

A STUDY ON OPERATIONAL EFFICIENCY OF OUTPATIENT DEPARTMENT SERVICES AT PRIMARY HEALTH CENTRES OF GUJARAT, INDIA: AN OBSERVER-BASED ASSESSMENT OF RESOURCES, PATIENT FLOW, QUALITY AND DIGITAL READINESS

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ABSTRACT

Background. Outpatient departments (OPDs) are the first point of contact between communities and Primary Health Centres (PHCs). Gujarat lacks facility-level evidence on how PHC OPDs are resourced, organised and digitally supported. We assessed resources, operational efficiency, quality and technology use in PHC OPDs across Gujarat.

Methods. In July 2026, observers completed 100 structured OPD assessments at 100 PHCs in 25 talukas of eight districts. A 44-item instrument, rated on a five-point agreement scale, covered manpower, medicines, laboratory services, equipment and infrastructure, patient flow and waiting, service quality, referral coordination, overall efficiency and technology. We compared domain scores across districts with Kruskal-Wallis and Dunn tests (Holm-adjusted). We examined correlates of overall efficiency with OLS regression and HC3 robust errors.

Results. Observers rated overall efficiency 3.66 of 5 (SD 0.57). Manpower (3.62), medicines (3.56) and patient flow (3.51) scored higher than laboratory services (3.43), referral coordination (3.31) and quality (3.07). Compliance with certification and quality standards scored lowest (2.60). Computers (67%) and internet (59%) were available in most OPDs, yet only 2% to 4% of observers reported digital use for OPD activity, and 79% reported no digital use on any of three use items. Even so, observers agreed that digitalization could improve flow (78%) and efficiency (76%). Efficiency differed sharply by district ($p < 0.001$): about 4.0 in Ahmedabad, Gandhinagar, Amreli and Mehsana, versus 3.1 to 3.4 in Porbandar, Chhota Udepur and Devbhumi Dwarka. Referral coordination ($b = 0.38$, 95% CI 0.22 to 0.54) and patient flow ($b = 0.22$, 95% CI 0.005 to 0.44) were independently associated with overall efficiency ($R^2 = 0.74$).

Conclusions. Observers rated PHC OPDs moderately efficient. District performance was uneven, quality certification was weak, and PHCs used little of their available digital capacity. Priorities are district-targeted resource support, stronger referral coordination and patient-flow management, and activation of existing digital infrastructure.

KEYWORDS: Operational Efficiency; Outpatient department; Primary Health Centre; Gujarat; Patient flow; Digital health; Ayushman Arogya Mandir

Key points

- **What is known:** Efficiency studies of Indian PHCs rely mostly on administrative data and say little about patient flow, quality or digital use inside the OPD.
- **What this study adds:** In 100 structured observations at 100 PHCs in eight Gujarat districts, basic inputs were adequate, but referral coordination and patient flow were the strongest correlates of efficiency, and digital tools were present but almost unused (2% to 4%).
- **Implications:** Digital investment should shift from hardware to staff capability and workflow integration, and support should be tailored to the lowest-rated districts (Porbandar, Chhota Udepur, Devbhumi Dwarka).

Abbreviations

Abbreviation	Meaning
AAM	Ayushman Arogya Mandir
ABDM	Ayushman Bharat Digital Mission
CI	Confidence interval
DEA	Data envelopment analysis
HC3	Heteroskedasticity-consistent standard error estimator (type 3)
HMIS	Health management information system
IPHS	Indian Public Health Standards
MoHFW	Ministry of Health and Family Welfare
NCD	Non-communicable disease
NQAS	National Quality Assurance Standards

Abbreviation	Meaning
OLS	Ordinary least squares
OPD	Outpatient department
PHC	Primary health centre
SD	Standard deviation
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
VIF	Variance inflation factor
b	Unstandardised regression coefficient
β	Standardized regression coefficient
α	Cronbach's alpha
ε^2	Epsilon-squared (effect size for the Kruskal-Wallis test)
ρ	Spearman rank correlation coefficient
R^2	Coefficient of determination
HR, MED, LAB, EQ, INF, REF, RES	Item codes for manpower, medicines, laboratory, equipment, infrastructure, referral facilities and resource utilisation
PF, WT, Q, REFE, OE, TECH	Item codes for patient flow, waiting time, quality, referral efficiency, operational efficiency and technology

1. INTRODUCTION

The Outpatient department (OPD) is where most people first meet the public health system. In India, Primary Health Centres (PHCs) are expected to deliver consultation, diagnostics, medicines, preventive care and referral through this single front door. The National Health Policy 2017 places primary care at the centre of the system (Ministry of Health and Family Welfare [MoHFW], 2017). The Ayushman Arogya Mandir programme has since widened the PHC service package to include non-communicable disease care, teleconsultation and basic diagnostics (Gulati et al., 2026; MoHFW, n.d.). These additions raise the demands on staff, supplies and OPD processes. PHCs can meet them only if the OPD itself runs well, not merely if services are sanctioned on paper.

Buildings and staff on paper do not guarantee a well-run OPD. We define operational efficiency as the extent to which a PHC uses its human, physical, material and informational resources to deliver outpatient care in an organised and timely way, without compromising safety or quality. It depends on how the PHC deploys resources and how patients move through registration, consultation, diagnostics, dispensing and referral. Measuring it therefore requires data on both resources and processes.

