Section: Community Medicine

Original Research Article

HEALTH LITERACY AND PATIENT ACTIVATION AMONG ADULTS WITH MULTIMORBIDITY IN URBAN INDUSTRIAL INDIA: A CROSS-SECTIONAL STUDY FROM SURAT WITH DIRECT IMPLICATIONS FOR NURSE-LED CHRONIC DISEASE MANAGEMENT

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Received *: 20/01/2026*
Received in revised form *: 05/03/2026*
Accepted *: 23/03/2026*

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DOI: 10.70034/ijmedph.2026.2.61

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (2); 370-379

ABSTRACT

Background: Non-communicable diseases impose an expanding burden on primary healthcare systems across urban India, particularly in industrial cities where large numbers of working-age migrants live with multiple co-existing chronic conditions. Surat, a major diamond-processing and textile manufacturing hub in South Gujarat, is home to hundreds of thousands of such workers. Despite the scale of this population and the complexity of its health needs, evidence on whether these individuals possess adequate knowledge, skill, or confidence to manage their own conditions — or whether the health information they receive is accessible to them — remains limited. This study was designed to measure health literacy and patient activation in adults with multimorbidity attending outpatient clinics across four Surat hospitals, to assess blood pressure control as a direct clinical outcome, and to identify the characteristics most strongly associated with poor self-management capacity.

Materials and Methods: A cross-sectional observational study was conducted between September and December 2024 across four outpatient clinical settings in Surat: Sardar Multispeciality Hospital, Shraddha Multispeciality Hospital, SIMS Hospital, and Dhameliya Kidney Hospital. Adults aged 30 to 65 years with at least two confirmed ICD-10-defined chronic conditions were enrolled using consecutive sampling (n=287). Patient activation was measured with the PAM-13 (Cronbach's alpha = 0.87); health literacy with the HLS-EU-Q16 (Cronbach's alpha = 0.83); and medication adherence with the MMAS-8. Blood pressure was measured following triplicate protocol using a calibrated automated sphygmomanometer. Multivariable logistic regression with VIF diagnostics was used to identify independent predictors of poor self-management. A sensitivity analysis excluding obesity and anxiety/depression as sole qualifying conditions was performed. Reporting follows STROBE guidelines. Structured patient education and literacy-adapted communication strategies were applied during data collection to ensure patient comprehension of study instruments.

Results: Mean PAM-13 score was 52.4 (SD 14.7; 95% CI 50.7–54.1). Over three in five participants (61.7%; 95% CI 56.0–67.1%) registered poor self-management capacity at PAM Level 1 or 2. Low or problematic health literacy affected 68.3% of the sample (95% CI 62.7–73.5%). Among 205 hypertensive participants, 120 (58.5%) had uncontrolled blood pressure. Only 23.6% of those on prescribed medication showed high MMAS-8 adherence. In the adjusted regression model, low health literacy carried the strongest association with poor self-management (aOR 3.84; 95% CI 2.41–6.12), followed by low education

(aOR 2.67), unskilled occupation (aOR 2.19), and three or more concurrent conditions (aOR 2.02). All VIFs were below 2.3; Nagelkerke R^2=0.38. Findings were robust in sensitivity analysis. No participant had ever accessed a nurse-led chronic disease service; only 18.1% had received any structured self-management education.

Conclusion: Low health literacy, poor patient activation, and inadequate medication adherence are common in this population and are associated with objectively poor blood pressure control. The gap between patients receiving prescriptions and receiving structured education, coaching, or follow-up is precisely what nurse-led chronic disease management is designed to address. These findings support the case for integrating nurse-led primary care services into India's urban health infrastructure and contribute to the international evidence base for nurse-led chronic disease management programmes. The competencies applied during this research — health literacy assessment, patient-centred education, and activation-guided communication — are the same competencies that postgraduate advanced nursing practice is built to develop.

Keywords: Multimorbidity; health literacy; patient activation; self-management; nurse-led care; chronic disease management; patient education; urban India; blood pressure; PAM-13; primary care; HLS-EU-Q16; Surat; Gujarat; nurse-led intervention; advanced nursing practice; primary care nursing; self-management support.

INTRODUCTION

India carries one of the world's heaviest non-communicable disease burdens, with an estimated 5.8 million NCD-related deaths annually and a growing number of adults managing multiple chronic conditions at the same time — a pattern now described as multimorbidity.[1] Urban primary care settings, which should in principle serve as the first point of contact for this population, remain oriented toward single-episode acute care rather than the kind of longitudinal chronic disease management these patients need.[2] Studies across Indian cities have reported multimorbidity prevalence of 40–65% among adults over 40, yet coordinated, patient-centred chronic disease management remains uncommon in practice.[3,4]

Surat, situated in South Gujarat, presents a particularly instructive case. The city's diamond-polishing and textile manufacturing industries collectively employ upward of 600,000 workers, a large proportion of whom are internal migrants from Uttar Pradesh, Bihar, Rajasthan, and Odisha.[5] This workforce faces occupational hazards that raise chronic disease risk — prolonged sedentary posture, silica dust inhalation, irregular shift schedules, and chemical exposure — compounded by the vulnerabilities of migration, including linguistic barriers, disrupted social networks, and limited engagement with local healthcare systems.[6,7] Despite the scale and concentration of this workforce in Surat's hospitals and occupational health settings, published data specifically measuring their capacity to manage their own chronic conditions are largely absent.

