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# Missed opportunities for detection of hypertension in public health facilities of 18 districts in India, 2022

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## Abstract

**Background** More than half of the individuals with hypertension remain undiagnosed in India. The National Non-Communicable Disease (NCD) program has implemented opportunistic screening to improve diagnoses. In the public health facilities across 18 districts in nine states of India, we estimated the missed opportunity for hypertension detection in routine program settings.

**Methods** In each of the chosen districts, we conducted a cross-sectional study in one district hospital (DH), one community health centre (CHC), and three primary health centres (PHCs), selected randomly. We collected data from 706 consecutively enrolled eligible out-patient department (OPD) attendees in each facility type and abstracted the data regarding coverage and yield of opportunistic screening for hypertension from the available registers. We then derived the missed opportunity for hypertension detection. We also estimated the median time for Blood Pressure (BP) measurement through observation and derived the staff requirement for BP screening at each facility type.

**Results** Of the 41,012 eligible OPD attendees, 32.1% [31.6%–32.5%]) were screened for hypertension. The yield for hypertension screening was 23.2% (3,050/13,157). Among the OPD attendees, the proportion of missed diagnoses for hypertension among the expected was 57.1% (1,962/3,437), 67.4% (1,860/2,758), and 79.3% (2,597/3,274) in PHCs, CHCs, and DHs, respectively. The minimum number of dedicated staff required for measuring BP was one at PHC/CHC and two at DH.

**Conclusions** Sixteen out of every 100 eligible OPD attendees miss the opportunity to get diagnosed with hypertension due to inadequate screening coverage. Innovative measures like task-sharing and utilizing trainee nurses for BP measurement to overcome staff shortages can help improve screening coverage.

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**Keywords** Hypertension, Blood Pressure, India, Non-communicable diseases, Cardiovascular diseases

## Introduction

Cardiovascular diseases (CVDs) are the leading cause of mortality worldwide. In India, nearly 23% of all NCD deaths are attributable to CVDs [1, 2]. Hypertension is the leading modifiable risk factor for cardiovascular diseases [3]. Among the individuals aged 15–49 years with hypertension, only 45% of individuals with hypertension are aware of their condition, and only a meagre 8% have their blood pressure under control [4]. Bridging this gap in the detection and management of hypertension is vital to achieving the global non-communicable disease (NCD) targets of reducing CVD mortality by 25% and achieving a 25% relative reduction in the prevalence of hypertension [5, 6].

The Ministry of Health and Family Welfare, Government of India, implemented the National Programme for Prevention and Control of Non-Communicable Diseases (NP-NCD) to improve the early detection and management of NCDs [7]. In addition, a multi-partner initiative called the India Hypertension Control Initiative (IHCI) supported the program to strengthen the detection and control of hypertension in primary health-care settings based on the World Health Organization (WHO) HEARTS package between 2017–2023 [8, 9]. The National program employs both population-based screening and opportunistic screening to improve the detection of hypertension. The Study on Global Ageing and Adult Health found that nearly 26% of the older adults who were unaware of their hypertensive status had a visit to a health facility in the past 12 months [10].

Several studies globally have documented improved detection of non-communicable diseases among people visiting health facilities through opportunistic screening [11–13]. Analysis of Greece's nationally representative data showed that 21.3% were diagnosed with hypertension through opportunistic screening [11]. Around one in ten individuals with tuberculosis were newly diagnosed with diabetes through opportunistic screening in India [12]. An Indian study documented that the cost of conducting opportunistic screening in primary care settings is 15 times lower compared to a home-based approach [13]. In a facility-based survey conducted in Puducherry, the proportion of hypertension and pre-hypertension detected through opportunistic screening was 17.9% and 37.7%, respectively [14]. However, none of the studies have documented the coverage of opportunistic screening in real-life scenarios across various levels of the public health system in India. In addition, the barriers and challenges to opportunistic screening need to be documented for better program implementation.

With this background, we estimated the coverage and yield of opportunistic screening in primary and secondary care public health facilities of selected districts in India. We also estimated the proportion of individuals who missed getting diagnosed with hypertension due to inadequate coverage of opportunistic screening and documented the challenges faced, along with potential solutions, to facilitate the implementation of opportunistic screening in public health facilities. In addition, we estimated the minimum number of human resources required to perform opportunistic screening at each facility type.