The dominant Indian method, data envelopment analysis (DEA), rarely supplies both. A systematic review of 54 DEA studies in primary care found no standard choice of inputs, outputs or models (Zakowska & Godycki-Cwirko, 2020). Indian applications have relied on routine administrative data, for example from district hospitals in Madhya Pradesh (Jat & San Sebastian, 2013). Broader PHC performance research shows the same limit. A review of measures used in developing countries concluded that existing tools cover only part of PHC functioning and rarely undergo validation (Bangalore Sathyananda et al., 2018). Provider perspectives suggest that the work environment and facility management are under-measured (Bangalore Sathyananda et al., 2021). Administrative indicators reveal little about the registration counter, the waiting area or the pharmacy queue, so facility-level data must fill the gap.

Facility-level studies identify several determinants of OPD performance. In Maharashtra, PHCs with in-house malaria and tuberculosis testing had higher odds of 80 or more OPD visits per day (Jain & Rao, 2019). In Rajasthan, people were far more likely to use PHCs with better human resources, equipment and medicines (Srivastava et al., 2023). Capacity often falls short of standards: a national facility survey found that PHC capacity for basic delivery and newborn care fell short of Indian Public Health Standards, with the largest gaps in skilled staff and emergency obstetric services (Sharma et al., 2018). Studies of Health and Wellness Centres have likewise examined system readiness, compliance with staffing norms and service performance (Brar et al., 2022; Kaur et al., 2025; Tripathi et al., 2024).

Quality certification adds further demands on the same facilities. National Quality Assurance Standards (NQAS), Kayakalp and related programmes overlap in what they ask of facilities (Gandhi et al., 2025). Leadership influences whether facilities meet these demands. In Gujarat's Bhavnagar district, certification depended on district leadership and peer mentoring (Lekha et al., 2025).

Digital tools are the newest lever for easing these constraints, but the evidence is mixed. India's Scan and Share service, built on the Ayushman Bharat Digital Mission, operated in 16,939 facilities by October 2024. Neogi et al. (2025) reported that it cut registration waits from about one hour to two to five minutes. Such gains are not automatic. In two government facilities in Hyderabad, a health management information system did not reduce long waits, because patient load, staffing and system reliability still drove delays (Gowda et al., 2026). Health workers in rural PHCs accepted telemedicine but raised confidentiality concerns (Mathur et al., 2025). Evaluations of the usability and adoption of primary care digital tools continue (Jat et al., 2025; Sood et al., 2025). We therefore assess digital readiness together with resources and processes.

Gujarat illustrates why a combined assessment is needed. A World Bank assessment highlighted facility management, essential inputs and health information systems as areas to strengthen in the state's primary health care system (Villar Uribe et al., 2023). A national DEA of PHCs, however, reported high state-level technical efficiency for Gujarat (Sehgal & Kour, 2024). The two views are hard to reconcile. State-level scores cannot show how individual OPDs differ across districts, and they do not describe patient flow, quality or digital use at the facility. We found no facility-level study in

Gujarat that assessed resource availability, utilization, patient flow, service quality and digital readiness together across districts.

To fill this gap, we assessed OPD services at PHCs across Gujarat through structured observation. We had three objectives: (1) to assess the availability and utilization of resources in OPD services; (2) to assess the operational efficiency and quality of OPD services; and (3) to assess technology and digital service use in the OPD and its relationship with operational efficiency. A companion paper reports patient satisfaction, the experience-based counterpart of these observations.

2. METHODS

2.1 Design and setting

This was a cross-sectional, observer-based study of OPD services at PHCs in Gujarat, western India. Observations were made between October 2025 to July 2026 in eight districts: Ahmedabad, Amreli, Chhota Udepur, Devbhumi Dwarka, Gandhinagar, Mehsana, Porbandar and Surat. Based on the provided observational dataset, a total of 100 responses covering 100 unique PHCs across 28 taluka entries were recorded. The districts and talukas represented geographical diversity, while PHCs were included to assess variations in human resources, medicine availability, laboratory services, infrastructure, patient flow, referral systems, quality practices and digital technology utilization in outpatient department (OPD) services. The selection of facilities was purposive, with emphasis on assessing operational efficiency across different primary healthcare settings. The study is reported in line with the STROBE statement for cross-sectional studies.

2.2 Instrument

The observer questionnaire contained 44 statements rated on a five-point agreement scale (1 = strongly disagree to 5 = strongly agree), organized by the study objectives: resource availability and utilization (14 items), operational efficiency and quality (18 items) and technology and digital services (12 items) (Table 1). Observers rated each statement from what they saw in the OPD and the functioning of the PHC. The paper version allowed "Not available/Not applicable" for technology items; the electronic records contain only ratings of 1 to 5, so a facility without a given digital resource appears as a low rating, which we read as disagreement. [Authors to add: how the instrument was developed, any expert review or pilot testing.]

