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Digital Readiness and Telemedicine Preparedness Among Nursing Officers for Hypertension Care in a Tertiary Care Hospital, Bengaluru: A Cross-Sectional Analytical Study

[1]Mr. Sreekanth A. N, [2]Dr. Rama Taneja.
[1]Ph.D. Scholar, Mansarovar Global University, Sehore, Madhya Pradesh, India
[2] Professor and Guide, Mansarovar Global University, Sehore, Madhya Pradesh, India
Email: Sreekanth.adhevar@gmail.com, Mobile: 91645 05540

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ABSTRACT

Background: Telemedicine can improve continuity of hypertension follow-up, but safe nurse-led virtual care requires digital access, eHealth literacy, communication confidence, privacy awareness, documentation skill, and timely referral preparedness.3,14,16

Objective: To assess digital readiness and telemedicine preparedness among nursing officers involved in hypertension care in a tertiary care hospital at Bengaluru, Karnataka.3,20

Methods: This cross-sectional analytical study included finalized data from 200 nursing officers. A 45-item Digital Readiness and Telemedicine Preparedness Inventory covering seven domains was scored on a 0-100 scale. High preparedness was defined as a total score of 75 or above. Descriptive tests, correlation, and multivariable logistic regression were used.8,10,20

Results: The mean total preparedness score was 73.08 (SD 6.15). High preparedness was observed in 78/200 participants (39.0%), moderate preparedness in 117/200 (58.5%), and low preparedness in 5/200 (2.5%). Digital access and infrastructure showed the highest domain mean (81.04), while documentation, privacy, and consent showed the lowest mean (65.27). Prior digital health/telemedicine training, routine digital clinical documentation, stable internet access, and higher eHealth information literacy independently predicted high preparedness.8,10,20

Conclusion: Nursing officers demonstrated moderate baseline readiness, with priority gaps in documentation, privacy, teleconsultation workflow, home BP review, and escalation. Targeted training and hospital workflow support are required before scale-up.8,11,19

INTRODUCTION

Hypertension is a major modifiable cause of cardiovascular disease, stroke, kidney disease, disability, and premature mortality. Effective control depends on continuity of follow-up, adherence support, lifestyle counselling, home blood pressure monitoring, and timely escalation when readings remain outside individualized targets.14-17

Digital health and telemedicine are increasingly used to strengthen access, continuity, and efficiency. WHO guidance emphasizes service design, governance, workforce preparedness, evaluation, equity, and safety. In India, the Telemedicine Practice Guidelines, eSanjeevani, and Ayushman Bharat Digital Mission have accelerated digital health integration.1-7

Successful digital transformation depends on workforce competency, not platforms alone. Health professionals require basic digital operations, eHealth information literacy, digital communication, privacy protection, safe documentation, clinical judgement, and patient education. Evidence shows that readiness is shaped by access, knowledge, attitude, training, and exposure to digital systems.8-13

Nursing officers are central to hypertension follow-up because they provide repeated patient contact, counselling, BP-log review, adherence reinforcement, reminders, and referral coordination. In nurse-led telemedicine, they must verify home readings, communicate clearly, recognize red flags, protect confidentiality, document contacts, and escalate care appropriately.14-19

Baseline assessment is therefore needed before scale-up. It helps identify preparedness level, domain-specific gaps, barriers, and predictors, and guides video-assisted modules, skill-lab activities, mentoring, documentation checklists, and implementation pathways.3,8,10,11,19

This article assesses digital readiness and telemedicine preparedness among nursing officers for hypertension care in a tertiary care hospital at Bengaluru and complements the author group's related intervention work.19,20

METHODS

Study design and setting

A hospital-based cross-sectional analytical study was conducted among nursing officers in a tertiary care hospital at Bengaluru, Karnataka. Eligible clinical areas included hypertension or cardiology OPD, medical wards, emergency services, and critical care units. Reporting was aligned with STROBE principles.20

Participants

Participants were registered nursing officers involved directly or indirectly in adult hypertension care. Inclusion criteria were at least one year of clinical experience, active patient-care placement, and willingness to participate. Nursing officers on long leave, without direct clinical responsibilities, or with incomplete responses were excluded. Of 214 approached, 200 complete responses were analyzed, giving a 93.5% response rate.10,20