## Methods

### Study design, setting, and period

We conducted a cross-sectional study in 18 districts of nine states in India in 2022. The study was part of the group epidemiological project of trainees enrolled in the Field Epidemiology Training Program (Intermediate) in NCDs (I-FETP NCD) at the National Institute of Epidemiology (ICMR-NIE) in the year 2021–22. I-FETP training is a field-based, on-the-job training for district program managers/coordinators of the NP-NCD program [15]. The training helps build essential epidemiological and data management skills for the program managers to strengthen the delivery of health services. We included all the 18 districts where the trainees were posted (Supplementary File 1). We conducted the study at the primary and secondary level health facilities, namely, primary health centres (PHC), community health centres (CHC), and district hospitals (DH), respectively. DH and SDH provide secondary care services for the entire district, while Community Health Centres (CHCs) serve approximately 100,000 people each. PHCs cater to a population of 30,000, with each PHC overseeing five to six sub-centres.

### Process of opportunistic screening at DH, CHC, and PHC

As per the NP-NCD program, the PHCs have a designated NCD corner, where a staff nurse conducts opportunistic screening for all eligible out-patient attendees. People with raised blood pressure (BP) are referred to the medical officer for diagnosis and further management. At CHCs and DHs, there is a dedicated NCD clinic where the nurse conducts opportunistic screening for hypertension.

### Study population

We included all adults aged 30 years and above who attended the outpatient departments (OPD) of the selected facilities. We excluded those who were previously diagnosed with hypertension and women attending the antenatal clinic.

### Sample size and sampling strategy

Based on a pilot study done in two district hospitals at Karimnagar and Peddapelli in Telangana, the coverage of opportunistic screening for hypertension was 63.3%. After accounting for a design effect of 2, the minimum number of eligible individuals required to be observed to estimate coverage of 63.3% with 95% confidence limits and absolute precision of 5% was calculated to be 706 per facility type in each district.

We purposively selected 18 districts where the trainees of the I-FETP NCD program were placed. In each of the selected districts, we randomly chose one CHC and three PHCs from the full list. All the district hospitals in the selected districts were included in the study. If the district had both urban and rural PHCs, then we randomly selected one urban and two rural PHCs.

Since the calculated size was 706 per facility type in each district, we included 706 eligible OPD attendees for each of the selected CHC, DH, and 250 eligible OPD attendees from each selected PHC.

### Data collection procedure

In each of the selected facilities, we collected data from all eligible OPD attendees on consecutive days till we reached the required sample size. We placed two staff for data collection per facility, one at the OPD registration counter and one at the NCD corner/ clinic. The staff at the OPD registration counter entered information related to the eligibility of each OPD attendee in the OPD register, including previous history of hypertension. The NCD corner/ clinic staff entered data about age, sex, and BP measurements in the screening register. We later digitized the information from the registers in a standardized Microsoft Excel file created by the investigators.

The staff also separately interviewed nurses and medical officers using semi-structured questionnaires to document the barriers and challenges in conducting opportunistic screening. (Supplementary file 2) Within each selected facility, we randomly included one staff nurse and doctor involved in NCD screening.

The staff at the NCD screening clinic also observed every fifth individual for whom the staff nurse did hypertension screening. Using a digital stopwatch, the time taken for BP measurement was measured from when the BP cuff was tied to the patient's arm until the cuff was removed.

### Operational definitions

#### Coverage of opportunistic screening

Proportion of eligible OPD attendees whose BP was measured by the staff nurse.

### Yield of opportunistic screening

Proportion of individuals with systolic BP  $\geq 140$  mmHg or diastolic BP  $\geq 90$  mmHg among the screened OPD attendees [16].

### Time taken for BP measurement

We defined the time taken for BP measurement as the duration from placing the BP cuff on the patient's arm, conducting the BP measurement, and removing the cuff [17].

### Data analysis

The data was entered into Microsoft Excel 365 and analyzed using Epi-Info. We calculated the coverage and yield of opportunistic screening by age group, sex, and facility type and represented it as percentages with a 95% confidence interval (CI). We documented the time taken for BP measurement as median with interquartile range (IQR).

We used the yield of opportunistic screening to estimate the total number of individuals who will be detected with hypertension in an ideal scenario where screening coverage was 100% for each selected facility. Using information on the actual number detected in each facility, we estimated the proportion of missed opportunities for detecting hypertension.

We estimated the daily average time required for opportunistic screening for hypertension in each facility by multiplying the daily average number of eligible OPD attendees and the average time taken for BP measurement. We then estimated the number of staff nurses required per facility for opportunistic screening by dividing the daily average time required for opportunistic screening by the total functional OPD hours in each facility.