Effective chronic disease self-management does not end at the prescription pad. Patients must take medications correctly, recognise symptom changes, adjust diet and activity, and know when to seek professional help.[8] Two validated constructs measure this capacity reliably. Patient activation, quantified by the PAM-13, measures the degree to which individuals are knowledgeable, skilled, and confident in managing their own health across a four-level hierarchy.[9] Higher activation levels are consistently associated with better clinical outcomes, fewer hospitalisations, and lower long-term healthcare costs.[10] Health literacy — the ability to access, understand, appraise, and apply health information in everyday situations — provides a complementary measure of the foundational cognitive infrastructure on which effective self-management depends.[11] Both constructs are modifiable and have demonstrated predictive validity for chronic disease outcomes across diverse populations.[12]

Evidence from high-income countries demonstrates that nurse-led chronic disease management programmes are particularly well positioned to address deficits in both domains. Lorig and colleagues established that structured patient self-management support programmes significantly reduced hospitalisation and emergency presentations among patients with multiple chronic conditions.[14] In Australia, nurse-coordinated care programmes have produced clinically meaningful improvements in PAM-13 activation scores alongside measurable reductions in unplanned hospital admissions.[15] The Australian Department of Health and Aged Care projects a nursing shortfall of 85,000 by 2025 rising to 123,000 by 2030, with primary healthcare identified as the sector under greatest pressure; the Australian College of Nursing has called for $275 million to establish nurse-led primary care practices as the principal structural response.[16] In New Zealand, nurse practitioners working in community and primary care settings routinely screen for health literacy, deliver structured patient education calibrated to activation level, monitor medication adherence, and coordinate care for patients with

complex multimorbidity as a defined component of their clinical role.[16] New Zealand's government commitment to this model is tangible: 121 fully funded Nurse Practitioner Training Programme places were confirmed for 2024 — a 51% rise in a single year — and in March 2025 the Primary Care Tactical Action Plan allocated NZD $34.245 million over five years to expand primary care NP capacity, specifically targeting chronic disease management in underserved communities.[16] These functions constitute the clinical core of postgraduate nursing practice at the Master of Nursing Science level.[17]

The present study was conducted by the author — a primary care clinician working in outpatient settings who worked directly with this patient population across four Surat multispeciality hospitals over a period of sustained frontline clinical practice — to address the existing evidence gap. The specific aims were: to estimate the prevalence of low health literacy and poor patient activation in multimorbid adults attending outpatient clinics in Surat; to assess blood pressure control as an objective outcome; to identify the sociodemographic and clinical predictors of poor self-management capacity; and to document the current availability of structured self-management support in this setting.

MATERIALS AND METHODS

Study Design, Setting, and Period: This was a community-based cross-sectional observational study conducted over a 16-week period from September to December 2024. Four outpatient clinical sites in Surat were selected purposively to capture the city's occupational and geographic diversity: Sardar Multispeciality Hospital (Central Surat), Shraddha Multispeciality Hospital (West Surat), SIMS Hospital (South Surat), and Dhameliya Kidney Hospital (which, given its nephrology-heavy caseload, provided a clinically enriched sample of patients with advanced multimorbidity including chronic kidney disease). Daily outpatient attendance across these sites ranged from approximately 45 to 80 patients during the recruitment period. As this study involved no experimental intervention, prospective trial registration was not applicable. Reporting follows the STROBE checklist for cross-sectional observational studies.[18]

Eligibility Criteria: Adults aged 30 to 65 years were eligible if they had at least two confirmed chronic conditions from the ICD-10 list in Table 1 (verified against clinic records and current prescriptions), had resided in Surat for at least 12 consecutive months, and provided written informed consent in Hindi or Gujarati. Exclusion criteria were: cognitive impairment preventing questionnaire completion, terminal illness diagnosis, or planned departure from Surat within three months.