Sample size estimation

Sample size was estimated by the single-proportion formula $n = Z^2pq/d^2$ using a telemedicine readiness estimate of 68.8%, 95% confidence, 6.5% precision, and 10% allowance for non-response. The final analyzed sample of 200 was retained.10

Instrument

Digital readiness and telemedicine preparedness were measured using a structured 45-item inventory for nursing officers in hypertension care. Seven domains were assessed: digital access and infrastructure, basic digital operations, eHealth information literacy, teleconsultation communication confidence, hypertension telemonitoring preparedness, documentation/privacy/consent, and referral escalation/patient safety. Items were rated on a five-point scale and transformed to a 0-100 score. Scores were classified as low (<60), moderate (60-74), or high (>=75) preparedness.8,10,11

Content validity was established by experts in nursing, medicine, digital health, and biostatistics. The content validity index was 0.91 and overall Cronbach's alpha was 0.94.8,20

Variables

The primary outcome was high telemedicine preparedness. Secondary outcomes were total and domain scores, perceived barriers, attitude, organizational readiness, and willingness for further training. Explanatory variables included sociodemographic, professional, infrastructure, and prior digital exposure factors.8,10

Data collection procedure

After permission and ethical approval, eligible nursing officers received study information and gave written consent. Questionnaires were completed during non-duty-disruptive hours, coded without identifiers, and checked for completeness.4,20

Statistical analysis

Descriptive statistics, chi-square tests, independent-sample t tests, Pearson correlation, and multivariable logistic regression were used. Domain scores were presented with 95% confidence intervals, adjusted odds ratios with 95% confidence intervals were reported, and significance was set at $P < .05$.20

Ethical considerations

Ethical approval: Institutional Ethics Committee approval and administrative permission from the Medical Superintendent, Victoria Hospital, Bengaluru, were obtained before data collection.4,20

Informed consent: Written consent was obtained from all participants after explaining the purpose, voluntary nature, confidentiality, absence of penalty for refusal, and right to withdraw.20

Confidentiality: No personally identifiable data were reported. Electronic data were password-protected and results were presented only in aggregate form.4,20

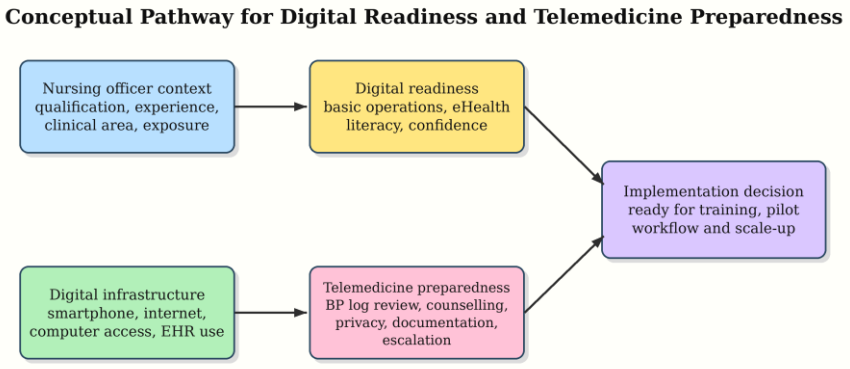

Figure 1. Conceptual pathway for digital readiness and telemedicine preparedness among nursing officers.

RESULTS

Participant characteristics

Two hundred nursing officers were included. Mean age was 36.17 (SD 7.57) years and median clinical experience was 7.1 years. Females constituted 72.0%; prior telemedicine exposure was 32.5% and prior digital health training was 35.0%.20

Table 1. Baseline characteristics of nursing officers

Characteristic	Category / measure	n (%) or mean (SD)
Age, years	Mean (SD)	36.17 (7.57)
Clinical experience, years	Median (IQR)	7.1 (4.7-10.3)
Sex	Female	144 (72.0)
Sex	Male	56 (28.0)
Qualification	GNM	79 (39.5)
Qualification	BSc Nursing	74 (37.0)
Qualification	Post Basic BSc	29 (14.5)
Qualification	MSc Nursing	18 (9.0)
Department	Medical ward	71 (35.5)
Department	Hypertension/Cardiology OPD	34 (17.0)
Department	Emergency/Critical care	63 (31.5)
Prior telemedicine exposure	Yes	65 (32.5)
Prior digital health training	Yes	70 (35.0)
Routine digital clinical documentation	Yes	102 (51.0)
Stable internet access	Yes	147 (73.5)
Workplace computer access	Yes	104 (52.0)
Personal smartphone availability	Yes	189 (94.5)