Table 1. Instrument domains, item counts and internal consistency (n = 100 observations)

Domain	Items	Cronbach's α
Manpower	HR1–HR4 (4)	0.76
Medicines	MED1–MED3 (3)	0.57
Laboratory and diagnostic services	LAB1–LAB3 (3)	0.59
Equipment, infrastructure, referral facilities and utilization	EQ1, INF1, REF1, RES1 (4)	0.86
Patient flow, queue and waiting time	PF1–PF3, WT1–WT2 (5)	0.91
Service quality	Q1–Q4 (4)	0.87
Referral and coordination	REFE1–REFE3 (3)	0.89
Overall operational efficiency	OE1–OE6 (6)	0.92
Technology availability and use	TECH1–TECH8 (8)	0.85
Technology: perceived potential	TECH9–TECH12 (4)	0.96

The three-item medicines and laboratory domains cover different services within one heading (for example, basic versus specialized tests), so their lower α is expected, and we interpret them at item level.

2.3 Data collection and management

Observations were recorded in an electronic form. The lead researcher completed 95 of the 100 records and five other observers completed the rest. Records had no missing values. District, taluka and PHC names were standardized to ensure consistency across the dataset (e.g., "Ahmedabad" was corrected to "Ahmedabad"). The Surat observation (n = 1) was included in the pooled analysis, while district-level comparisons were conducted for the other seven districts.

2.4 Scoring

Domain scores were the mean of their items. A resource index was the mean of the 14 items in the manpower, medicines, laboratory and equipment/infrastructure/referral/utilization domains. Technology items were also grouped into availability (TECH1, TECH2, TECH6), use (TECH3 to TECH5), staff capability (TECH7, TECH8) and perceived potential (TECH9 to TECH12). We report the proportion of ratings of 4 or 5 as "agree" and 1 or 2 as "disagree".

2.5 Statistical analysis

Items and domains were summarized using means, standard deviations and percentages, while internal consistency was assessed using Cronbach's alpha (Tavakol & Dennick, 2011). Domain means were compared with the Friedman test. Districts were compared with the Kruskal-Wallis test (effect size ϵ^2) followed by Dunn's test with Holm adjustment (Dunn, 1964; Holm, 1979; Kruskal & Wallis, 1952). Technology availability and use were compared with the Wilcoxon signed-rank test, and associations between domains with Spearman's rank correlation. To examine correlates of the overall efficiency score, we fitted an ordinary least squares model with resource index, patient flow, service quality, referral coordination and technology availability and use as predictors, using HC3 heteroskedasticity-robust standard errors. Because composite Likert scores behave well in parametric models (Norman, 2010; Sullivan & Artino, 2013), we report unstandardized coefficients with 95% confidence intervals and standardized coefficients. Collinearity was checked with variance inflation factors. Sensitivity analyses (i) dropped the overall item OE6 from the outcome, (ii) added district fixed

effects, (iii) kept only the first record per PHC, and (iv) restricted the sample to the lead researcher's records. Tests were two-sided with $\alpha = 0.05$. Analyses used Python 3 (pandas, SciPy, statsmodels and scikit-posthocs).

3. RESULTS

3.1 Sample

The 100 observations covered 100 distinct PHC names in 25 talukas of eight districts: Devbhumi Dwarka ($n = 23$), Chhota Udepur (19), Gandhinagar (16), Ahmedabad (12), Amreli (12), Porbandar (11), Mehsana (6) and Surat (1). Observers gave a rating of 4 to 49.8% of items, 3 to 27.6% and 2 to 19.1%. They rarely gave 5 (3.4%) or 1 (0.1%). This compresses differences between facilities toward the middle of the scale. Domain means differed significantly (Friedman $\chi^2 = 368.7$, 9 df, $p < 0.001$; Figure 1). Technology perceived potential had the highest mean (3.85, SD 0.78), followed by overall efficiency (3.66, SD 0.57), manpower (3.62, SD 0.42), medicines (3.56, SD 0.43) and patient flow (3.51, SD 0.55). Service quality (3.07, SD 0.72) and technology availability and use (2.77, SD 0.46) had the lowest means.

