maximum score), moderate (51–75% of maximum score), or good (≥76 of maximum score). Content validity was confirmed using CVI and CVR measures, and inter-rater reliability was established with Cohen's kappa across twelve facilities (4 CCHCs, 4 HPs, and 4 HHs) before data collection began. Data were analyzed using descriptive statistics in SPSS version 22.

FINDINGS:
Across all 147 facilities, readiness was highest for the care system and lowest for medical equipment and supplies. In CCHCs, the information and care systems were strongest (each 90.6% good) and medical equipment and supplies was weakest (31.2% good; 15.6% poor). In HPs, the care system was strongest (83.0% good) and medical equipment and supplies was weakest (81.5% poor). In HHs, accessibility was strongest (96.0% good) and medical equipment and supplies was weakest (2.0% good; 54.0% poor). Overall, the care system had the highest good ratings (82.3%), whereas medical equipment and supplies had the highest poor ratings (57.8%; 7.4% good).

CONCLUSION:
Facility readiness was strongest in the care system, routine monitoring and feedback from higher levels, referral tracking, and related information-system functions, and weakest in medical equipment and supplies, particularly in HPs and HHs. Priority actions include targeted procurement of essential screening/diagnostic tools, fixing intranet/data-support gaps, and regular team training on referral closure.

KEYWORDS
Non-communicable diseases, Primary Health Care, IraPEN, package of essential non-communicable diseases, Iran

INTRODUCTION

Non-communicable diseases (NCDs), principally cardiovascular diseases, cancers, diabetes and chronic respiratory diseases, drive most premature mortality globally, with these four groups accounting for 80% of all premature NCD deaths [1].

NCDs account for 43.8 million deaths annually and 1.73 billion disability-adjusted life years (DALYs) globally [2]. In 2021, 18 million people died from an NCD before age 70 years, 82% of these premature deaths occurring in low- and middle-income countries (LMICs), and these four groups of diseases account for 80% of all premature NCD deaths [1].
In south Asian countries – which share similar demographic and health system transitions with Iran – the share of all mortality attributed to NCDs ranges from 55% in Pakistan to 82% in Sri Lanka, and the risk of premature death (age 30–70) from the four major NCDs varies between 13% and 29% [3].

In Iran, non-communicable diseases (NCDs) are the leading cause of death, responsible for 82% of all deaths in 2017. The overall burden of NCDs has shifted from premature mortality toward disability over the past three decades, with increasing age-standardized disability rates despite declining death rates [4]. NCDs not only harm health but also hurt the economy. They reduce productivity, increase healthcare costs, and push families into financial trouble, especially in low- and middle-income countries, where people often get sick during their most productive years. This creates a heavy burden on the country's development [5]. In the coming decades, the burden of non-communicable diseases in Iran is anticipated to undergo a marked transition from premature mortality to chronic disability, largely driven by the escalating prevalence of diabetes, the rising tide of obesity among younger cohorts, and the progressive aging of the population [4].

Despite high political commitment to NCD prevention and control across the region, evidence shows poor multisectoral engagement and weak health system preparedness at the primary health care (PHC) level. Common challenges include shortages of skilled human resources, inadequate infrastructure, lack of essential NCD medicines and technologies, and insufficient dedicated financing. Even where innovative community-based or integrated interventions exist, scaling up remains problematic [3].

PHC-based strategies are therefore pivotal to prevention, early detection, risk-factor management, and longitudinal care. The World Health Organization's (WHO) recommends strengthening primary health care (PHC) as the cornerstone of NCDs prevention and control [6]. This package focuses on training healthcare workers and ensuring access to essential

equipment, medications, and diagnostics, thereby strengthening PHC services for NCD [7]. To operationalize WHO's Package of Essential Noncommunicable Disease Interventions (WHO-PEN) in the Iranian context, the Ministry of Health (MoH) launched the Iran Package of Essential NCD Interventions (IraPEN) in 2014, piloted it in four districts, and then scaled elements nationally [8]. The primary goal of IraPEN is to establish a systematic, continuous program for managing NCD risk factors. Within an integrated framework, it gathers, analyzes, and disseminates information critical for developing, implementing, and evaluating individual- and population-level NCD interventions. By actively engaging in policy-making, IraPEN aims to play a significant role in effectively controlling NCDs [6]. It standardizes cardiovascular risk assessment (≥30 years), early detection pathways for cervical, breast, and colorectal cancers, and case-finding for asthma/COPD, with defined referral and follow-up protocols inside PHC.

Given the importance of IraPEN and its potential impact on strengthening preventive care, evaluating the program's readiness requires reliable information to identify its strengths and weaknesses. About one decade has passed since IraPEN's introduction, yet, consistent with the regional evidence that facility readiness for NCD services remains limited, and evidence on facility readiness to deliver IraPEN at scale remains scarce [3]. Moreover, global evidence on the implementation and effectiveness of PEN interventions is limited and conflicting, a knowledge gap that further underscores the need for local assessments [9]. Therefore, this study aims to quantitatively assess the readiness of IraPEN within the PHC system of Kerman, Iran, using a district-wide census of PHC facilities.

METHODS

CONTEXT

Iran's PHC system, established between 1974-1985, provides primary care in both rural and urban areas [10]. This system consists of health houses (HHs) in villages (each staffed by Behvarz as a community health worker, serving around 1,200 people) and rural health centers (with physicians and a team of 5-10 staff for approximately 7000 people). Urban areas are served by health posts (HPs) and urban health centers offering similar services. District health centers supervise these centers under the medical sciences universities in each province [11, 12].

