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Original Research Article

Multi-cadre human resource gaps and their association with service delivery and NCD screening in urban health and wellness centres, Ahmedabad: a cross-sectional study

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ABSTRACT

Background: Urban health and wellness centres (HWCs) under India's Ayushman Bharat programme provide comprehensive primary health care, including universal screening for non-communicable diseases (NCDs). Achieving screening targets depends heavily on multi-cadre workforce availability. To assess multi-cadre human resource gaps in Urban HWCs across Ahmedabad and analyse their association with service delivery and universal NCD screening.
Methods: A cross-sectional analytical study was conducted from January 2022 to December 2022 in 14 Urban HWCs selected purposively. Staffing availability across clinical and outreach cadres was benchmarked against Indian public health standards (IPHS) 2022 guidelines. A composite human resource gap index (HRGI) was formulated and analysed against different health outcomes. Predictive models were evaluated using bivariate linear and logistic regression.
Results: Facility-based clinical cadres demonstrated robust baseline adequacy in comparison to community outreach cadres, which showed severe deficits. Multi-Purpose Workers faced 83.1% vacancy rate and Accredited Social Health Activist (ASHA) placement was highly erratic (10%–100%). The composite HRGI revealed significant inverse linear relationships with population-level CBAC coverage (β=-0.420, $p<0.001$, $R2=0.710$) and monthly average OPD attendance (β=-18.600, $p<0.001$, $R2=0.640$). Facilities operating with low overall staffing gaps (HRGI<30%) had significantly higher odds of achieving adequate universal NCD screening outputs (COR=3.812, 95% CI: 2.104–6.908; $p<0.001$).
Conclusions: Physical expansion of urban HWCs failed to achieve preventive primary health targets especially NCD screening due to depleted community-level outreach workforces. Bridging frontline staffing deficits is a critical prerequisite to optimizing universal NCD risk identification.

Keywords: Mass screening, Non-communicable diseases, Primary healthcare, Urban HWCs, Workforce

INTRODUCTION

There is a global shift in epidemiological transition of primary burden of disease from infectious and communicable vectors to chronic non-communicable conditions, which account for 71% of global mortality approximately.[1] In India, the burden of NCDs mainly involving cardiovascular diseases, chronic respiratory conditions, cancers and diabetes mellitus is growing rapidly, accounting for nearly 60% of all mortalities.[1,2] This public health pressure is particularly concentrated in rapidly expanding urban localities, where sedentary lifestyles, nutritional shifts and environmental changes accelerate the onset of metabolic risk factors.[3] To address

these challenges, the Government of India launched the Ayushman Bharat initiative, which pioneered the creation of HWCs across the country.[4] This program represented a structural reorganization of entire health system, moving away from selective, vertical healthcare packages toward the universal delivery of comprehensive primary health care (CPHC).[4,5] Urban HWCs are strategically located within municipal limits to provide these essential services to vulnerable, marginalized and slum-dwelling urban populations.[6,7]

A major operational mandate of the urban HWC framework is the implementation of universal screening program for common NCDs among all individuals aged 30 years and older.[2,8] The operational sequence for universal screening begins in the community, where frontline health workers perform population enumeration and complete the community based assessment checklist (CBAC).[6,8] The CBAC form helps in individual health risk assessment including age, tobacco consumption, alcohol use, waist circumference measurements, physical activity levels and family history of chronic illness.[8] To support this newly developed service delivery model, the Ministry of Health and Family Welfare released the updated IPHS 2022 guidelines.[9] These standards define strict cadre-wise staffing baselines for primary health care centres, setting required compositions for medical officers, staff nurses, pharmacists, laboratory technicians, MPWs and accredited social health activists (ASHAs).[9]

However, health systems research globally do not indicate that nominal adherence to institutional staffing norms automatically translate into effective service delivery unless these numbers are adequately balanced with localized workloads and community demand.[10,11] The World health organization's workload indicators of staffing need (WISN) framework emphasizes that severe local health work shortages can emerge even within established facilities if the demand for community outreach exceeds real operational capacity.[12,13]

While the physical infrastructure of urban HWCs has expanded rapidly across major cities, studies to analyse the role of multi-cadre workforce gaps in influencing specific CPHC outcomes remains limited.[7] This study addresses this research gap and examine the exact relationship between multi-cadre human resource deficits and critical performance metrics specifically OPD volumes, CBAC tracking efficiency, universal hypertension and diabetes screening and teleconsultation platform use across the urban primary health centres of Ahmedabad.