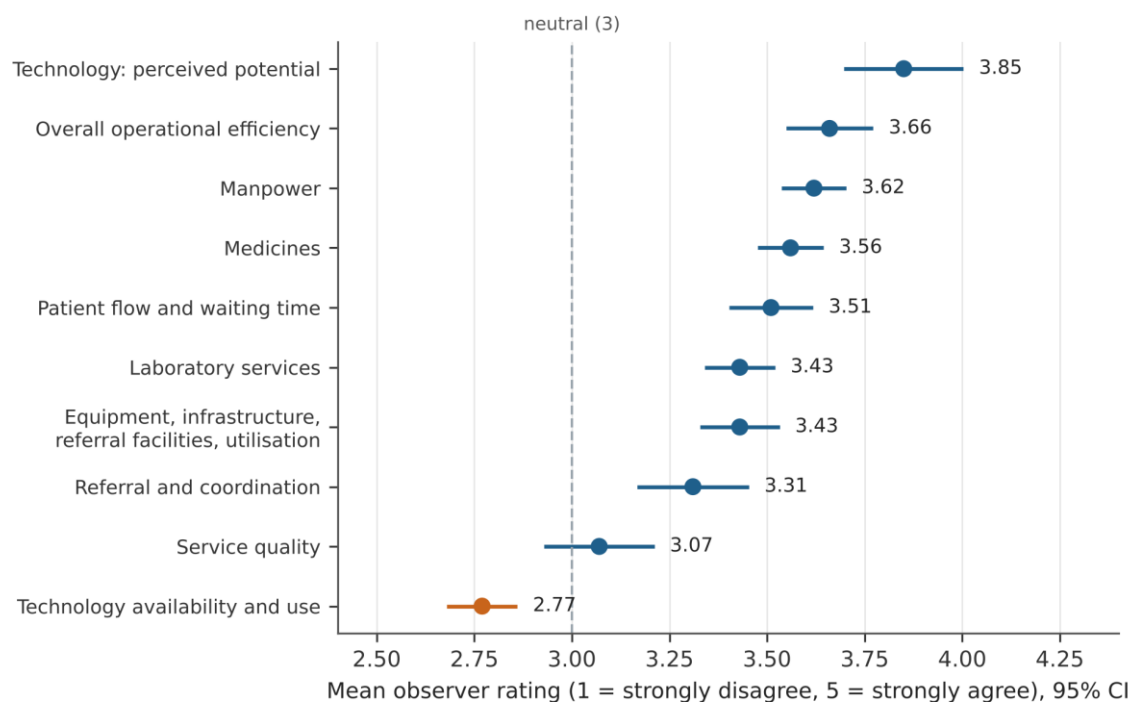


Figure 1. Mean observer rating by domain ($n = 100$). Dots show means with 95% confidence intervals; the dashed line marks the neutral midpoint.

3.2 Availability and Utilization of Resources (Objective 1)

Objective 1 asks what resources PHCs have and how they use them. The resource index, the mean of 14 availability and utilization items, was 3.51 (SD 0.41; $\alpha = 0.91$). Observers rated basic inputs well: medical officers available during OPD hours (4.02; 95% agreed), basic laboratory tests (3.93; 92%) and essential medicines (3.90; 89%). They rated three items weakest: advanced or specialized diagnostics (2.69; 56% disagreed), medicines for chronic or special conditions (3.10; 27% disagreed) and manpower sufficiency for the routine workload (3.26; 11% disagreed, 54% neutral). Observers also rated utilization of manpower and resources (3.27; 41% agreed) below the average availability item (3.53). Even so, availability and utilization correlated strongly across PHCs (Spearman $\rho = 0.86$, $p < 0.001$). PHCs with more resources therefore appeared to use them better.

Table 2. Resource availability and utilization items ($n = 100$)

Item	Mean (SD)	Disagree 1–2 (%)	Neutral 3 (%)	Agree 4–5 (%)
HR1 Medical officers available in OPD hours	4.02 (0.35)	0	5	95
HR2 Nursing staff adequate	3.73 (0.58)	2	25	73
HR3 Other support staff adequate	3.47 (0.54)	2	49	49
HR4 Manpower sufficient for routine workload	3.26 (0.68)	11	54	35
MED1 Essential medicines available	3.90 (0.33)	0	11	89
MED2 Medicines for special/chronic conditions	3.10 (0.81)	27	37	36
MED3 Medicines dispensed without delay	3.68 (0.51)	1	31	68
LAB1 Basic laboratory tests available	3.93 (0.36)	1	7	92

Item	Mean (SD)	Disagree 1–2 (%)	Neutral 3 (%)	Agree 4–5 (%)
LAB2 Advanced tests available or referred	2.69 (0.85)	56	19	25
LAB3 Laboratory services timely	3.67 (0.55)	2	31	67
EQ1 Essential equipment available and functional	3.45 (0.50)	0	55	45
INF1 OPD infrastructure and waiting facilities adequate	3.51 (0.52)	0	50	50
REF1 Referral facilities available	3.48 (0.72)	12	29	59
RES1 Manpower and resources utilised efficiently	3.27 (0.72)	15	44	41

3.3 Operational Efficiency and Quality (Objective 2)

Objective 2 asks how well PHCs convert these inputs into service. The overall efficiency score was 3.66 (SD 0.57). At least two thirds of observers agreed that the OPD manages its workload (75%), minimises delays (69%), coordinates its service areas (70%) and delivers services in a logical sequence (67%). Overall, 68% agreed that the OPD operates efficiently (OE6 = 3.80). Maintaining quality when workload varies was the weakest efficiency item (3.51; 16% disagreed).

Patient flow and waiting scored 3.51. Observers judged registration efficient in 74% of OPDs (PF1 = 3.76). Queue management was the weakest flow item (3.36), with half of observers neutral. Quality scored lowest among the efficiency-related domains (3.07). Infection control and patient safety drew a split verdict (3.00; 33% disagree, 37% neutral, 30% agree). Observers rated record keeping mostly neutral (3.23; 58%). Most striking, 74% disagreed that the PHC followed quality assessment or certification requirements (Q4 = 2.60). Referral coordination scored 3.31, with 50% agreement and about 20% disagreement on each of its three items.