Domain-wise digital readiness and telemedicine preparedness

Mean total preparedness was 73.08 (SD 6.15). Digital access and infrastructure was the strongest domain, while documentation, privacy, and consent was the weakest. This shows that technology availability alone is insufficient and must be supported by safe clinical workflow, consent, confidentiality, documentation, and escalation training.8,11

Table 2. Domain-wise digital readiness and telemedicine preparedness scores

Domain	Items	Mean (SD)	95% CI	Interpretation
Digital access and infrastructure	6	81.04 (8.89)	79.81-82.27	Relatively strong
Basic digital operations	6	77.57 (9.09)	76.30-78.83	Moderate to strong
eHealth information literacy	7	74.27 (11.25)	72.71-75.83	Moderate
Teleconsultation communication confidence	6	71.99 (11.36)	70.41-73.56	Needs strengthening
Hypertension telemonitoring preparedness	7	69.67 (10.84)	68.16-71.17	Needs strengthening
Documentation, privacy and consent	7	65.27 (11.72)	63.64-66.89	Priority gap
Referral escalation and patient safety	6	71.77 (10.29)	70.35-73.20	Moderate

Domain	Items	Mean (SD)	95% CI	Interpretation
Total preparedness score	45	73.08 (6.15)	72.23-73.93	Moderate overall readiness

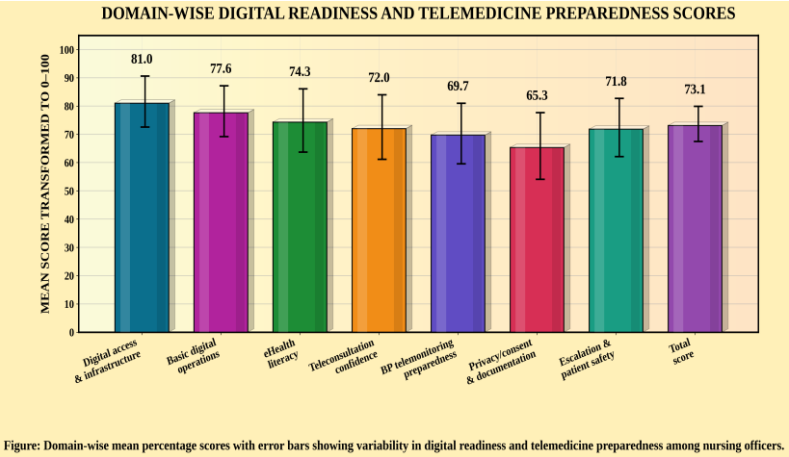

Figure 2. Domain-wise mean scores for digital readiness and telemedicine preparedness.

Preparedness categories

Using predefined cut-points, 39.0% showed high preparedness, 58.5% moderate preparedness, and 2.5% low preparedness. The distribution supports differentiated training with peer champions and focused mentoring.8,10

Table 3. Classification of telemedicine preparedness

Preparedness category	Score range	n (%)	Suggested implementation interpretation
Low preparedness	<60	5 (2.5)	Requires foundational digital skills and supervised practice
Moderate preparedness	60-74	117 (58.5)	Suitable for structured video-assisted training and checklist-based practice
High preparedness	>=75	78 (39.0)	Suitable for pilot telemedicine workflow, peer mentoring, and advanced skill-lab training