In this context, the Ministry of Health and Medical Education (MoHME) initiated IraPEN in 2014, aiming to seamlessly integrate NCDs services into the PHC framework. The program consists of three core components. First, cardiovascular risk assessments are conducted in rural health houses (HHs) and urban health posts (HPs) for individuals aged 30 and above. These assessments involve measuring blood glucose and total cholesterol levels to estimate the 10-year risk of major cardiovascular events, followed by tailored preventive or therapeutic interventions. Second, the program includes early detection of three common cancers, cervical, breast, and colorectal, through targeted screening protocols such as patient history, Pap smear or HPV testing, clinical breast examinations, and fecal occult blood tests, with appropriate referral pathways. Third, since 2019, community health workers have been assigned to identify individuals showing symptoms of asthma or chronic obstructive pulmonary disease (COPD) and refer them to family physicians for further evaluation and management [1].

STUDY DESIGN AND SETTING

We conducted a cross-sectional study of IraPEN readiness in Kerman district health network as one of main districts of PHC from 2019–2020. IraPEN readiness was assessed at three levels of service delivery: CCHCs, HPs, and HHs.

SAMPLE SIZE AND DATA COLLECTION

The study population comprised all 147 PHC facilities in Kerman, including thirty-two comprehensive community health centers (CCHCs), sixty-five health posts (HPs), and fifty health houses (HHs). These facilities were further categorized by location (urban, rural, and mixed urban–rural) for comparative analysis. In this research, no specific sampling method was considered, as all PHC centers were assessed through a general census.

ASSESSMENT INSTRUMENT

The data collection instrument was a researcher-made checklist, developed based on WHO's global NCD control principles and tailored to Iran's PHC system. This checklist covered five main domains: accessibility (physical and geographical access to PHC services), human resource (staff availability, training, and skills), medical equipment and supplies (availability of medical devices, technologies, and drugs), information system (patient record-keeping, referral processes, data archiving), and care system (monitoring and supervision of NCD services in PHC). Each domain consisted of multiple indicators corresponding to IraPEN guidelines and standards.

VALIDITY AND RELIABILITY MEASURES

To validate the checklist, we used content validity ratio (CVR) and content validity index (CVI) measures. Items with CVR < 0.7 were removed; CVR 0.7–0.77 were revised; CVR ≥ 0.78 were retained. The overall CVI ensured we included the most essential content. For reliability, we assessed inter-rater reliability via Cohen's kappa. Two independent evaluators each rated a subset of twelve facilities (4 CCHCs, 4 HPs, 4 HHs) using the checklist, and we calculated agreement. Kappa values >0.8 were considered ideal (≥0.6 was the minimum acceptable). In our pilot reliability test, kappa values ranged 0.84–0.91 across the checklist domains, indicating excellent agreement. Table 1 summarizes the validity and reliability results by domain.

DATA COLLECTION METHOD

Two trained interviewers of researchers (MG, MJ) collected data by visiting each facility in person. Interviewers were selected based on prior experience and familiarity with the local context of PHC and IraPEN program to facilitate communication. To standardize administration, interviewers were trained in a four-hour online session before fieldwork and used a common protocol for introducing the study, sequencing the interview, locating required documents, and conducting unobtrusive observations. To ensure consistency, all checklists were completed electronically using a secure, web-based form on smart tablets. The electronic instrument was designed with domain-specific sections, built-in skip logic, mandatory fields for critical items, and automated range checks to minimize missing or inconsistent data. Entries were time-stamped and uploaded in real time (or synced at the end of the site visit where connectivity was limited). The primary researcher remotely monitored incoming submissions during the eight-week data-collection period, queried anomalies when needed, and provided feedback to ensure uniform application of the checklist across facilities. The checklist and instructions were developed using an online platform named Porsline so that interviewers could enter responses electronically on-platform using tablets, thereby eliminating paper forms. Before each visit, interviewers coordinated with facility managers and staff of each PHC center. Data were collected on site at each facility using three complementary techniques: 1) a structured interview with the facility's designated focal person (e.g., general physician, Behvarz/community health worker, family healthcare provider) to elicit responses to each checklist item; 2) a targeted review of documentary evidence relevant to every sub-item within each domain (e.g., equipment logs, training records, supervision reports, referral registers, and information-system printouts); and 3) direct field observation to verify the presence, functionality, and use of infrastructure, equipment, and processes described by respondents. Interviewers first confirmed informed consent, then completed the checklist item-by-item while triangulating interview responses against documents and observations; in case of discrepancy, the documentary/observational evidence prevailed and notes were recorded. Data collection spanned an 8-week period (November 2019 – January 2020). The principal investigator supervised all stages of data collection; the uploaded digital forms also were monitored in real time to verify completeness and accuracy.

TABLE 1: VALIDITY AND RELIABILITY OF THE READINESS CHECKLIST BY DOMAIN

Domain	Number of items	CVI*	CVR**	Cohen's κ *** (inter-rater)	Min &max scores	
Accessibility	24	0.79	0.84	0.86	CCHC	0-44
					HP	0-32
					HH	0-32
Human resources	24	1.00	1.00	0.91	CCHC	0-22
					HP	0-10

					HH	0-10
Medical equipment and supplies	61	0.94	0.87	0.87	CCHC	0-10
					HP	0-34
					HH	0-32
Information system	14	0.91	0.83	0.84	CCHC	0-28
					HP	0-16
					HH	0-16
Care system	7	0.95	1.00	0.88	CCHC	0-14
					HP	0-12
					HH	0-12

* CVI: Content Validity Index; ** CVR: Content Validity Ratio; ***κ: Cohen's kappa for inter-rater reliability)

DATA ANALYSIS

We scored each facility on each checklist indicator and then categorized scores into three levels of readiness: "good" (≥ 76% of maximum score), "moderate" (51–75% of maximum score), or "poor" (≤ 50% of maximum score). Indicators not applicable to certain facility types, based on the PHC organizational structure, were recorded as NA and excluded from scoring .We aggregated these scores for each domain and facility type. Descriptive statistics (frequencies, percentages, means) were used to summarize readiness levels. We present results for each domain stratified by facility type (CCHC, HP, HH) and by location (urban vs. rural) as applicable. All analyses were performed using SPSS v.22.