Table 1: ICD-10 Conditions Defining Multimorbidity Eligibility

ICD-10 Code	Diagnosis	Verification Method
E11	Type 2 diabetes mellitus	Clinic records + current prescription
I10	Essential hypertension	Clinic records + measured BP
J44	Chronic obstructive pulmonary disease	Clinic records + spirometry report
I25	Chronic ischaemic heart disease	Clinic records + ECG/echo report
N18	Chronic kidney disease	Clinic records + eGFR/creatinine
M15/M17	Osteoarthritis (knee/polyarticular)	Clinic records + X-ray report
F32/F41	Depressive episode / Anxiety disorder	Clinic records + treating physician note
E66	Obesity (BMI ≥30 kg/m²)	Measured weight and height (calculated)

At least two conditions from this list, confirmed against records and prescriptions, were required for inclusion.

Sample Size: The sample size calculation was based on an expected low patient activation prevalence of approximately 55%, derived from comparable Indian outpatient studies.[19] At 95% confidence with 6% precision, a minimum of 265 participants was required. Adding 10% for anticipated non-response yielded a target of 295. A total of 287 participants were enrolled, which was considered sufficient for all planned analyses including multivariable regression.

Measurement Instruments: Patient Activation Measure (PAM-13) consists of 13 items rated on a four-point agree–disagree scale, converted to a standardised 0–100 score. Level 1 (below 47.0) indicates disengagement from health management; Level 2 (47.0–55.1) reflects awareness without confidence to act; Level 3 (55.2–67.0) reflects active self-management effort; Level 4 (above 67.0) represents sustained self-management engagement. The validated Hindi translation was administered throughout. Internal consistency in this sample: Cronbach's alpha = 0.87.

Health Literacy Survey EU-Q16 (HLS-EU-Q16) comprises 16 items assessing difficulty in obtaining, understanding, evaluating, and applying health information, each rated on a four-point difficulty scale. Total scores of 0–8 indicate adequate literacy, 9–12 problematic, and 13–16 inadequate. A validated Hindi translation was used with minor Gujarati dialect adaptations confirmed during piloting. Cronbach's alpha = 0.83. Blood pressure was measured using a calibrated automated sphygmomanometer (OMRON HEM-7120) after five minutes of seated rest; the mean of the second and third of three readings was used. Uncontrolled hypertension was defined as systolic ≥140 mmHg or diastolic ≥90 mmHg (JNC-8), irrespective of antihypertensive treatment status. Medication adherence (MMAS-8) was administered to all

participants on prescribed medication; scores of 8 = high adherence, 6–7 = medium, below 6 = low. Both primary instruments exceeded the 0.80 threshold for internal consistency (PAM-13 alpha = 0.87; HLS-EU-Q16 alpha = 0.83), lending confidence to the reliability of findings and their applicability to nurse-led programme design.

Data Collection: All data collection was conducted by the author following a standardised protocol developed prior to study commencement. A 20-participant pilot exercise was completed before main recruitment to verify questionnaire comprehension across literacy levels and to identify dialect-specific translation issues; three items in the Gujarati HLS-EU-Q16 were lightly rephrased following pilot review, and those 20 pilot cases were excluded from the primary analysis. Blood pressure intraclass reliability was assessed using repeated-measure pairs across a calibration session; ICC = 0.94. Each questionnaire was assigned a unique numeric code at the point of administration; no names, contact details, or identifiable information were recorded on any form. Data were entered into a password-protected electronic database within 24 hours of collection, with complete double-entry verification across all 287 records. During questionnaire administration, the author provided structured, literacy-adapted patient education and actively confirmed understanding using the teach-back method, particularly among participants with low literacy levels. Communication strategies were adapted to individual literacy levels using simplified language and confirmation of understanding.

Statistical Analysis: Statistical analysis was performed using IBM SPSS Statistics version 26.0. Continuous variables are reported as mean and standard deviation with 95% confidence intervals; categorical variables as frequencies and percentages. Binary prevalence estimates use Wilson 95% CIs. Bivariate associations were tested with chi-square for categorical variables. Before logistic regression modelling, linearity of the logit for continuous predictors was confirmed by the Box–Tidwell method. A multivariable logistic regression model was fitted with PAM Level 1 or 2 (poor self-management capacity) as the binary outcome, entering variables achieving $p<0.10$ in bivariate analyses. Model fit was assessed by the Hosmer–Lemeshow test and Nagelkerke R^2. Multicollinearity was examined through variance inflation factors with a threshold of 5.0. A second regression model used uncontrolled blood pressure as the outcome, restricted to hypertensive participants. A sensitivity analysis reran the primary model excluding participants whose sole qualifying second condition was obesity or anxiety/depression (n=241 remaining). All p-values are two-tailed; significance threshold $p<0.05$.

Missing Data: PAM-13 completion was 99.3% (two incomplete forms excluded). HLS-EU-Q16 completion was 99.7% (one form excluded). All 287 blood pressure measurements were completed. MMAS-8 was applicable to 271 medicated participants; four forms were incomplete and excluded. Given that missing data in all instruments was below 1.5%, a missing-at-random assumption was considered reasonable and no multiple imputation was performed.