Table 3. Operational efficiency and quality items (n = 100)

Item	Mean (SD)	Disagree 1–2 (%)	Neutral 3 (%)	Agree 4–5 (%)
PF1 Registration process efficient	3.76 (0.55)	2	24	74
PF2 Queue management effective	3.36 (0.61)	7	50	43
PF3 Flow from registration to consultation well managed	3.53 (0.67)	9	30	61
WT1 Waiting for registration and consultation reasonable	3.44 (0.67)	9	39	52
WT2 Laboratory and pharmacy without unnecessary delay	3.46 (0.69)	10	35	55
Q1 Services follow prescribed quality standards	3.45 (0.70)	11	34	55
Q2 Patient safety and infection control followed	3.00 (0.85)	33	37	30
Q3 Records and documentation maintained	3.23 (0.68)	11	58	31
Q4 Quality assessment/certification requirements followed	2.60 (1.08)	74	4	22
REFE1 Referral process efficient	3.30 (0.81)	21	29	50
REFE2 Referral guidance appropriate	3.32 (0.82)	20	30	50
REFE3 Coordination with higher facilities effective	3.31 (0.77)	19	31	50
OE1 Routine workload managed effectively	3.71 (0.64)	7	18	75
OE2 Unnecessary delays minimised	3.66 (0.64)	6	25	69
OE3 Service areas coordinated	3.64 (0.63)	7	23	70
OE4 Services delivered in logical sequence	3.61 (0.67)	8	25	67
OE5 Quality maintained despite workload variation	3.51 (0.78)	16	19	65
OE6 Overall, the OPD operates efficiently	3.80 (0.70)	2	30	68

3.4 Technology and Digital Services (Objective 4)

Objective 3 asks whether technology supports efficiency. Technology scored 2.77 overall, but this average hides a split. Availability items (computers, internet, telemedicine) averaged 3.42 (SD 0.56). The three use items (current digital use,

digital records, digital registration) averaged 2.18 (SD 0.42; Wilcoxon signed-rank $Z \approx 8.5$, $p < 0.001$). Observers reported computers in 67% of OPDs, internet in 59% and telemedicine in 36%. Only 4%, 2% and 4% agreed that digital technology served OPD activity, patient records and registration. Seventy-nine PHCs reported no digital use on any of the three use items. Among the 57 PHCs with both computers and internet, 42 (74%) reported no current digital use. Staff capability was also limited: 36% of observers agreed that staff know how to use available digital systems, and 13% agreed that facilities are used effectively (mean 2.68, SD 0.79). Observers nonetheless saw potential. Between 75% and 80% agreed that more digital use is possible and that digitalisation could cut waiting, improve coordination and raise efficiency and quality (perceived potential 3.85, SD 0.78; Table 4, Figure 2).

Table 4. Technology and digital service items (n = 100)

Item	Mean (SD)	Disagree 1–2 (%)	Neutral 3 (%)	Agree 4–5 (%)
TECH1 Computer facilities available	3.65 (0.56)	3	30	67
TECH2 Internet connectivity available	3.49 (0.67)	10	31	59
TECH6 Telemedicine or teleconsultation available	3.13 (0.76)	23	41	36
TECH3 Digital technology currently used for OPD activity	2.19 (0.51)	84	12	4
TECH4 Digital systems used for records or OPD data	2.19 (0.44)	83	15	2
TECH5 Digital technology used for registration or other patient processes	2.15 (0.48)	88	8	4
TECH7 Staff have adequate knowledge of digital systems	2.84 (0.95)	53	11	36
TECH8 Available digital facilities used effectively	2.53 (0.74)	61	26	13
TECH9 Scope for greater digital use	3.92 (0.82)	9	11	80
TECH10 Digitalisation can reduce waiting and improve flow	3.83 (0.80)	10	12	78
TECH11 Digitalisation can improve coordination and service delivery	3.81 (0.85)	11	14	75
TECH12 Digitalisation can improve efficiency and quality	3.85 (0.82)	9	15	76

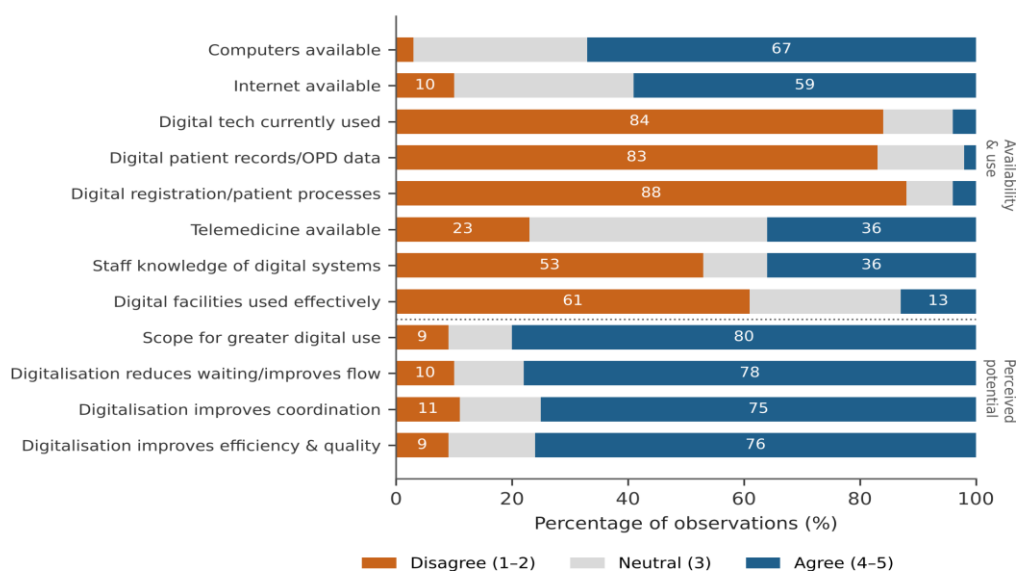


Figure 2. Observer agreement with technology statements (n = 100), grouped as availability and use (upper block) and perceived potential (lower block).