ETHICAL APPROVAL AND CONSENT

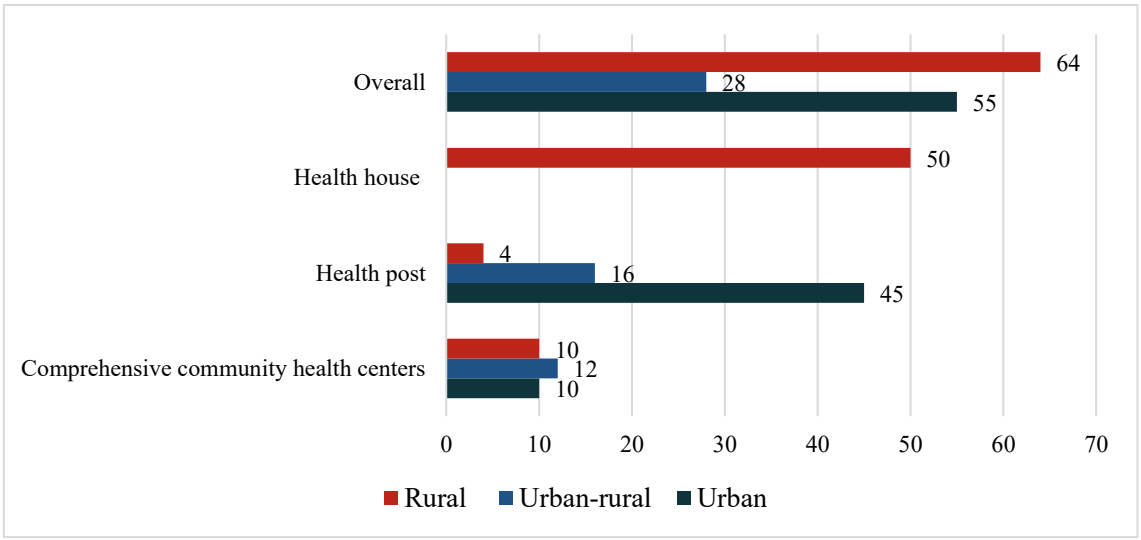
This study received ethical approval from the ethics committee of Kerman University of Medical Sciences with ID number IR.KMU.REC.1398.406. All participants provided written informed consent before participating in the study, ensuring their voluntary and informed participation in accordance with ethical standards.

RESULTS

FACILITY CHARACTERISTICS

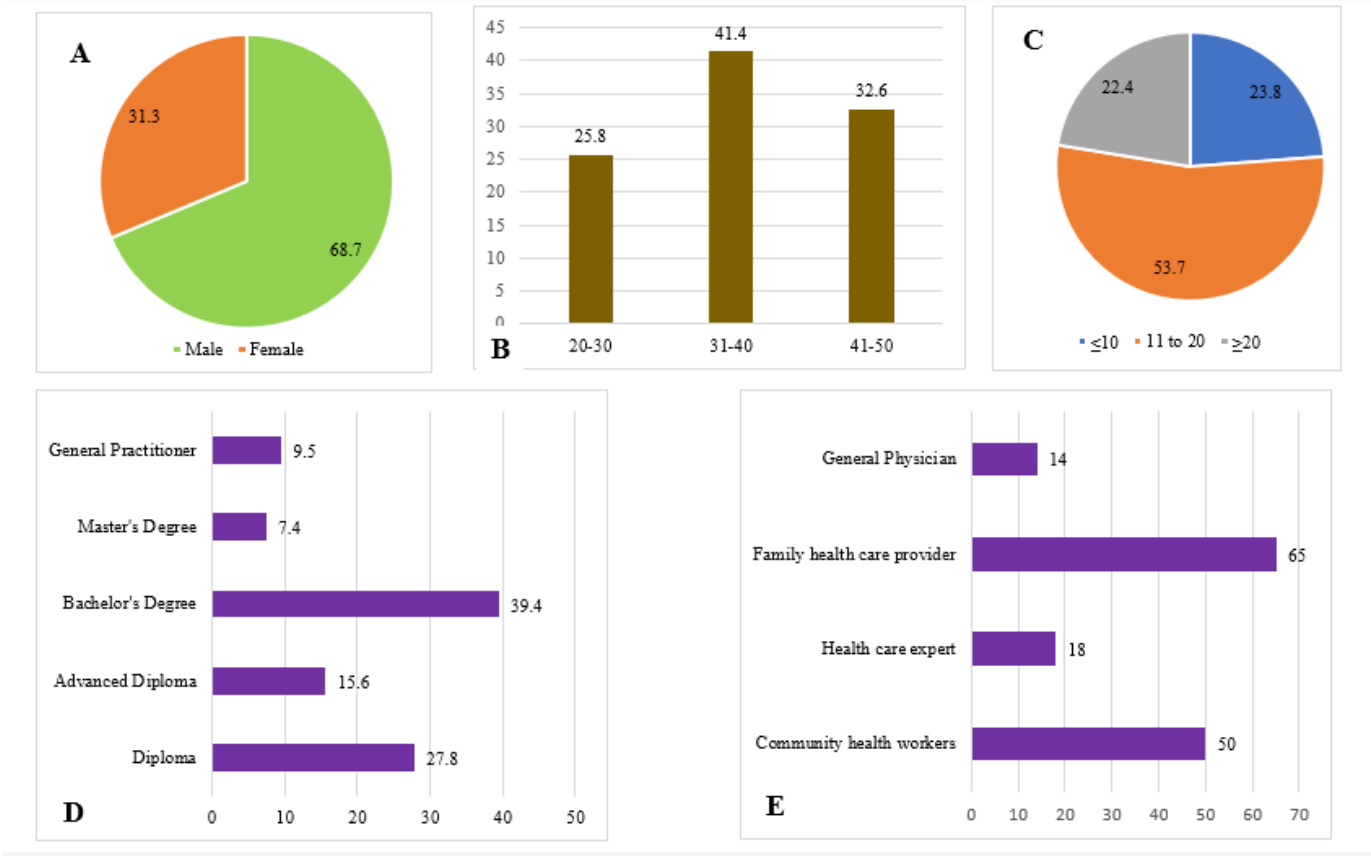
A total of one hundred and forty-seven PHC facilities were evaluated (32 CCHCs, 65 HPs, 50 HHs). The majority of these facilities (about 56%) are located in urban or mixed urban–rural areas, while roughly 44% are in purely rural areas. Here, "urban–rural" denotes centers situated in towns that serve both urban and surrounding rural populations. Details on the number of centers, stratified by the type of population covered (rural, urban, and mixed rural–urban), are presented in Figure 1.