METHODS

Study design and setting

A facility-based, cross-sectional study was conducted from January 2022 to December 2022 in Urban HWCs of Ahmedabad municipal corporation (AMC). Fourteen structurally functional Urban HWCs (2 from each zone selected randomly) satisfying the inclusion criteria distributed across 7 urban administrative zones (Central, North, South, North west, South west, East and West) were selected purposively for the study. Data collection, facility audits and statistical tracking were completed during the 2022 operational reporting cycle.

Inclusion criteria

All Urban HWCs under AMC that were fully functional during the study period and had complete records on human resources, outpatient services, CBAC coverage, NCD screening activities and teleconsultation services were eligible for inclusion.

All the health personnels belonging to different sanctioned cadres posted at the selected Urban HWCs for 2022 operational reporting cycle were included for assessment of workforce availability. Data was obtained for all the patients from the official records.

Exclusion criteria

Urban HWCs that were newly established (after 31st December 2021), undergoing major restructuring during the study period or had incomplete or unavailable administrative or service delivery records were excluded from the study. Patient level data that was incomplete or duplicate were excluded from the analysis.

Data sources and verification protocols

Physical visit was conducted to the selected urban HWCs and data was collected using standardised pre validated questionnaire, assessment checklist and records. To ensure data integrity, primary and secondary data were triangulated across multiple official record systems.

Human resource registers

Official municipal corporation attendance and roster logs were reviewed to verify the actual structural presence and functional deployment of health personnel across all cadres.

Clinical performance dashboards

Daily and monthly outpatient department (OPD) logs were checked to obtain real patient footfall volumes.

NCD tracking records

Physical and digitized copies of the CBAC files were verified against community registers.

E-sanjeevani teleconsultation logs

Digital activity histories on the national teleconsultation platform were reviewed to evaluate daily utilization rates.

Human resource assessment and classification framework

Workforce evaluation was guided by IPHS 2022 guidelines for urban health settings, which outline ideal baseline workforce numbers.[9] The structural data were analysed and interpreted within the contextual framework of WHO's workload-aware staffing models.[12]

To standardize the workforce deficit data across heterogeneous cadres, a standardized percentage-based health workforce availability classification system was established.

HR availability (%)= (physically available personnel across cadre/total mandated cadre personnel under IPHS 2022)×100

Based on this calculated percentage, individual centres and respective cadres were categorized into four operational tiers.

Adequate availability ≥90% of standard workforce requirement met.

Moderate deficit 70% to 89% of standard workforce requirement met.

Severe deficit 30% to 69% of standard workforce requirement met.

Highly severe deficit <30% of standard workforce requirement met.

Highly variable

Characterized by fluctuations ranging across the entire spectrum (10%-100%), uniquely applied to community-based urban ASHA distribution dynamics.

Composite human resource gap index

To analyse workforce shortages as a continuous variable rather than isolated cadre data, we constructed a composite human resource gap index (HRGI) for each facility. The index aggregated data across all clinical and outreach cadres, expressing the overall institutional workforce gap as a percentage.

HRGI (%)=((Required Personnel-Available Personnel)/Required Personnel)×100

An HRGI score of 0% indicates full compliance with IPHS human resource norms, while increasing values represented growing overall personnel shortages within the health care facility. None of the cadres were assigned specific importance in advance. Equal weighting was used due to lack of established empirical hierarchy among cadres. Sensitivity analysis was conducted by applying alternative weighting schemes, excluding individual cadres and modifying HRGI classification thresholds. The direction and magnitude of associations between HRGI and service delivery indicators remained stable across all models. The HRGI showed good construct validity as it consistently showed a negative relationship with CBAC coverage and OPD use across all tested models.

Definition of outcome variables

The structural impact of HRGI variance was measured against five key primary healthcare indicators:

OPD attendance volume

The average number of patients seeking curative primary consultations within a 30-day reporting window.

CBAC form coverage rate

The percentage of the target population (individuals aged 30 years and older in the catchment area) successfully registered and risk-profiled via the CBAC protocol.

Hypertension screening rate

The proportion of eligible adults screened for elevated systolic and diastolic blood pressure within the facility or during outreach.

Diabetes screening rate

The proportion of eligible adults screened via blood glucose tests within the facility or during outreach.

Teleconsultation platform utilization

The average number of digital teleconsultations successfully conducted per working day.

Ethical considerations

Ethical approval was obtained from the Institutional Review Board (IRB) (NHLIRB/2021/Aug/31) and necessary permissions were secured from the health departments of AMC and Ahmedabad district.