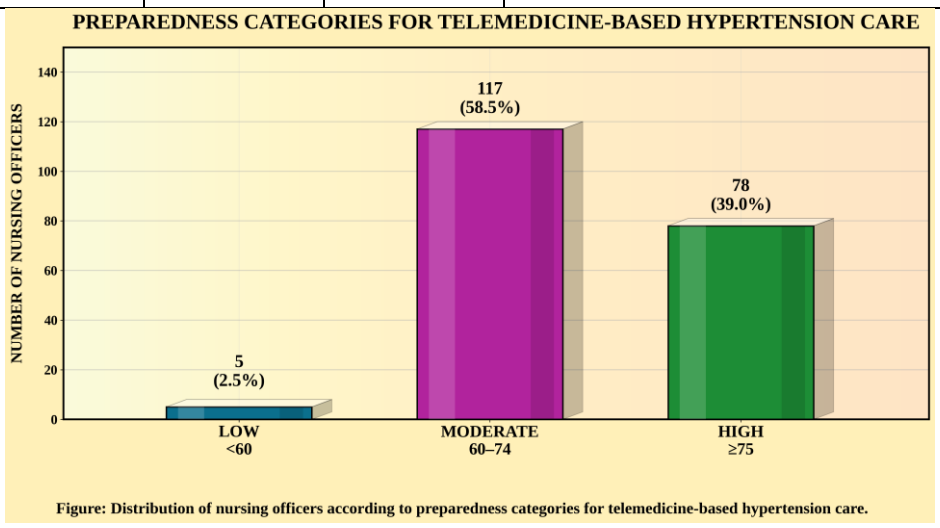

Figure 3. Distribution of nursing officers by preparedness category. Bivariate associations with high preparedness

High preparedness was more frequent among nursing officers with prior digital health training, telemedicine exposure, routine digital documentation, stable internet, and workplace computer access. Experience alone was less influential than digital workflow exposure.8,10,11

Table 4. Bivariate comparison between high-preparedness and non-high-preparedness groups

Variable	High preparedness n (%)	Not high preparedness n (%)	Test	P value
Prior digital health training	41 (52.6)	29 (23.8)	Chi-square	<.001
Previous telemedicine exposure	30 (38.5)	35 (28.7)	Chi-square	.199
Routine digital clinical documentation	44 (56.4)	58 (47.5)	Chi-square	.281
Stable internet access	63 (80.8)	84 (68.9)	Chi-square	.089
Workplace computer access	48 (61.5)	56 (45.9)	Chi-square	.044
Personal smartphone availability	75 (96.2)	114 (93.4)	Chi-square	.615
Age, years	36.78 (7.26)	35.79 (7.76)	t test	.359
Experience, years	9.31 (5.63)	7.32 (4.30)	t test	.009
eHealth information literacy score	81.83 (8.90)	69.43 (9.87)	t test	<.001
Organizational readiness score	3.75 (0.66)	3.66 (0.69)	t test	.347

Correlation analysis

Total preparedness correlated strongly with eHealth information literacy, teleconsultation confidence, hypertension telemonitoring preparedness, and documentation/privacy/consent. Barrier count showed a negative correlation, indicating the effect of unresolved system and workflow barriers.8,11

Table 5. Correlation of domain and system factors with total preparedness score

Variable correlated with total preparedness	Pearson r	P value	Interpretation
Digital access and infrastructure	0.53	<.001	Moderate positive
Basic digital operations	0.57	<.001	Moderate positive
eHealth information literacy	0.63	<.001	Moderate positive
Teleconsultation confidence	0.61	<.001	Moderate positive
Hypertension telemonitoring preparedness	0.58	<.001	Moderate positive
Documentation, privacy and consent	0.64	<.001	Moderate positive
Organizational readiness score	0.05	.485	Weak positive
Barrier count	-0.39	<.001	Negative

Predictors of high telemedicine preparedness

In adjusted analysis, prior digital health/telemedicine training, routine digital clinical documentation, stable internet access, and higher eHealth information literacy independently predicted high preparedness. Privacy or legal concern reduced the likelihood of high preparedness.8,10,11

Table 6. Multivariable logistic regression for high telemedicine preparedness

Predictor	Adjusted odds ratio	95% CI	P value	Interpretation
Prior digital health/telemedicine training	3.28	1.71-6.29	<.001	Independent positive predictor
Previous telemedicine exposure	1.46	0.76-2.80	.256	Not independently significant
Routine digital clinical documentation	2.21	1.15-4.24	.018	Independent positive predictor

Predictor	Adjusted odds ratio	95% CI	P value	Interpretation
Stable internet access	2.10	1.08-4.06	.029	Independent positive predictor
eHealth information literacy, per 10 points	1.74	1.29-2.31	<.001	Independent positive predictor
Privacy/legal concern barrier	0.52	0.27-0.99	.047	Negative predictor
Experience >10 years	1.22	0.66-2.27	.518	Not independently significant
Higher nursing qualification	1.44	0.80-2.60	.222	Not independently significant
Age, per 10 years	0.91	0.63-1.31	.614	Not independently significant