The gap between availability and use raises the question of whether use matters for efficiency. PHCs with higher digital use received higher efficiency ratings. Digital use correlated with overall efficiency ($\rho = 0.43$, $p < 0.001$), service quality ($\rho = 0.43$, $p < 0.001$) and patient flow ($\rho = 0.36$, $p < 0.001$). The 79 PHCs with a mean of 2.0 or below on the use items had a mean efficiency score of 3.55. The 10 PHCs with moderate use scored 4.05, and the 11 with higher use scored 4.08. Digital use clusters in districts that also score well on other domains, so these associations do not show an effect of digitalization (see 3.6).

3.5 Variation across districts

Averages conceal large differences between places. Every domain differed across the seven districts with at least six observations (Kruskal-Wallis $p < 0.001$ for all; Table 5, Figure 3). Effect sizes were large for resources ($\epsilon^2 = 0.53$), referral coordination (0.53), technology availability and use (0.46) and overall efficiency (0.42). They were moderate to large for service quality (0.36) and patient flow (0.29). Overall efficiency reached about 4.0 in Ahmedabad (4.07), Gandhinagar (4.01), Mehsana (4.00) and Amreli (3.99), against 3.41 in Devbhumi Dwarka, 3.38 in Chhota Udepur and 3.11 in Porbandar. In Dunn tests, Ahmedabad, Gandhinagar and Amreli each scored significantly higher than Chhota Udepur, Devbhumi Dwarka and Porbandar (Holm-adjusted p between 0.001 and 0.021). Mehsana ($n = 6$) did not differ significantly from any district. Porbandar had the lowest patient-flow score (2.85) and Chhota Udepur the lowest quality score (2.63). Technology use rose above the floor only in Ahmedabad (2.86); other districts ranged from 2.00 to 2.12 (Table 5).

	Resources (availability & utilisation)	Patient flow & waiting	Service quality	Referral & coordination	Overall efficiency	Technology availability & use
Ahmedabad (n=12)	3.92	3.90	3.50	3.94	4.07	3.48
Gandhinagar (n=16)	3.85	3.95	3.53	3.83	4.01	2.95
Mehsana (n=6)	3.73	3.47	3.46	3.83	4.00	3.08
Amreli (n=12)	3.74	3.38	3.52	3.81	3.99	2.75
Devbhumi Dwarka (n=23)	3.25	3.44	2.72	2.80	3.41	2.59
Chhota Udepur (n=19)	3.21	3.43	2.63	2.93	3.38	2.45
Porbandar (n=11)	3.27	2.85	2.66	2.70	3.11	2.45

Figure 3. Mean domain scores by district. Districts are ordered by overall efficiency; Surat ($n = 1$) is omitted.

Table 5. Mean domain scores by district (all domains and technology sub-indices)

District	n	Resource index	Patient flow	Service quality	Referral coord.	Overall efficiency	Tech. availability	Tech. use	Staff capability	Perceived potential
Ahmedabad	12	3.92	3.90	3.50	3.94	4.07	3.92	2.86	3.75	4.29
Gandhinagar	16	3.85	3.95	3.53	3.83	4.01	3.75	2.12	2.97	4.50
Mehsana	6	3.73	3.47	3.46	3.83	4.00	3.83	2.06	3.50	4.00
Amreli	12	3.74	3.38	3.52	3.81	3.99	3.50	2.00	2.75	3.85
Devbhumi Dwarka	23	3.25	3.44	2.72	2.80	3.41	3.33	2.06	2.28	3.50
Chhota Udepur	19	3.21	3.43	2.63	2.93	3.38	3.11	2.04	2.08	3.95
Porbandar	11	3.27	2.85	2.66	2.70	3.11	2.85	2.12	2.36	2.91
All PHCs (incl. Surat, $n = 1$)	100	3.51	3.51	3.07	3.31	3.66	3.42	2.18	2.68	3.85

3.6 Correlates of Overall Operational Efficiency

Which domains account for these differences? Overall efficiency correlated strongly with referral coordination ($p = 0.86$), the resource index (0.84), service quality (0.79), technology availability and use (0.79) and patient flow (0.65); all $p < 0.001$. In the multivariable model ($R^2 = 0.74$, adjusted $R^2 = 0.73$; $F(5, 94) = 39.6$, $p < 0.001$), referral coordination ($b = 0.38$, 95% CI 0.22 to 0.54; standardized $\beta = 0.48$) and patient flow ($b = 0.22$, 95% CI 0.005 to 0.44; $\beta = 0.21$) were independently associated with the efficiency score. The resource index was positive, but its interval included zero ($b =$

0.30, 95% CI −0.09 to 0.70). Service quality and technology use showed no independent association. The largest variance inflation factor was 5.31 (resource index), so estimates for correlated domains are imprecise. Results held when we dropped OE6 from the outcome, added district fixed effects, kept only the first record per PHC and analysed only the lead researcher's records (Table 6). Referral coordination remained significant in every model. Patient flow remained significant in all models except the district fixed-effects model ($p = 0.107$).