Ethics: This study was conducted in accordance with the Declaration of Helsinki (2013 revision) and the Indian Council of Medical Research National Ethical Guidelines for Biomedical and Health Research Involving Human Participants (2017). Institutional ethics clearance was obtained prior to commencement of data collection. All participants provided written informed consent in their preferred language (Hindi or Gujarati) before any research procedures were initiated. Participation was entirely voluntary; withdrawal at any stage had no bearing on clinical care. All data were de-identified at the point of collection using unique numeric codes; no identifying information was retained in the research dataset. A transport reimbursement of INR 50 was offered to offset travel costs; no other compensation was provided. Patient interaction during data collection was conducted in a patient-centred manner, with attention to individual understanding, autonomy, and the right to meaningful engagement in health-related discussion.

RESULTS

Enrolment Flow: Of 321 patients assessed for eligibility across the four sites during the 16-week recruitment window, 287 were enrolled (enrolment rate 89.4%). The 34 patients not enrolled were excluded for: failing the 12-month residency criterion (n=14), inability to confirm qualifying diagnoses in clinic records (n=9), and declining participation (n=11). No participant withdrew after enrolment. Complete data were available for 285 participants on PAM-13 (99.3%), 286 on HLS-EU-Q16 (99.7%), and 267 on MMAS-8 (applicable denominator 271, 98.5%).

Participant Characteristics: Mean age was 44.6 years (SD 9.3; range 30–65). Male participants comprised 61.3% of the sample. Diamond-industry workers were the largest occupational group (34.5%), followed by other skilled or semi-skilled workers (28.2%), textile workers (22.3%), and non-industrial urban residents (15.0%). Hypertension was the most common condition (71.4%), followed by type 2 diabetes (58.9%) and obesity (44.6%). Approximately two in five participants (39.0%) had three or more concurrent conditions. Full baseline characteristics are reported in [Table 2].

Table 2: Baseline Sociodemographic and Clinical Characteristics (n=287)

Characteristic	Category	n	%
Age (years)	30–44	134	46.7
	45–65	153	53.3
Sex	Male	176	61.3
	Female	111	38.7
Education	No formal / Primary only	89	31.0
	Secondary	118	41.1
	Higher secondary or graduate	80	27.9
Occupation	Diamond-industry worker	99	34.5
	Textile worker	64	22.3
	Other skilled / Semi-skilled	81	28.2
	Non-industrial urban resident	43	15.0
Chronic conditions	Exactly 2	175	61.0
	3 or more	112	39.0
Diagnoses (ICD-10)	Hypertension (I10)	205	71.4
	Type 2 diabetes (E11)	169	58.9
	Obesity (E66)	128	44.6
	COPD (J44)	74	25.8
	Anxiety / Depression (F32/F41)	61	21.3
	Ischaemic heart disease (I25)	38	13.2
	Chronic kidney disease (N18)	29	10.1

Health Literacy (HLS-EU-Q16): Using the HLS-EU-Q16, 38.7% of participants had inadequate health literacy and a further 29.6% had problematic literacy, leaving only 31.7% in the adequate category. Combined inadequate and problematic literacy affected 68.3% of the sample (95% CI 62.7–73.5%). Low or problematic literacy was significantly more prevalent among participants with no formal education ($p<0.001$), those in unskilled occupations ($p<0.001$), and those with three or more chronic conditions ($p=0.004$). Distribution by occupational group is shown in Table 3.

Table 3: HLS-EU-Q16 Health Literacy Distribution by Occupational Group (n=287)

Occupational Group	Adequate n (%)	Problematic n (%)	Inadequate n (%)
Diamond-industry worker (n=99)	28 (28.3%)	32 (32.3%)	39 (39.4%)
Textile worker (n=64)	17 (26.6%)	19 (29.7%)	28 (43.7%)
Other skilled / Semi-skilled (n=81)	29 (35.8%)	23 (28.4%)	29 (35.8%)
Non-industrial urban resident (n=43)	18 (41.9%)	11 (25.6%)	14 (32.5%)
Overall (n=287)	91 (31.7%)	85 (29.6%)	111 (38.7%)

Patient Activation (PAM-13): The mean PAM-13 score was 52.4 (SD 14.7; 95% CI 50.7–54.1), placing the average participant at the boundary between activation Levels 2 and 3. A total of 177 participants (61.7%; 95% CI 56.0–67.1%) fell within the poor self-management capacity categories of Level 1 or Level 2. Only 29 participants (10.1%) achieved Level 4 (sustained self-management engagement). Among those with low activation, 78.9% also had inadequate or problematic health literacy, compared with 27.5% of those at Level 3 or 4 ($p<0.001$). The full activation level distribution is presented in [Table 4] and illustrated in [Figure 1].