Perceived barriers

The leading barriers were lack of structured training, workload or time pressure, patient digital literacy limitations, difficulty verifying home BP readings, legal/privacy concerns, and internet instability. These barriers require training combined with workflow support, patient education materials, documentation templates, and infrastructure planning.3,4,11

Table 7. Perceived barriers and implementation implications

Barrier	n (%) reporting barrier	Implementation meaning
Lack of structured telemedicine training	142 (71.0)	Need for video-assisted module and skill lab
Workload and time pressure	128 (64.0)	Need for protected telemedicine time and role clarity
Patient digital literacy limitations	128 (64.0)	Need for patient instruction leaflet and assisted calls
Difficulty verifying home BP readings	112 (56.0)	Need for BP log format and device validation guidance
Legal/privacy concern	97 (48.5)	Need for consent, privacy and documentation protocol
Internet or network instability	99 (49.5)	Need for connectivity plan and backup phone protocol
Lack of private space for teleconsultation	89 (44.5)	Need for designated teleconsultation corner
Device availability issues	69 (34.5)	Need for shared device pool
Documentation uncertainty	94 (47.0)	Need for standardized telemedicine note template

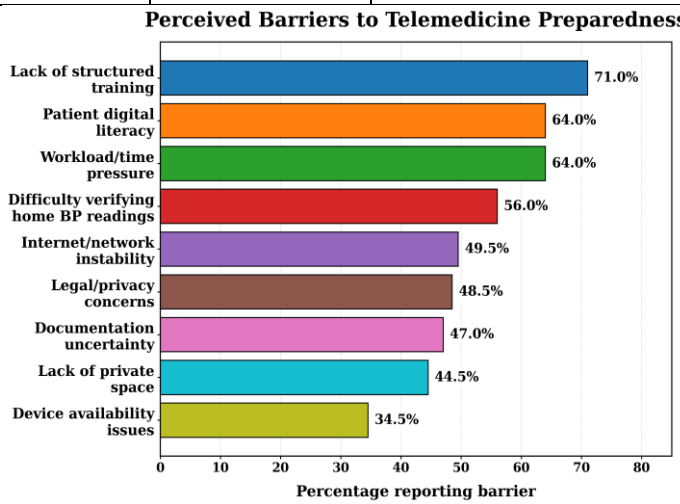

Figure 4. Perceived barriers to telemedicine preparedness among nursing officers.

Implementation-readiness action matrix

The action matrix identifies high-impact immediate interventions: a structured video-assisted module, BP-log checklist, privacy and consent micro-session, standardized documentation template, and peer digital champions. Network strengthening and private teleconsultation space need system investment.1,3,4,19

Table 8. Practical implementation actions derived from readiness findings

Implementation action	Priority level	Responsible unit	Expected outcome
Structured video-assisted telemedicine module	Immediate high priority	Nursing education unit	Improved baseline knowledge, confidence, and workflow understanding
Hypertension BP-log review checklist	Immediate high priority	Medical/Nursing OPD team	Standardized review of home readings and escalation triggers
Privacy, consent, and documentation micro-session	Immediate high priority	Nursing education and ethics committee	Reduced legal/privacy uncertainty and safer documentation
Peer digital champions	High priority	Nursing superintendent and department heads	Ongoing bedside mentoring and rapid problem solving
Dedicated telemedicine documentation template	High priority	Hospital quality team / IT support	Improved continuity, auditability, and medico-legal clarity
Patient digital instruction leaflet	Medium-high priority	OPD nursing team	Better patient participation and fewer avoidable call failures
Network strengthening and device pool	Strategic investment	Hospital administration / IT	Reduced implementation failure due to infrastructure gaps
Private teleconsultation corner	Strategic investment	Hospital administration	Improved confidentiality and professional communication environment