Table 6. OLS models for overall operational efficiency (b, 95% CI or p)

Predictor	Main model (n = 100)	Without OE6	District fixed effects	First record per PHC (n = 95)	Lead researcher only (n = 95)
Resource index	0.30 (−0.09 to 0.70)	0.30, $p = 0.179$	0.32, $p = 0.186$	0.32, $p = 0.128$	0.34 (−0.10 to 0.77)
Patient flow	0.22 (0.005 to 0.44)	0.26, $p = 0.043$	0.26, $p = 0.107$	0.26, $p = 0.032$	0.23 (0.02 to 0.45)
Service quality	0.00 (−0.14 to 0.15)	−0.05, $p = 0.508$	−0.05, $p = 0.597$	0.00, $p = 0.955$	−0.07 (−0.23 to 0.08)
Referral coordination	0.38 (0.22 to 0.54)	0.41, $p < 0.001$	0.34, $p < 0.001$	0.34, $p < 0.001$	0.37 (0.20 to 0.53)
Technology availability and use	0.04 (−0.20 to 0.27)	−0.01, $p = 0.946$	0.15, $p = 0.370$	0.05, $p = 0.713$	0.08 (−0.15 to 0.31)
R ²	0.74	0.70	0.76	0.75	0.73

4. DISCUSSION

4.1 Principal findings

Observers judged that PHC OPDs in these districts had most basic inputs in place and ran reasonably well. Three gaps stood out: advanced diagnostics and quality-assurance compliance, referral coordination, and digital use. Observers rated overall efficiency 3.66 of 5, and two thirds or more agreed with each efficiency statement. Basic inputs earned the highest ratings: staffing, medicines and laboratory tests. Advanced tests, medicines for chronic conditions and compliance with quality certification requirements earned the lowest. Most PHCs had computers and internet, yet almost none used digital tools in the OPD. District differences were large and consistent across domains.

4.2 Resources and their use (Objective 1)

Resources come first because every later step in the OPD depends on them. Strong basic inputs and weaker specialised inputs match a national facility survey, which found PHC capacity for basic delivery and newborn care short of Indian Public Health Standards, with the largest gaps in skilled staff (Sharma et al., 2018). They also match evidence that in-house laboratory testing is associated with OPD load (Jain & Rao, 2019) and that people use better-equipped PHCs more (Srivastava et al., 2023). The shortfalls in advanced tests and chronic-condition medicines matter for the Ayushman Arogya Mandir package, which expands chronic disease care (Gulati et al., 2026; Kaur et al., 2025; Tripathi et al., 2024). A PHC without these inputs cannot deliver the expanded package. Having resources does not ensure using them. Observers rated utilization (3.27) below availability (3.53), which suggests that PHCs do not fully use what they have. The two still correlated strongly ($\rho = 0.86$), and that correlation may reflect observers' general impression of a facility rather than separate judgements (see Section 5). We used observer ratings, not counts of staff, stock or throughput. The results therefore show how well PHCs appear to use resources, not how many resources they use.

4.3 Efficiency, Patient flow and Quality (Objective 2)

Next, we ask how patients move through the OPD. Observers saw registration as the most efficient step and queue management as the weakest, and half stayed neutral on queues. Quality showed a sharper weakness: 74% of observers disagreed that the PHC followed quality assessment and certification requirements. This matters because quality programmes such as NQAS and Kayakalp overlap in their demands and depend on district leadership and mentoring (Gandhi et al., 2025; Lekha et al., 2025). Observers split almost evenly on infection control across disagree, neutral and agree. This split suggests uneven practice between facilities, not a uniform weakness.

Which aspects of the OPD matter most for overall efficiency? Referral coordination had the strongest association in every model, and patient flow came second but less stably. Resources, quality and technology showed no independent association once these two entered the model. The high correlations between domains (largest VIF 5.31) caution against concluding that those domains do not matter. Two readings fit the pattern. OPDs that manage handovers, from registration to doctor or from PHC to higher facility, may be those that observers see as efficient overall. A PHC does not work in isolation. When referral guidance, transport or communication with higher facilities falters, doctors must either treat complex patients with limited tools or send them on without coordination, which can disrupt flow and lengthen waits. Alternatively, observers may have rated related items alike. Cross-sectional ratings cannot separate the two explanations.

4.4 Technology and Digital Services (Objective 4)

Technology needs separate treatment because it shows a different pattern. The gap between availability (3.42) and use (2.18) is the central technology finding. Among PHCs with both a computer and internet, 74% reported no digital use. Observers also rated staff knowledge and effective use low. These findings point to implementation capacity, not hardware, as the immediate constraint. A health management information system likewise failed to shorten waits in two Hyderabad facilities (Gowda et al., 2026), and evaluation of the usability and adoption of primary care digital tools

continues (Jat et al., 2025; Sood et al., 2025). The constraint matters because digital registration at scale was reported to cut registration waits sharply (Neogi et al., 2025). Observers in our sample were optimistic: 75% to 80% agreed that digitalization could reduce waiting, improve coordination and raise efficiency. Telemedicine existed in 36% of PHCs. Health workers elsewhere have accepted telemedicine while raising confidentiality concerns (Mathur et al., 2025). This optimism could tempt readers to treat the higher efficiency ratings of PHCs with more digital use as proof that digitalization works. The data do not support that reading. Digital use concentrated in Ahmedabad, which also scored high on most other domains. Technology use added nothing to the multivariable model. Longitudinal or interventional studies that measure waiting times directly should test whether digital registration or records improve OPD performance in Gujarat.