FIGURE 1: CHARACTERISTICS OF HEALTH FACILITIES BY COVERED POPULATION



One focal point employee from each PHC facility center participated as interviewee, comprising family healthcare providers, health care expert, community health worker, and family and general physicians. The majority of the respondents were male, accounting for 67.7%, and the highest proportion of respondents fell into the 31-40 age group, with the majority (39.4%) holding a bachelor's degree. Additionally, nearly half of the respondents (53.7%) had work experience of 11-20 years in the study (Figure 2).

FIGURE 2: DEMOGRAPHIC CHARACTERISTICS OF THE STUDY PARTICIPANTS: A) GENDER B) AGE C) WORK EXPERIENCE D) EDUCATION E) JOB



HEALTH FACILITIES READINESS

Focusing on CCHCs, the information system and care system domains showed the strongest performance, with 29 out of 32 CCHCs (90.6%) in the good range in each domain and none rated poor. The accessibility and human resources domains also performed well, with no facilities receiving a poor score in these areas. In contrast, the medical equipment and supplies domain was the weakest for CCHCs: only 10 out of 32 CCHCs (31.2%) achieved a good score in this domain, while 5 CCHCs (15.6%) were rated poor in terms of medical equipment and supplies availability.

For HPs, the care system domain had the best performance, with 54 out of 65 HPs (83%) in the good range and none in poor. The accessibility and information system domains were also strong (about two-thirds of HPs good). Notably, the medical equipment and supplies domain was very problematic for health posts: none of the 65 HPs achieved a good score in medical equipment and supplies availability, and 53 HPs (81.5%) were rated poor in this domain.

Among HHs, the accessibility domain was excellent– 48 of 50 health houses (96%) had good accessibility (e.g., acceptable travel distance, waiting times) and zero were poor. The human resources domain was also high, with 44 HHs (88%) scoring good (largely because each health house had its trained Behvarz in place). However, similar to HPs, the medical equipment and supplies domain was the weakest area for health houses: 27 out of 50 HHs (54%) were rated poor in medical equipment and supplies, indicating that over half of the rural health houses lacked necessary medical devices or diagnostics. (Table 2)

TABLE 2: HEALTH FACILITIES READINESS SCORES BY CENTERS TYPES

Healthcare centers	Dimensions	Health facilities scores								
		≤50			50-75			≥75		
		Mean	Frequency	Percent	Mean	Frequency	Percent	Mean	Frequency	Percent
Comprehensive community health centers	Accessibility	0	0	0	24.7	9.0	28.1	33.2	23.0	71.8
	Human resource	0	0	0	10.9	12.0	37.5	15.3	20.0	62.5
	Medical equipment and supplies	37.6	5.0	15.6	69.6	17.0	53.1	97.6	10.0	31.2
	Information system	0	0	0	16.3	3.0	9.3	22.2	29.0	90.6
	Care system	0	0	0	8.6	3.0	9.3	13.8	29.0	90.6
Health post	Accessibility	14.0	2.0	3.0	20.0	20.0	30.7	28.8	43.0	66.1
	Human resource	0	0	0	2.6	25.0	38.4	4.0	40.0	61.5
	Medical equipment and supplies	11.6	53.0	81.5	19.0	12.0	18.4	0	0	0
	Information system	6.0	2.0	3.0	10.7	20.0	30.7	14.6	43.0	66.1
	Care system	0	0	0	7.4	11.0	16.9	11.5	54.0	83.0
Health house	Accessibility	0	0	0	20.0	2.0	4.0	30.2	48.0	96.0
	Human resource	0	0	0	2.6	6.0	12.0	4.0	44.0	88.0
	Medical equipment and supplies	12.6	27.0	54.0	17.9	22.0	44.0	26.0	1.0	2.0
	Information system	0	0	0	10.4	22.0	44.0	14.8	28.0	56.0
	Care system	5.0	2.0	4.0	7.0	10.0	20.0	11.8	38.0	76.0
Overall	Accessibility	14.0	2.0	1.3	21.4	31.0	21.0	30.3	114.0	77.5
	Human resource	0	0	0	4.9	43.0	29.2	6.1	104.0	70.7
	Medical equipment and supplies	13.5	85.0	57.8	35.4	51.0	34.6	91.0	11.0	7.4
	Information system	6.0	2.0	1.3	10.9	45.0	30.6	16.9	100.0	68.0
	Care system	5.0	2.0	1.3	7.4	24.0	16.3	12.1	121.0	82.3

DETAILED INDICATOR PERFORMANCE

We further examined specific indicators within each domain (Table 3–5 present these for accessibility, human resources, medical equipment and supplies, and Information & Care systems, respectively).