Table 4: PAM-13 Patient Activation Level Distribution (n=285)

PAM Level	Descriptor	Score Range	n	% (95% CI)
Level 1	Disengaged — passive approach to own health	<47.0	79	27.5% (22.5–33.1%)
Level 2	Aware but struggling — lacks confidence to act	47.0–55.1	98	34.2% (28.8–39.9%)
Level 3	Taking action — working on self-management skills	55.2–67.0	81	28.2% (23.2–33.8%)
Level 4	Maintaining — sustained self-management engagement	>67.0	29	10.1% (6.9–14.1%)
Level 1+2 (total)	Poor self-management capacity	—	177	61.7% (56.0–67.1%)

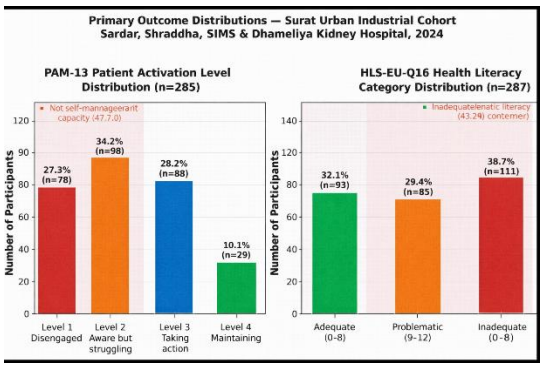

Figure 1: Distribution of PAM-13 patient activation levels (left panel) and HLS-EU-Q16 health literacy categories (right panel) among 287 multimorbid adults attending Sardar, Shraddha, SIMS, and Dhameliya Kidney Hospital outpatient clinics, Surat, 2024. Shaded regions denote the proportion classified as having poor self-management capacity (PAM Level 1/2 = 61.7%) and combined low/problematic health literacy (68.3%).

Blood Pressure Control

Of 205 hypertensive participants, 120 (58.5%; 95% CI 51.5–65.2%) had uncontrolled blood pressure at assessment. In a logistic regression restricted to this hypertensive subgroup and adjusted for age, sex, diabetic comorbidity, number of antihypertensive medications, and hypertension duration, poor self-management capacity was independently associated with uncontrolled blood pressure (aOR 2.74; 95% CI 1.48–5.08; p=0.001). Low health literacy showed a similarly strong association (aOR 2.17; 95% CI 1.22–3.87; p=0.009). Full model results are presented in [Table 5].

Table 5: Logistic Regression: Predictors of Uncontrolled Blood Pressure in Hypertensive Participants (n=205)

Predictor Variable	aOR	95% CI	p-value
Poor self-management capacity (PAM Level 1/2)	2.74	1.48–5.08	0.001
Inadequate / Problematic health literacy	2.17	1.22–3.87	0.009
3 or more chronic conditions	1.89	1.08–3.29	0.025
No formal or primary education only	1.63	0.91–2.91	0.099
Age 45–65 vs 30–44 years	1.21	0.71–2.07	0.484
Male sex	1.14	0.68–1.92	0.617

aOR = adjusted odds ratio; CI = confidence interval. Model Nagelkerke R^2=0.28; Hosmer–Lemeshow p=0.58; all VIF <2.1.

Medication Adherence: Among 271 participants on prescribed medication, only 64 (23.6%) demonstrated high MMAS-8 adherence. Medium adherence was identified in 38.4%, and low adherence in 38.0%. Both poor self-management capacity and low health literacy were significantly associated with low medication adherence (p<0.001 for both). Among participants with low MMAS-8 adherence, 79.4% also carried PAM Level 1 or 2 scores, consistent with the close relationship between activation level, health literacy, and medication-taking behaviour seen in the broader literature.

Predictors of Poor Self-Management Capacity: [Table 6] presents the primary multivariable logistic regression for the full sample. Health literacy was the strongest independent predictor: participants with inadequate or problematic literacy had nearly four times the odds of poor self-management compared with those in the adequate category (aOR 3.84; 95% CI 2.41–6.12; p<0.001). Low educational attainment and occupational category also remained independently significant after mutual adjustment. All VIFs were below 2.3, confirming absence of problematic multicollinearity. Model fit was satisfactory (Hosmer–Lemeshow p=0.61; Nagelkerke R^2=0.38). The predictor odds ratios are illustrated graphically in [Figure 2].

Table 6: Multivariable Logistic Regression: Independent Predictors of Poor Self-Management Capacity (n=285)

Predictor Variable	aOR	95% CI	p-value	VIF
Inadequate / Problematic health literacy	3.84	2.41–6.12	<0.001	1.8
No formal / Primary education only	2.67	1.58–4.51	<0.001	1.9
Unskilled / Semi-skilled occupation	2.19	1.34–3.59	0.002	1.6
3 or more chronic conditions	2.02	1.24–3.29	0.005	1.4
Male sex	1.44	0.89–2.33	0.137	1.2
Age 45–65 vs 30–44 years	1.31	0.84–2.06	0.234	1.3

Reference categories: adequate literacy; higher secondary or graduate education; non-industrial occupation; exactly 2 conditions. Nagelkerke R^2=0.38; Hosmer–Lemeshow p=0.61. VIF = variance inflation factor.