Statistical analysis

The gathered data was entered into Microsoft Excel and analysed using SPSS Version 26.0. Descriptive statistics was used to map cadre-specific availability across the 14 centres.

Bivariate linear regression models were used to analyse the impact of Composite HRGI on continuous outcomes (population-level CBAC coverage and monthly OPD volumes). Linear parameters were reported using standardized regression coefficients (β), coefficients of determination (R2) and corresponding p values. To

conduct univariate logistic regression, facilities were categorized into two cohorts: those with a low HR gap (HRGI<30%) and those with a high HR gap (HRGI > 30%).

Universal NCD screening adequacy (>50% coverage of eligible adult population) was treated as a binary outcome variable. The strength of these associations was reported using crude odds ratios (COR) alongside 95% confidence intervals (CI). The statistical significance threshold for all models was maintained at $p<0.05$.

RESULTS

Out of all the selected 14 HWCs for the study, 9 were converted into health and wellness centre in year 2019, whereas 2 were converted in 2017, 2 were converted in 2021 and 1 was converted in 2018.

Cadre-wise and facility-level health workforce

As shown in table 1, this study found 100% availability of medical officers and laboratory technicians across 7 zones of AMC. However, data entry operator (DEO) and Female health workers (FHWs) were moderately deficit (10%-15%) in the Urban HWCs studied.

The study revealed a clear structural division between availability of internal facility positions like medical officers, staff nurses, laboratory technicians etc and community-facing outreach positions which showed severe shortages with Male MPW showing just 16.9% availability while ASHA showing high variable distribution (10-100%). This means more than 80% of mandated male outreach positions across these urban centres remained vacant.

Table 2 demonstrates the presence of ASHA alongside achieved population-level CBAC risk-profiling. The facility-level breakdown revealed notable operational patterns. UHWCs like Stadium and Jamalpur, which operated with low ASHA availability (24% and 41% respectively) reported low CBAC coverage (12% and 10%). Conversely, Bapunagar maintained a 100% nominal ASHA roster but achieved just 11% CBAC coverage. It suggested that high nominal staff numbers do not always ensure high coverage. Additionally, New Gota reached 54% CBAC coverage despite a low nominal ASHA presence (32%).

Impact of workforce gaps on healthcare delivery

As shown in table 3, facilities classified as low deficit facilities (HRGI<30%) sustained high patient volumes between 3,000 and 4,500 per month in comparison to facilities with high overall deficits (HRGI>30%), where patient footfalls dropped to between 600 and 1,500 visits per month, demonstrating understaffing related OPD attendance degradation.

The overall human resource index showed clear links to direct clinical volumes. When workforce deficits grew, overall facility utilization declined, as shown by monthly patient volumes.

Table 4 found that facilities with low overall workforce gaps maintained high screening performance. Conversely, centres with higher workforce gaps showed significantly lower rates of CBAC data capture and routine NCD screening.

Across Urban HWCs, a consistent gradient was observed where increasing HRGI-based workforce deficits were associated with proportional reductions in CBAC coverage and NCD screening performance. Facilities with higher ASHA (70–88%) and MPW (30–50%) availability demonstrated CBAC coverage of 40–60% and screening performance of 60–80%, whereas facilities with critically low MPW availability (0–20%) showed CBAC levels below 25% and screening coverage below 30%, suggesting a linear relationship between workforce availability and preventive service delivery.

Digital healthcare tools also showed vulnerability to staffing and operational disruptions. Only the Stadium facility maintained a stable teleconsultation workflow, averaging 10 entries per day.

The remaining 13 evaluation sites averaged fewer than two teleconsultations daily, may be due to technical connectivity drops or internal staff shortages that forced doctors to prioritize crowded physical clinics over digital platforms. NCD screening camps were carried out at all HWCs with average frequency of 1 camp per week.

Quantitative regression and predictive models

Statistical validity of the relationships was tested using linear and logistic regression models to find the specific impact of the Composite HRGI on health outcomes in Table 5 and 6.

The linear models demonstrated a strong, statistically significant inverse relationship.

For every unit increase in a facility's overall human resource gap index, population-level CBAC risk capture dropped by 0.420% ($\beta=-0.420$, $p<0.001$). There was 71.0% variance in CBAC coverage ($R2=0.710$). Similarly, monthly OPD volume decreased significantly as the human resource gap index rose ($\beta=-18.600$, $p<0.001$, $R2= 0.640$).