Regarding accessibility, the waiting time for services received a "good" rating in the vast majority of facilities. A breakdown shows that 100% of CCHCs, 84.6% of HPs, and 94% of HHs attained high scores for prompt service delivery. (Table 3)

TABLE 3: ACCESSIBILITY INDICATORS SCORES BY CENTERS TYPES

Accessibility indicators	Comprehensive community health centers			Health post			Health house			Overall		
	≤50	50-75	≥75	≤50	50-75	≥75	≤50	50-75	≥75	≤50	50-75	≥75
Services provision	0	6(18.7)	26(81.2)	5(7.6)	19(29.2)	41(63)	0	2(4)	48(96)	5(3.4)	27(18.3)	115(78.2)
Identification and patients Care	1(3.1)	14(43.7)	17(53.1)	5(7.6)	33(50.7)	27(41.5)	0	19(38)	31(62)	6(4)	66(44.8)	75(51)
Accessibility of individuals aged over thirty to PEN	0	4(12.5)	28(87.5)	0	24(36.9)	41(63)	0	10(20)	40(80)	0	38(25.8)	109(74.1)
Availability of a facility for laboratory services	6(18.7)	4(12.5)	22(68.7)	NA	NA	NA	NA	NA	NA	6(18.7)	4(12.5)	22(68.7)
Availability of a dedicated injection room for emergencies	1(3.1)	10(31.2)	21(65.6)	NA	NA	NA	NA	NA	NA	1(3.1)	10(31.2)	21(65.6)
Medical check-ups for hypertensive and diabetic patients	0	8(25)	24(75)	0	16(24.6)	49(75.3)	0	6(12)	44(88)	0	30(20.4)	117(79.5)
No difference in service delivery between urban and rural areas	0	10(31.2)	22(68.7)	1(1.5)	17(26.1)	47(72.3)	0	4(8)	46(90)	1(1.5)	31(21)	115(78.2)
Convenient access for the population to service locations	2(6.2)	5(15.6)	25(78.1)	4(6.1)	12(18.4)	49(75.3)	0	0	50(100)	6(4)	17(11.5)	125(85)
The desirability of waiting time for service reception	0	0	32(100)	0	10(15.3)	55(84.6)	0	3(6)	47(94)	0	13(8.8)	134(91.1)

*NA = Not applicable

In the human resources domain, physician training received a "good" or higher rating in 23 out of 32 CCHCs (71.8%). Similarly, community health worker training was rated well in 21 out of 32 CCHCs (65.6%). The majority of HPs and HHs also achieved good scores in this area, with (83%) and (96%) respectively. However, in CCHCs, only 50% of centers received a "good" or higher rating for personnel presence according to the development plan, indicating a significant gap in this area. (Table 4, upper section)

In the medical equipment and supplies domain (Table 4, bottom section), the availability of basic screening equipment was good in most centers. Specifically, 21 Comprehensive Health Centers (34.6%) and 10 Health Posts (15.3%) achieved a high score of 75, indicating good availability. Regarding conducting essential tests, more poor scores were observed in CCHCs, with 12 centers (37.5%) receiving poor ratings. In contrast, within HHS and HPs, the "Availability of medical and diagnostic devices" domain garnered the poorest scores, with 48 (73.8%) and 49 (98) respectively.

TABLE 4: SCORES OF HARDWARE DIMENSION INDICATORS BY CENTERS TYPES

Human resource indicators	Comprehensive community health centers			Health post			Health house			Overall		
	≤50	50-75	≥75	≤50	50-75	≥75	≤50	50-75	≥75	≤50	50-75	≥75
Physician training	2(6.2)	7(21.8)	23(71.8)	NA	NA	NA	NA	NA	NA	2(6.2)	7(21.8)	23(71.8)
Community health worker training	0	11(34.3)	21(65.6)	0	11(16.9)	54(83)	0	2(4)	48(96)	0	24(16.3)	123(83.6)
Midwife training	2(6.2)	4(12.5)	26(81.2)	NA	NA	NA	NA	NA	NA	2(6.2)	4(12.5)	26(81.2)
Other staff member training	2(6.2)	9(28.1)	21(65.6)	NA	NA	NA	NA	NA	NA	2(6.2)	9(28.1)	21(65.6)
Development of training programs	0	2(6.2)	30(93.7)	2(3)	18(27.6)	45(69.2)	0	6(12)	44(88)	2(1.3)	26(17.6)	119(80.9)
Seasonal training	0	3(9.3)	29(90.6)	NA	NA	NA	NA	NA	NA	0	3(9.3)	29(90.6)
Training committees' formation	0	7(21.8)	25(78.1)	NA	NA	NA	NA	NA	NA	0	7(21.8)	25(78.1)
Personnel presence according to development plan	3(9.3)	13(40.6)	16(50)	NA	NA	NA	NA	NA	NA	3(9.3)	13(40.6)	16(50)
Medical equipment and supplies indicators	**Comprehensive community health centers**			**Health post**			**Health house**			**Overall**		
	≤50	**50-75**	**≥75**	**≤50**	**50-75**	**≥75**	**≤50**	**50-75**	**≥75**	**≤50**	**50-75**	**≥75**
Basic screening equipment	0	11(34.3)	21(65.6)	5(7.6)	50(76.9)	10(15.3)	0	30(60)	20(40)	5(3.4)	91(61.9)	51(34.6)
Availability of medical and diagnostic devices	1(3.1)	1(3.1)	30(93.7)	48(73.8)	12(18.4)	5(7.6)	49(98)	1(2)	0	98(66.6)	14(9.5)	35(23.8)
Conducting essential tests	12(37.5)	8(25)	12(37.5)	32(49.2)	27(41.5)	6(9.2)	11(22)	36(72)	3(6)	55(37.4)	71(48.2)	21(14.2)
Availability of essential medications	11(34.3)	10(31.2)	11(34.3)	NA	NA	NA	NA	NA	NA	11(34.3)	10(31.2)	11(34.3)

In the information system domain (Table 5, upper section), provision of individual computers for each team member was nearly universal in CCHCs and high in HPs. Specifically, 96.8% of CCHCs and 81.5% of HPs had a dedicated computer for every healthcare team member. In Patient data collection and support, we had the lowest good scores across all centers.

In the care system domain (Table 5, bottom section), systematic supervision of health centers by higher levels was excellent, particularly in CCHCs. For example, 93.7% of CCHCs received good scores on supervision and regular monitoring, and even among the more peripheral health houses, about 82% were rated good in this aspect. Conversely, Operational program updates and monitoring at health center command displays had the lowest performance scores in this domain.