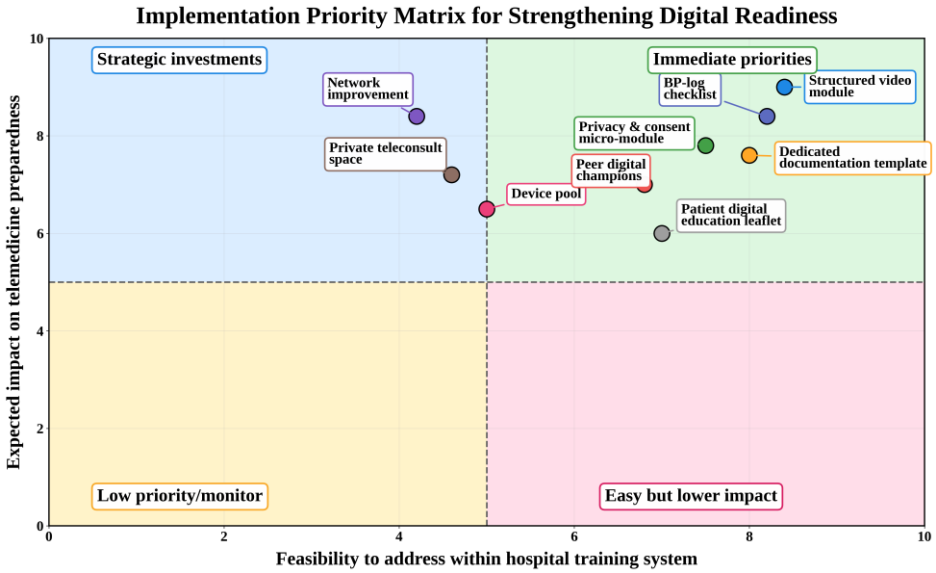

Figure 6. Implementation priority matrix for strengthening digital readiness.

DISCUSSION

Principal findings

This study found moderate digital readiness and telemedicine preparedness among nursing officers for hypertension care. Only 39.0% reached high preparedness. Access to smartphones and basic digital tools was favorable, but teleconsultation communication, BP-log review, documentation, privacy, consent, and escalation remained important gaps for safe nurse-led telemedicine.8,11,14,19

Comparison with previous literature

The findings are consistent with evidence that telemedicine readiness improves with digital access, training, knowledge, attitude, and routine system use. They also support the author group's earlier video-assisted teaching work by identifying baseline domains requiring targeted strengthening.8,10,11,19

Implications for nursing practice

For nursing practice, digital readiness should be treated as a measurable competency. Prepared nursing officers can serve as telemedicine champions, while those with low readiness need basic skill support, mentoring, and supervised practice in identity verification, BP-log review, counselling, documentation, and escalation.14-16,19

Implications for hospital implementation

For hospital implementation, training must be paired with system readiness. A video module may improve knowledge, but sustainability requires stable internet, devices, private communication space, documentation formats, patient education materials, and clear referral pathways. The most feasible immediate actions are a module, checklist, privacy micro-session, template, and peer champions.1,3,4,11,19

Strengths

Strengths include an implementation-focused design, domain-wise assessment, sample size justification, barrier analysis, regression-based predictor identification, and direct linkage with hypertension nursing care and telemedicine scale-up.20

Limitations

Limitations include cross-sectional design and possible overestimation due to self-report. Future studies should include objective skill assessment, simulated teleconsultation, post-training follow-up, patient outcomes, and multicenter validation.20

CONCLUSION

Nursing officers showed moderate readiness for telemedicine-based hypertension care, with priority gaps in privacy, documentation, teleconsultation confidence, BP-log review, and escalation. Prior digital health training, routine digital documentation, stable internet, and eHealth literacy predicted high preparedness. The findings support targeted training and hospital workflow strengthening before scale-up.1,3,8,11,19

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY

Deidentified data may be available from the corresponding author on reasonable request, subject to institutional permission, ethics approval conditions, and participant confidentiality.

AUTHOR CONTRIBUTIONS

Sreekanth A.N. conceptualized the study, developed the framework, coordinated statistical planning, and drafted the manuscript. Dr. Rama Taneja supervised academic development, provided methodological guidance, reviewed the manuscript, and approved the final version.

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ABBREVIATIONS

ABDM: Ayushman Bharat Digital Mission; BP: blood pressure; CI: confidence interval; DRTPI: Digital Readiness and Telemedicine Preparedness Inventory; EHR: electronic health record; OPD: outpatient department; OR: odds ratio; SD: standard deviation; WHO: World Health Organization.

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