The univariate logistic regression model found facilities with low overall health workforce shortages to have a 3.812 times higher chance of achieving adequate universal NCD screening rates compared to high-deficit facilities (COR=3.812, 95% CI: 2.104–6.908; $p<0.001$).

Table 1: Cadre-wise human resource availability against IPHS 2022 guidelines.

Evaluated health care cadre	Overall calculated availability (%)	Standardized operational classification
Medical officer (MBBS)	100	Adequate availability
Staff nurse	92.8	Adequate availability
Pharmacist	92.8	Adequate availability
Lab technician	100	Adequate availability
Data entry operator (DEO)	85-90	Moderate deficit
Female health worker (FHW ANM)	85	Moderate deficit
Multi-purpose worker (MPW-male)	16.9	Highly severe deficit
Accredited social health activist (ASHA)	10-100	Highly variable distribution

Table 2: Urban HWC ASHA availability vs. population-level CBAC coverage.

Evaluated urban HWC site	Local ASHA availability (%)	Achieved CBAC coverage (%)
Jamalpur	41	10
Madhupura	62	19
Arbudanagar	78	36
Odhav	72	35
Thakkarbapanagar	88	46
Bapunagar	100	11
Kankariya	54	59
Maninagar	29	27
New Ranip	69	16
Stadium	24	12
New Gota	32	54
Ambli	20	30
Jodhpur	34	29
Sarkhej	63	39

Table 3: Institutional HR gap tiers vs. monthly average OPD attendance volumes.

HR gap category (HRGI)	No. of HWCs	Monthly OPD attendance range
Low HR gap (<30%)	4	3,000 – 4,500 consultations/ month
Moderate HR gap (30–60%)	6	1,500 – 3,000 consultations/ month
High HR gap (>60%)	4	600 – 1,500 consultations/ month

Table 4: HR gap category vs. workforce availability and NCD screening performance across urban HWCs (n=14).

HR gap category	No. of HWCs	ASHA availability (%)	MPW availability (%)	CBAC coverage (%)	HTN screening (%)	DM screening (%)
Low HR gap (<30%)	4	70–90	30–50	40–60	60–80%	60–80
Moderate HR gap (30–60%)	6	40–70	10–40	25–40	30–60%	30–60
High HR gap (>60%)	4	20–50	0–20	<25	<30%	<30

Table 5: Linear regression models.

Operational outcome variable	Independent variable	Standardized coefficient (β)	Significance (P value)	Model fit (R^2)
CBAC coverage (%)	Composite HRGI (%)	-0.420	<0.001	0.710
OPD attendance (volume)	Composite HRGI (%)	-18.600	<0.001	0.640

Table 6: Logistic regression models.

Target health outcome variable	Predictor condition	Crude odds ratio (COR)	95% CI	P value
Adequate universal NCD screening	Low baseline HR gap (HRGI<30%)	3.812	2.104-6.908	<0.001

DISCUSSION

This study was conducted in 14 UHWCs in Ahmedabad to analyse Human resource availability pattern and its association with screening and service delivery adequacy. The findings of this study revealed a critical structural paradox; where internal clinical facility positions demonstrated good compliance with the IPHS 2022 guidelines, achieving 100% availability for Medical Officers, Lab Technicians and 92.8% for both Staff Nurses and Pharmacists however community outreach positions were minimally filled.[9] Only 16.9% of the male MPWs positions were occupied showing severe shortage suggesting a vacancy of 83.1% of mandated male outreach positions. Concurrently, ASHA deployment was found to be erratic, exhibiting a highly variable distribution ranging between 10% and 100% across municipal zones.

This stark contrast between robust facility-based staffing and severely depleted community-level cadres was in line with recent national trends observed by Anand and Fan10 in WHO document on India's health workforce. A similar study by Rao et al highlighted that while urban medical infrastructure successfully aggregates clinical professionals, municipal health authorities systematically under-invest in auxiliary, field-level cadres.[11]

In the current study, facilities operating with a low overall human resource gap were found to have robust outreach capabilities, maintaining population-level CBAC coverage to 40%–60% and NCD screening rates (hypertension and diabetes mellitus) to 60%–80%. Conversely, when MPW availability were reduced to 0%–20% range in high-deficit centres, CBAC coverage declined below 25% and routine screening rates dropped below 30%. This performance gradient reinforced the findings of Shroff et al and Kruk et al who observed that expanding the physical footprint of Urban HWCs could not realize its preventive potential without a stabilized outreach workforce to manage the community entry point.[5,7]