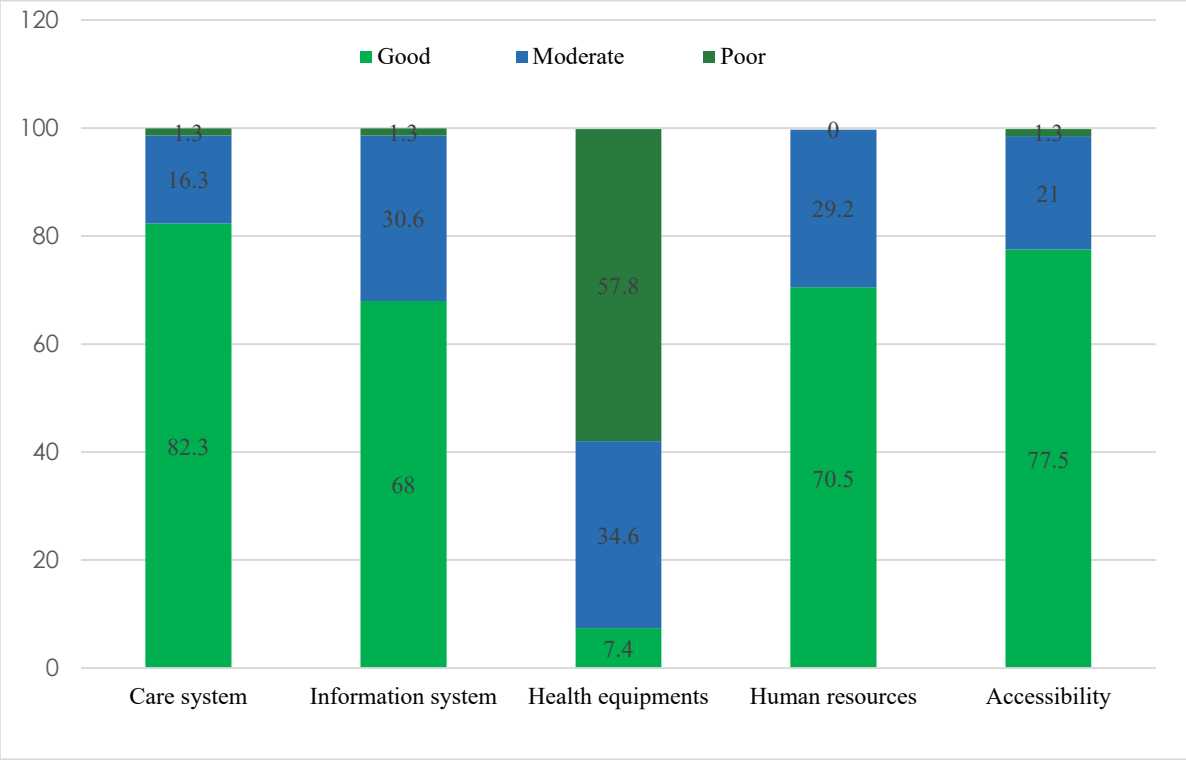
TABLE 5: SCORES OF SOFTWARE DIMENSION INDICATORS BY CENTERS TYPES

Information system indicators	Comprehensive community health centers			Health post			Health house			Overall		
	≤50	50-75	≥75	≤50	50-75	≥75	≤50	50-75	≥75	≤50	50-75	≥75
Electronic patient referrals within the SIB system to higher levels	0	5(15.6)	27(84.3)	2(3)	22(33.8)	41(63)	2(4)	18(36)	30(60)	4(2.7)	45(30.6)	98(66.6)
Individual computers for each healthcare team member	0	1(3.1)	31(96.8)	2(3)	10(15.3)	53(81.5)	4(8)	25(50)	21(42)	6(4)	36(24.4)	105(71.4)
Interanet connectivity establishment	0	10(31.2)	22(68.7)	5(7.6)	17(26.1)	42(64.6)	6(12)	20(40)	24(48)	11(7.4)	47(31.9)	88(59.8)
Patient data collection and support	1(3.1)	11(34.3)	20(62.5)	2(3)	23(49.2)	31(47.6)	0	21(42)	29(58)	3(2)	64(43.5)	80(54.4)
Care system indicators	**Comprehensive community health centers**			**Health post**			**Health house**			**Overall**		
	≤50	50-75	≥75	≤50	50-75	≥75	≤50	50-75	≥75	≤50	50-75	≥75
Regular monitoring program for health centers	0	2(6.2)	30(93.7)	NA	NA	NA	NA	NA	NA	0	2(6.2)	30(93.7)
Systematic supervision of health centers by higher levels	0	2(6.2)	30(93.7)	0	7(10.7)	58(89.2)	0	9(18)	41(82)	0	18(12.2)	131(89.1)
Submission of inspection reports from higher levels to health centers	0	3(9.3)	30(93.7)	0	8(12.3)	57(87.6)	0	10(20)	40(80)	0	21(14.1)	126(85.7)
Validation of data accuracy in systems by evaluation teams	0	4(12.5)	29(90.6)	0	11(16.9)	54(83)	0	12(24)	38(76)	0	27(18.3)	12.(81.6)
Timely follow-up and referral of patients	0	2(6.2)	28(87.5)	0	13(20)	52(80)	2(4)	8(16)	40(80)	2(1.3)	21(14.2)	122(82.9)
Operational program updates and	0	4(12.5)	30(93.7)	0	23(35.3)	42(64.6)	0	14(28)	36(72)	0	41(27.8)	106(72.1)

monitoring at health center command displays												
Submission of monitoring feedback by health centers to higher levels	0	2(6.2)	28(87.5)	0	12(18.4)	53(81.5)	0	14(28)	36(72)	0	28(19)	119(80.9)

Overall, considering all facilities in Kerman, the care system domain had the greatest proportion of facilities with good readiness (82.3% of all centers scored good in care coordination and supervision). Following care system, accessibility (77.5% good), human resources (70.7% good), and information system (68.0% good) were strong areas across the network. The domain with the most significant shortfall was medical equipment and supplies, with only 34.6% of facilities scoring good and 57.8% of all facilities scoring poor in this domain. This highlights a widespread lack of medical equipment and supplies in the PHC network. (figure 3)

FIGURE 3: OVERALL SCORES OF HEALTH FACILITIES READINESS



DISCUSSION

This study aimed to investigate healthcare facilities' readiness to deliver IraPEN services in Kerman, highlighting both strengths and weaknesses in the current system and pinpointing areas for improvement in NCD management.