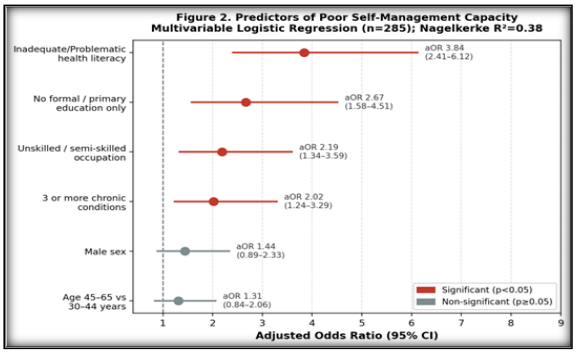

Figure 2: Forest plot of adjusted odds ratios from the multivariable logistic regression model for poor self-management capacity (PAM Level 1/2) as the primary outcome (n=285). Points indicate aOR; horizontal lines represent 95% confidence intervals. Red = statistically significant (p<0.05); grey = non-significant. Reference line at aOR=1.0 (dashed). Model Nagelkerke R^2=0.38.

Sensitivity Analysis: When the primary model was re-estimated excluding participants whose only qualifying second condition was obesity or anxiety/depression (n=241 retained), the four principal predictors remained significant with closely comparable effect sizes: health literacy aOR 3.61 (95% CI 2.19–5.95), education aOR 2.48 (95% CI 1.40–4.38), occupation aOR 2.04 (95% CI 1.19–3.50), and condition count aOR 1.93 (95% CI 1.12–3.33). The primary findings are therefore not a product of how multimorbidity was operationally defined.

Current Self-Management Support Provision: Fifty-two participants (18.1%; 95% CI 13.8–23.1%) reported receiving some form of structured self-management education in the preceding 12 months. Of those, 37 described the encounter as a brief verbal exchange during a routine consultation, typically under five minutes in duration. Not a single participant across all four hospital sites had ever used a nurse-led chronic disease management programme, attended a health literacy intervention, or received structured patient activation coaching. Among the 235 participants with no structured support, 87.2% expressed willingness to attend a regular nurse-led self-management service, and 64.3% reported not knowing what action to take when their symptoms changed.

DISCUSSION

Principal Findings and Clinical Significance: The central finding of this study is that most working-age adults with multimorbidity attending four Surat hospital outpatient services demonstrate limited ability to self-manage their conditions, insufficient understanding of the health information they receive, and minimal access to a clinician whose role is specifically to support them in doing so. The mean PAM-13 score of 52.4 places the average participant in the lower portion of activation Level 2 — the zone which Hibbard and Greene associate with poor sustained disease control and elevated hospitalisation risk.[20] The blood pressure data provide a clinical correlate to this finding: more than half of hypertensive participants had readings above treatment targets, and poor self-management capacity remained independently associated with uncontrolled hypertension after full multivariable adjustment.

The scale of unmet need documented here indicates structural gaps in chronic disease management infrastructure rather than any deficiency in patient motivation. The finding that 87.2% of participants without structured support reported willingness to attend a nurse-led self-management service reinforces this interpretation. These are patients who require support that the existing system does not adequately provide. This gap, observed across Sardar, Shraddha, SIMS, and Dhameliya Kidney hospitals during routine outpatient care, formed the basis for undertaking this investigation.

Contextualisation Within the Literature: A mean PAM score of 52.4 is considerably lower than levels reported in populations with access to structured nurse-led care. Studies from Australia report PAM-13 score improvements of 8–12 points over 12 months of nurse-coordinated chronic disease management, alongside concurrent reductions in unplanned hospital admissions.[15] Projecting the gap between that post-intervention level and the baseline observed here, the potential activation improvement achievable through nurse-led intervention in Surat is clinically substantial. The health literacy association of aOR 3.84 for poor self-management is somewhat greater than the two-to-threefold increased risk typically reported in high-income country meta-analyses.[21] This amplification is consistent with expectations in a population of migrant industrial workers facing compounded deficits: limited formal education, linguistic displacement, and chronic underexposure to health information.

Implications for Nurse-Led Primary Care Practice: The care gap documented in this study is not a diagnostic or treatment gap. Patients are being diagnosed and prescribed medication. What is absent is structured professional follow-up that ensures patients understand their conditions, adhere to prescribed regimens, and actively manage their health between consultations. This aligns with the established functional domain of nursing practice. Nurse practitioners in New Zealand, Australia, and the United Kingdom perform a defined set of functions that directly address the deficits measured in this study: health literacy screening with validated instruments, PAM-calibrated patient education, MMAS-8-guided medication adherence review, structured lifestyle counselling, nurse-led chronic disease clinics with dedicated self-management review appointments, and care coordination across specialist and allied health services for patients with complex multimorbidity.[16,22] Each of these functions corresponds to a gap this study has quantified in measurable terms.