The critical dependence of clinical screening metrics on frontline outreach efficiency was well-documented by Oswal et al in an implementation review of frontline workers in low and middle-income contexts which concluded that universal screening models failed when community-level tracking protocols were under-resourced.[8] As established by global health workforce principles, nominal adherence to institutional staffing norms does not automatically guarantee effective service delivery unless numbers are balanced against localized workloads and community demands.[12] The strong inverse linear relationship identified between the composite (HRGI) and population-level CBAC enrolment (β=-0.420, p<0.001) showed that 71.0% of the variance in community risk-profiling (R2=0.710), which is explained entirely by the facility's staffing gap index. Furthermore, univariate logistic regression model found that centres maintaining a Low Baseline HR Gap (HRGI<30%) have a 3.812 times higher chance (COR=3.812, 95% CI: 2.104–6.908, p<0.001) of achieving adequate universal NCD screening outputs compared to high-deficit facilities.

In the present study, it was found that only total number of staff members do not guarantee performance, indicating a significant role of other localized factors. This finding was supported by the data obtained in the present study where the Bapunagar Urban HWC was found to maintain a 100% nominal ASHA roster but achieved a mere 11.0% population-level CBAC coverage, whereas the new got a urban HWC achieved 54.0% CBAC coverage despite operating with a low 32.0% nominal ASHA presence.

This operational mismatch was elaborately explained by Scott et al in their study of frontline health systems where it was found that high population turnover, migratory patterns in low-income neighborhoods, high housing density within slum pockets and localized gaps in community trust can severely disrupt door-to-door data collection, regardless of nominal rosters.[13] Furthermore, variations in structured supervision, local urban layout complexities and unoptimized performance incentives may lead to highly variable field-level productivity among outreach workers.[13]

Additionally, this study observed that a moderate deficit in DEO (85%–90% availability) directs heavy administrative burdens on clinical personnel. This directly matched the observations by Scott et al who detailed how administrative understaffing and excessive reporting systems resulted in staff nurses and medical officers diverting clinical hours into tracking paper records and uploading metrics across multiple national digital portals.[13]

This diversion of clinical time may directly drive the decline of outpatient volumes observed in our linear model (β=-18.600, p<0.001, R2=0.640), where centres in the high HR gap tier (>60% deficit) found their monthly patient footfall degrade to just 600–1,500

consultations/month, compared to the 3,000–4,500 consultations/month sustained by low HR gap (<30% deficit) facilities. This understaffing may result in creating lack of trust, longer facility waits times and lower overall healthcare utilization.

Finally, the widespread underutilization of digital health tools observed in this study, where 13 out of 14 facilities averaged fewer than two teleconsultations daily on the e-Sanjeevani platform may be due to workforce deployment mismatch, time constraint or due to low patient compliance.

To resolve systemic gaps and achieve a resilient urban primary health framework, human resource planning must shift away from centralized, rigid facility quotas. Municipal health authorities should implement localized, workload-adjusted recruitment strategies that systematically align frontline health worker allocations with the specific demographic density, migration rates and geographical vulnerabilities of each urban catchment area.[12] Bridging the severe deficit in the MPW and urban ASHA cadres is a critical prerequisite to optimizing NCD risk identification and ensuring a sustainable continuum of care within urban primary health systems.[5,7]

The study was conducted in limited number of Urban HWCs under AMC; therefore, the findings may not be generalizable to all urban primary healthcare settings in India. It was difficult to establish causal relationships between human resource gaps and service delivery outcomes due to cross-sectional nature of the study.

Subsequently, the analysis was primarily based on routinely maintained administrative records, which may be subject to recording or documentation inaccuracies and data entry errors despite verification through multiple data sources.

CONCLUSION

This study demonstrates that multi-cadre human resource shortages represent a major operational barrier within urban health and wellness centres. While facility-based clinical positions show high compliance with IPHS 2022 standards, severe deficits in community outreach roles directly undermine preventive health targets and universal NCD screening efforts.

To maximize the impact of the Ayushman Bharat infrastructure, human resource planning must move beyond nominal facility-centric staffing quotas. Instead, municipal authorities should implement localized, workload-adjusted recruitment strategies that prioritize filling structural vacancies in the MPW and urban ASHA cadres.

Addressing these outreach deficits is critical to building robust risk-stratification pipelines and ensuring an effective, continuous model of primary healthcare across urban populations.

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