Based on our findings, in Kerman's PHC network the strongest dimensions were the *care system* and *information system*, while the *medical equipment and supplies* dimension was the weakest. Notably, the *human resources* dimension also had relatively few facilities in the "poor" category (only 0–4% poor across all centers), indicating that basic staffing and training have been addressed to some extent. These results mirror concerns raised in several countries about equipment shortages in PHC. Studies from Myanmar, the West Pacific, and Kyrgyzstan have similarly reported insufficient medical equipment and supplies as a major barrier in PEN implementation [13–17] Our data provide local evidence of this issue: more than

half of the facilities had suboptimal equipment availability, which could impede effective NCD screening and management.

In terms of access to NCD services, our facilities performed well overall – for example, waiting times for patients were rated satisfactory in almost all centers. This finding is encouraging and aligns with outcomes from the Occupied Palestinian Territory's PEN pilot, where reduced patient waiting time was noted as a significant improvement [18]. Furthermore, in the accessibility domain, most indicators were rated good, suggesting that Iran's PHC system offers generally good accessibility to NCD care. However, a study in Nepal by Gyawali et al. found that many individuals lacked access to NCD prevention and control services, in contrast to our findings [19]. The Nepalese experience attributed this gap to insufficient government budgeting for primary healthcare NCD programs and a higher priority given to curative services over preventive care. These differences underline how sustained investment and prioritization of PHC (as in Iran's Health Transformation Plan) can improve accessibility, whereas neglecting PHC funding (as reported in Nepal) can lead to service shortfalls. It is worth noting that Iran's PHC infrastructure, with its extensive rural network of health houses, likely contributes to better access, whereas in Nepal the lack of such an extensive network was a limiting factor.

Our study's findings show that *patient visits for managing blood pressure and diabetes* were being conducted and recorded properly at all levels (CCHCs, HPs, HHs) – these indicators received "good" readiness scores across the board. This suggests that the care protocols for common NCDs (hypertension, diabetes) are largely being followed. A similar positive outcome was observed in Tajikistan, where an evaluation noted improved blood pressure screening and control in primary care centers after implementing essential NCD interventions, echoing our results [20]. Likewise, in Moldova, PEN implementation centers saw better blood pressure control after one year [21]. Our findings reinforce these experiences: when PEN protocols (like regular BP checks and follow-ups) are put into practice, measurable improvements in chronic disease management can occur even within a year.

In the human resources dimension, *community health worker training* stood out with the highest good score (virtually all health houses had adequately trained Behvarz). This reflects the strength of Iran's PHC system in training and deploying community health workers. However, other HR indicators revealed gaps: for instance, many centers did not have the full complement of physicians or nurses as per the staffing norms, and ongoing in-service training for clinical staff (physicians, midwives, etc.) was lacking in a significant number of facilities (these were the indicators with highest "poor" scores in HR). From these results, we infer that human resource management in the IraPEN program has room for improvement. These findings indicate that further attention to workforce planning and staff development may improve readiness for IraPEN implementation. This conclusion aligns with findings from Nigeria's PEN implementation, where *Okpetu et al.* identified human resource shortages as a critical issue hindering NCD preventive services, urging policymakers to develop fundamental solutions [22]. Tripathy et al. likewise noted that insufficient training of staff is a major challenge in PEN effectiveness [7]. Our context is similar: despite having a strong PHC workforce base (Behvarz), there is a need to ensure adequate numbers of skilled clinicians in rural centers and to plan regular training to update staff on NCD care protocols. Policymakers might need to consider incentives for rural service and stronger workforce planning to fill these gaps.

The equipment domain was clearly the weakest link in facility readiness. Key equipment indicators – such as availability of advanced diagnostic devices (like lipid testing or ECG machines) – had very low scores in many facilities. Even essential drug availability was inconsistent, with half of centers lacking one or more medications for managing diabetes, hypertension, or other NCDs. These shortages point to systemic issues in supply chain and resource allocation. Our findings suggest that reorienting the health system to prioritize NCD supplies is urgently needed. This includes not only procurement of equipment but also maintenance and continuous supply of consumables (test strips, reagents, etc.). A reallocation of budget to PHC NCD care, improving inventory management, and perhaps leveraging technology (e.g., telemedicine to extend services where equipment is lacking) could be part of the solution. A qualitative study from Ethiopia similarly indicated gaps between different levels of PHC in terms of capacity and readiness, emphasizing that policymakers need to commit resources and leadership to address such weaknesses [23].

Within the information system domain, our facilities scored well on having basic computer infrastructure for health teams, which is encouraging. This indicates that the Health Transformation Plan's investments in health information technology (like the SIB electronic health record system) are paying off at least in hardware deployment. However, the stark finding was the lack of internet connectivity, particularly in rural and remote posts and houses. Only about one-third of facilities overall had internet connections established, and many health houses had none. This hinders real-time data entry, teleconsultation, and accessing updated guidelines. It also resonates with the experiences reported by Samuel et al. in Kenya, where insufficient digitalization was common, and with an Iranian study by Jafari et al. which pointed out that weak internet infrastructure is a serious barrier to e-health services [24, 25]. Our data underscore that to fully realize the benefits of digital health (which is a component of PEN), Iran must invest in infrastructure – extending broadband or other connectivity solutions to rural clinics. Encouragingly, aside from connectivity, other aspects like electronic record-keeping seemed to be adopted (as indicated by high scores in data collection and support). Therefore, if connectivity issues are solved, the PHC network is poised to effectively use digital tools to enhance NCD care (for example, electronic referrals and telemedicine, which only a minority of centers could currently do).