4.5 District Variation

The concentration of digital use in one district reflects a wider geographic pattern. Observers rated Ahmedabad, Gandhinagar, Mehsana and Amreli higher on most domains than Devbhumi Dwarka, Chhota Udepur and Porbandar, with large effect sizes. The higher-rated group includes districts with urban or peri-urban PHCs. Our data cannot show whether geography, staffing, supervision or management explains the gap. The finding helps most with targeting, because the weakest domains differ by district: patient flow in Porbandar, quality in Chhota Udepur, and technology capability in Devbhumi Dwarka and Chhota Udepur. A single state-level remedy is therefore unlikely to fit.

4.6 Implications

These findings suggest four priorities for programme managers. First, pair digital hardware with staff training and process redesign, because use, not availability, is the gap. Second, prioritise referral protocols and feedback with higher facilities, because referral coordination had the strongest association with efficiency. Third, strengthen queue management, the weakest flow item and an inexpensive target. Fourth, assess readiness for quality certification, particularly in the lowest-rated districts. All four rest on perceptions. Routine collection of waiting times and daily OPD counts would let managers check them against measured performance.

Table 7. Priorities linked to the study findings

Priority	Finding that supports it	Suggested action
Activate digital tools	Computers 67% and internet 59%, but digital use 2% to 4%; 36% agreed staff know the systems	Provide hands-on staff training and workflow support before buying more hardware; start with registration
Strengthen referral coordination	Strongest correlate of efficiency ($b = 0.38$); only 50% agreement on referral items	Use standard referral slips, agreed transport and feedback loops with higher facilities
Improve queue management	Queue management 3.36, with 50% neutral	Introduce token systems and assign staff to queues at peak hours
Support quality certification	Certification compliance 2.60; 74% disagreed	Provide district-level mentoring and peer review, especially in Chhota Udepur
Close gaps for chronic care	Advanced tests 2.69; chronic medicines 3.10	Align chronic-condition medicines and diagnostic referral with the Ayushman Arogya Mandir package

5. Strengths and limitations

Strengths include direct observation of 100 PHCs in eight districts from October 2025 to July 2026, a structured instrument that covers resources, flow, quality, referral and digital readiness together, internally consistent efficiency, flow, quality and technology scales ($\alpha = 0.85$ to 0.96), and robustness checks that left the main conclusions unchanged.

This study has eight limitations. First, observers gave perceptions on a five-point scale. We did not measure waiting times, throughput or costs, so the study describes perceived and observed efficiency, not technical efficiency. Second, the lead researcher completed 100 forms. This gave consistent scoring, but one observer's impressions drive the results. Ratings of different domains by one person at one visit invite common-method bias and halo effects (Podsakoff et al., 2012), which may inflate correlations between domains. Estimates were nearly identical when we analyzed only the lead researcher's records. The sampling frame and selection of PHCs were based on the availability of facility-level information and the feasibility of field observations across the eight selected districts of Gujarat. As the study used a non-probability sampling approach, the findings may not be fully generalizable to all PHCs in Gujarat. Fourth, we observed five PHCs twice, and one Surat record has an unverified PHC name. Results were unchanged with the first record per PHC, and we excluded Surat from district comparisons. Fifth, the electronic records have no "not applicable" option for technology items, so a missing resource appears as a low rating. Sixth, the medicines and laboratory scales had low internal consistency ($\alpha = 0.57$ and 0.59), and the Mehsana cell was small ($n = 6$). Seventh, the cross-sectional design prevents causal interpretation, and the regression models include highly correlated domains. Eighth, the companion paper analyses patient-reported measures, which the efficiency ratings here do not include.

6. CONCLUSION

Observers rated 100 PHC OPDs as moderately efficient, with an overall mean score of 3.66 out of 5. Basic resources were commonly available: 95% of observations reported medical officers available during OPD hours, 89% reported essential medicines, and 92% reported availability of basic laboratory tests. However, 56% indicated gaps in advanced diagnostic services, and 74% disagreed that PHCs met quality assessment or certification requirements. Digital readiness showed a marked gap between infrastructure and use: computers were available in 67% of OPDs and internet connectivity in 59%,

but only 2% to 4% reported digital use for OPD activities, records or registration; 79% reported no digital use across the three use items. Despite this, 78% considered that digitalisation could reduce waiting and improve patient flow, while 76% felt it could improve efficiency and quality. Overall efficiency ratings varied across districts, ranging from 4.07 in Ahmedabad to 3.11 in Porbandar. Referral coordination ($b = 0.38$, 95% CI 0.22 to 0.54) and patient flow ($b = 0.22$, 95% CI 0.005 to 0.44) were independently associated with overall efficiency in the main regression model. These findings support strengthening referral coordination and queue management, improving quality-assurance practices, and building staff capability to use existing digital infrastructure. Future studies should link observer ratings with measured waiting times, service volumes and patient outcomes.

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