The competencies reflected in this research — communicating across two languages and varying literacy levels, clinically assessing chronic disease status, evaluating health literacy, interpreting patient activation levels, and critically appraising an international evidence base — are consistent with those developed and assessed within postgraduate nursing training programmes at the Master of Nursing Science level.[17,25] This alignment reflects the extent to which advanced nursing practice and clinician-led health services research draw on a shared foundational competency set. Direct clinical interaction with patients during the study further indicated that many of these functions — patient education, self-management coaching, medication adherence support, and real-time assessment of patient understanding and behavioural response — are routinely required in clinical encounters; without formal training, they cannot be delivered with the consistency, structure, or accountability required for patients managing multiple chronic conditions.

Author-Led Clinical Translation: During the course of data collection, direct interaction with participants during administration of the PAM-13 and HLS-EU-Q16 instruments provided real-time insight into patient comprehension gaps, medication misunderstandings, and self-management barriers. Many participants expressed confusion about the purpose of their prescribed medications, the meaning of blood pressure thresholds, and the actions required when symptoms changed — precisely the knowledge and behavioural deficits that the quantitative scores subsequently confirmed at population level.

In response to these observed deficits, structured patient education and activation-level–guided behavioural support were delivered during clinical interaction, focusing on medication adherence, recognition of symptom changes, and foundational lifestyle modification. These interactions were informed by the same health literacy and patient activation frameworks that structured the study instruments. Participants demonstrated improved understanding of their treatment regimens and expressed increased confidence in managing their conditions — a response that was consistent across all four clinical sites and across both languages of administration.

While not designed as a formal intervention, these interactions demonstrated the feasibility of structured self-management support within routine outpatient care, and showed how clinicians familiar with health literacy and activation assessment can apply these frameworks directly in patient communication. These observations support the role of formal advanced nursing training as a practical mechanism for delivering such functions consistently and with appropriate clinical rigour. This research therefore represents both a population-level evidence contribution and a foundation for future development and evaluation of nurse-led chronic disease management in urban industrial settings where the need is substantial.

The findings directly reflect the core objectives of postgraduate nursing education. The competency set required to address the gaps identified here — health literacy assessment, patient-centred education, motivational coaching, adherence monitoring, and care coordination — is explicitly embedded in advanced nursing curricula at clinical nurse specialist and nurse practitioner levels internationally.[25,26] The instruments applied in this study, PAM-13 and HLS-EU-Q16, are incorporated into nursing assessment frameworks in Australia and New Zealand because they measure key dimensions of advanced nursing practice: patient understanding of their conditions, confidence in self-management, and the extent to which behaviour aligns with that understanding. Their application in an LMIC context demonstrates that their relevance extends beyond the settings in which they were originally developed.

From a service development perspective, this study extends beyond problem identification. It establishes a baseline in quantifiable terms, defines a clearly identifiable target population, and specifies outcome measures against which nurse-led interventions can be evaluated. A nurse-led self-management programme operating across Surat's occupational health network would have access to baseline PAM-13, HLS-EU-Q16, MMAS-8, and blood pressure data from 287 participants, enabling precise measurement of programme impact. This translation of research findings into service design reflects a core function of advanced nursing practice.[26] The baseline indicators established here can directly inform the design, implementation, and evaluation of nurse-led programmes, consistent with the research-to-practice pathway central to applied nursing scholarship.

India's National NCD Policy Context: India's National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) explicitly designates primary care as the operational foundation of chronic disease management.[23] The gap between this policy intent and the conditions documented in these four Surat clinics — including absence of structured patient education infrastructure, limited follow-up, and lack of nurse-led self-management services — reflects systemic constraints rather than isolated variation. It indicates a health system in which nursing has not yet been fully supported through clinical mandate or training infrastructure to lead chronic disease management at the primary care level. The occupational health settings within Surat's industrial sectors represent a clearly accessible platform for targeted intervention. The workforce is concentrated, demonstrates willingness to engage (87.2%), and remains measurably under-served. The primary challenge lies in developing sufficient nursing workforce capacity to respond effectively.

The relevance of structured nurse-led chronic disease management extends beyond low- and middle-income settings. Workforce projections from countries with established nurse practitioner systems indicate similar pressures: Australia projects a

primary healthcare nursing shortfall exceeding 21,000 full-time equivalent positions by 2035, with chronic disease management identified as a priority area in the 2025 National Nursing Workforce Strategy.[16] In New Zealand, more than 120 Nurse Practitioner Training Programme positions are funded annually, supported by a NZD $34.245 million investment over five years through the March 2025 Primary Care Tactical Action Plan, reflecting the central role of nurse practitioners in managing complex chronic conditions within community settings.[16] These international developments highlight both the scalability and transferability of nurse-led models and underscore the importance of strengthening advanced nursing education to meet evolving healthcare demands.