The care system domain highlights the programmatic aspects of NCD care – supervision, feedback, patient follow-up, and quality improvement. We found that systematic supervision (regular monitoring visits and reporting from higher levels to the centers) was occurring quite well in our study setting. Over 85% of facilities overall reported good practices in receiving supervisory visits and feedback. This is a positive finding, as effective supervision is linked to higher productivity and better identification of service delivery gaps. Our study likely benefited from the fact that Kerman University of Medical Sciences actively oversees the health network, reflecting a strong governance component. On the other hand, timely patient follow-up and referral was the lowest-scoring indicator in the care system. This suggests that once patients are referred (for example, from a health post to a specialist at a higher-level facility), the tracking of whether they went and whether they returned for follow-up is weak. Strengthening this aspect might involve establishing clearer referral pathways and follow-up registers, possibly aided by the information system (if connectivity improves).

Interestingly, the urban-rural gap was also evident here: urban CCHCs, which are closer to specialized services, had better follow-up rates than rural HHs, where patients may need to travel farther and are harder to track. Introducing a family physician program more robustly in urban and rural areas – as Iran has started for rural areas – could help improve follow-up, since each family physician would be responsible for the continuum of care of enrolled individuals. Studies have shown that when health workers actively follow up with patients (through phone or community visits), compliance and outcomes improve. Our findings on supervision correlate with those from an Iranian military health system study, which found that strong monitoring leads to early identification and resolution of service weaknesses [26]. Thus, reinforcing supportive supervision (already relatively good) and adding patient follow-up mechanisms are recommended steps to enhance the care system dimension.

STRENGTHS AND LIMITATIONS OF THE STUDY

A strength of this study is that it covered all PHC service delivery points in the district, providing a comprehensive picture rather than a sample. This lends confidence that our results are representative of the PHC system's status in our context and possibly similar contexts nationwide. We also adapted a standard WHO-PEN questionnaire, which means our findings can be benchmarked against other regions or countries implementing PEN. The timing of the study, however, coincided with the COVID-19 pandemic onset, which posed challenges for data collection and might have temporarily affected service readiness (e.g., some resources diverted to COVID response). We mitigated this by supplementing on-site observation with document review when direct observation was limited. Additionally, our study is descriptive and cross-sectional – it identifies readiness gaps but cannot ascertain causes or long-term outcomes. We did not include outcome measures like NCD control rates (that would require a longer follow-up or separate study). Another limitation is that our readiness scoring, while systematic, relied in part on self-reported information (e.g., staff reports of training received), which could introduce bias. We attempted to validate such information through records where possible.

Despite these limitations, our study provides valuable insights into the implementation gaps (especially equipment and workforce issues) in a real-world primary care NCD program. It highlights how a seemingly well-designed program can be

hampered by logistic issues, and conversely, how certain foundations (like a strong PHC network and good supervision) can facilitate program success. The findings point to important *gaps* – such as the need for better equipment and connectivity – and illustrate how a fragmented approach (where some components are strong and others weak) can impede overall progress in NCD services. Policymakers can use this information to target investments (e.g., equip rural clinics, hire/train staff) and to refine strategies (e.g., strengthen the referral loop via family physicians and digital health) to ensure that an integrated NCD program like IraPEN achieves its full potential in strengthening Iran's PHC.

CONCLUSION

This study provides a comprehensive assessment of IraPEN readiness across PHC facilities in Kerman district and identifies both strengths and areas requiring further improvement. Overall, readiness was highest in the care system and information system domains, reflecting relatively strong performance in monitoring, supervision, referral tracking, and routine program implementation. In contrast, the medical equipment and supplies domain demonstrated the lowest readiness levels, particularly among health posts and health houses, indicating important gaps in the availability of essential equipment and diagnostic resources required for effective NCD service delivery.

The findings suggest that strengthening IraPEN implementation should prioritize investment in essential medical equipment and supplies, enhancement of referral and follow-up mechanisms, and continued capacity-building of the PHC workforce through regular training and supportive supervision. Addressing these readiness gaps may improve the quality, continuity, and effectiveness of NCD prevention and management services within the PHC system.
A coordinated approach targeting infrastructure, workforce capacity, and service-delivery resources is essential to further strengthen facility readiness and support the sustainable implementation of IraPEN in PHC settings.

ETHICAL APPROVAL AND CONSENT:

This study received ethical approval from the ethics committee of Kerman University of Medical Sciences with ID number IR.KMU.REC.1398.406. All participants provided written informed consent before participating in the study, ensuring their voluntary and informed participation in accordance with ethical standards.

AUTHORS' CONTRIBUTIONS

Conceptualization: VYF, MGH, ZZ
Data curation: MJ, MGH
Formal analysis: VYF, MGH
Investigation: MGH, ZZ
Methodology: MGH
Software: MGH
Project administration: VYF
Supervision: VYF, MHM, MSH
Validation: VYF
Visualization: VYF, MGH, ZZ
Writing – original draft: VYF, MGH, ZZ
Writing – review & editing: VYF, ZZ, MHM, MSH, MJ, MGH

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AVAILABILITY OF DATA AND MATERIALS:

All data generated or analyzed during this study are included in this published article.

COMPETING INTERESTS

The authors declare that they have no competing interests

ABBREVIATION

NCD: Non-communicable Diseases
WHO-PEN: WHO package of essential non-communicable diseases
IraPEN: Iran package of essential non-communicable diseases
PHC: Primary Health Care
WHO: World Health Organization
CCHC: Comprehensive Community Health Center
HP: Health Post
HH: Health House
MoHME: Ministry of Health and Medical Education
CVI: Content Validity Index
CVR: Content Validity Ratio

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