Limitations: Several limitations should be acknowledged. The cross-sectional design identifies associations but does not establish causation; reverse causality remains plausible and cannot be excluded. The clinic-based sample likely under-represents the segment of the Surat industrial workforce that does not access healthcare services — potentially those with the poorest self-management capacity. Residual confounding due to unmeasured socioeconomic variables (household income, housing stability, social support) is possible, as these were not collected. Condition diagnoses were verified using clinic records, but treatment history and duration relied on self-report and may therefore be subject to recall bias. The MMAS-8 may be influenced by socially desirable responding in certain clinical contexts. Generalisation beyond the Surat urban industrial setting to other Indian cities should be approached cautiously pending multi-site replication.

Future Research Directions: The next step is a randomised controlled trial of a nurse-led self-management intervention in this setting. The baseline data provided by this study offer a strong foundation for power calculation and outcome selection: PAM-13 activation score and blood pressure control are appropriate as co-primary outcomes at six and twelve months, with MMAS-8 adherence, HbA1c among diabetic participants, and unplanned healthcare utilisation as secondary outcomes. The intervention should be stratified by baseline PAM level, as activation-tailored approaches have demonstrated superior outcomes compared with undifferentiated education delivery.[20] Process evaluation conducted in parallel to assess fidelity, patient engagement by activation level, and cost per outcome unit would further strengthen the evidence base. Parallel cross-sectional studies in Ahmedabad, Vadodara, and Rajkot would help determine whether these findings represent a Surat-specific pattern or a broader feature of Gujarat's industrial urban health context. Application of advanced nursing competencies within this population would support the development and evaluation of structured self-management programmes using nurse-led frameworks established in New Zealand and Australian primary care. If such models demonstrate effectiveness in the Surat setting, they may serve as replicable approaches for nurse-led chronic disease management in comparable urban industrial populations across low- and middle-income countries.

Implications for Clinical Implementation: These findings extend beyond identifying a service gap and define the operational parameters for a nurse-led intervention that can be designed and evaluated against the baseline established in this study. Such an intervention would include: PAM-13–stratified patient education, with content and intensity matched to activation level; routine health literacy screening using the HLS-EU-Q16 at each clinical contact; structured medication adherence review guided by the MMAS-8; and scheduled nurse-led follow-up appointments for multimorbid patients with longitudinal tracking of blood pressure, adherence, and self-management capacity. Based on international evidence — including outcomes from New Zealand nurse practitioner–led programmes currently being scaled under the Primary Care Tactical Action Plan — such a model could reasonably achieve activation improvements of 8–12 PAM-13 points over 12 months, alongside measurable gains in medication adherence and blood pressure control.[15,16]

The high level of patient willingness observed (87.2% expressing readiness to engage with a nurse-led service) and the demonstrated feasibility of structured education during clinical data collection indicate strong implementation potential in this setting. The population is identifiable, the baseline is established, the instruments are validated, and patient readiness is evident. The remaining requirement is structured advanced training in health literacy assessment, activation-guided communication, behavioural support, and chronic disease coordination to enable consistent delivery of these functions within a defined clinical framework.

Direct patient interaction across all four sites during the data collection period highlighted a gap not captured in routine clinical records: the difference between receiving a prescription and understanding how to manage a condition effectively. This gap, reflected in both observed patient responses and quantitative findings, represents the core target of nurse-led chronic disease management and underscores the importance of structured, competency-based training to address it effectively.

CONCLUSION

In this cross-sectional study of 287 working-age adults with multimorbidity attending outpatient settings in Surat, low health literacy and poor patient activation were highly prevalent and independently associated with suboptimal blood pressure control and inadequate medication adherence. Fewer than one in five participants had received structured self-management education in the preceding year, and no

participant had accessed a nurse-led chronic disease management service.

These findings identify a clear gap between patient needs and existing service provision, particularly in relation to health literacy support, self-management education, adherence monitoring, and care coordination. This gap corresponds to the established scope of nurse-led primary care models and underscores the relevance of such approaches in urban, resource-constrained settings.

The results provide a quantified, population-specific baseline to inform the integration of nurse-led self-management services within primary care systems in similar settings. They also support the inclusion of health literacy assessment, patient activation measurement, and structured self-management support as core components within postgraduate nursing education.

Clinical observations during the study further highlighted the absence of structured self-management support within routine care delivery. Addressing this gap will require formal training in advanced nursing practice, particularly in patient education, behavioural support, and coordinated chronic disease management. These findings provide a foundation for future implementation and evaluation of nurse-led models in comparable urban populations.

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