## Results

### Characteristics

Among the 18 districts surveyed, 17 DHs, 18 CHCs, and 54 PHCs were included. Chennai district in Tamil Nadu had no DH, and so the analysis did not include DH data of Chennai. A total of 41,012 individuals who were eligible for hypertension screening attended the OPD, with nearly equal distribution across facility types. Among the eligible OPD attendees, 28.6% (11,715/41,012) were in the age group of 60 years and above, and 51.4% (21,077/41,012) were men (Table 1).

### Coverage

Out of 41,012 eligible OPD attendees, 13,157 (32.1%, [31.6%–32.5%]) were screened for hypertension.

**Table 1** Characteristics of the eligible OPD attendees in the selected public health facilities of 18 districts in India, 2022 (N=41,012)

	DH*		CHC*		PHC*		Total	
	N	%	N	%	N	%	N	%
<b>Age group (in completed years)</b>								
30–39	3,962	29.3	3,636	26.4	3,236	23.6	10,834	26.4
40–49	3,631	26.8	3,281	23.8	3,174	23.2	10,086	24.6
50–59	2,734	20.2	2,934	21.3	2,709	19.8	8,377	20.4
60&above	3,202	23.7	3,938	28.5	4,575	33.4	11,715	28.6
<b>Sex</b>								
Female	6,971	51.5	6,949	50.4	7,157	52.3	21,077	51.4
Male	6,558	48.5	6,840	49.6	6,537	47.7	19,935	48.6
<b>Districts, State</b>								
South Andaman, A&N*	756	5.6	717	5.2	730	5.3	2,203	5.4
Azhapuzha, KL*	997	7.4	721	5.2	968	7.0	2,686	6.5
Balod, CG*	747	5.5	709	5.1	743	5.4	2,199	5.4
Chennai, TN*	NA	NA	1,546	11.2	731	5.3	2,277	5.6
Chhindwara, MP*	706	5.2	705	5.1	720	5.3	2,131	5.2
Dhamtari, CG*	717	5.3	738	5.4	721	5.3	2,176	5.3
Jaipur, RJ*	717	5.3	706	5.1	751	5.5	2,174	5.3
Jhabua, MP*	706	5.2	706	5.1	720	5.3	2,132	5.2
Kozhikode, KL*	760	5.6	744	5.4	853	6.2	2,357	5.7
Malerkotla, PB*	835	6.2	711	5.2	726	5.3	2,272	5.5
Mohali, PB*	793	5.9	745	5.4	795	5.8	2,333	5.7
Raipur rural, CG*	949	7.0	745	5.4	779	5.7	2,473	6.0
Rajnandgaon, CG*	705	5.2	715	5.2	753	5.5	2,173	5.3
Sangrur, PB*	754	5.6	705	5.1	710	5.1	2,169	5.3
Seoni, MP*	706	5.2	706	5.1	720	5.3	2,132	5.2
Thrissur, KL*	705	5.2	706	5.1	720	5.3	2,131	5.2
Dehradun, UK*	707	5.2	728	5.3	721	5.3	2,156	5.3
Wardha, MH*	1269	9.4	736	5.4	833	6.1	2,838	6.9
India	13,529	33	13,789	34	13,694	33	41,012	100.0

\* A&N Andaman and Nicobar Islands, KL Kerala, CG Chhattisgarh, MP Madhya Pradesh, PB Punjab, MH Maharashtra, TN Tamil Nadu, RJ Rajasthan, UK Uttarakhand, DH District Hospital, CHC Community Health Centre, PHC Primary Health Centre

The coverage of opportunistic screening was higher in PHCs (42%, 5,877/13,694) followed by CHCs (32.5%, 4,479/13,789), and DHs (20.7%, 2,801/13,529) (Chi-square:  $\chi^2$ : 1542.6,  $p < 0.01$ ). The screening coverage was significantly higher among women (33.2%, 7,004/21,077) as compared to men (30.9%, 6,153/19,935) (Chi-square  $\chi^2$ : 26.2,  $p < 0.01$ ). It was observed that the coverage was higher among the older age groups, with the highest being among those 60 years and above (35.2%, 4,126/11,715), followed by those aged more than 50 years (33.1%, 2771/8377) (Chi-square  $\chi^2$ : 129.4,  $p < 0.01$ ) (Table 2). The coverage varied widely among the districts, from 4% in Thrissur to a maximum of 96% in Andaman among the districts surveyed (Fig. 1, Supplementary file 3).

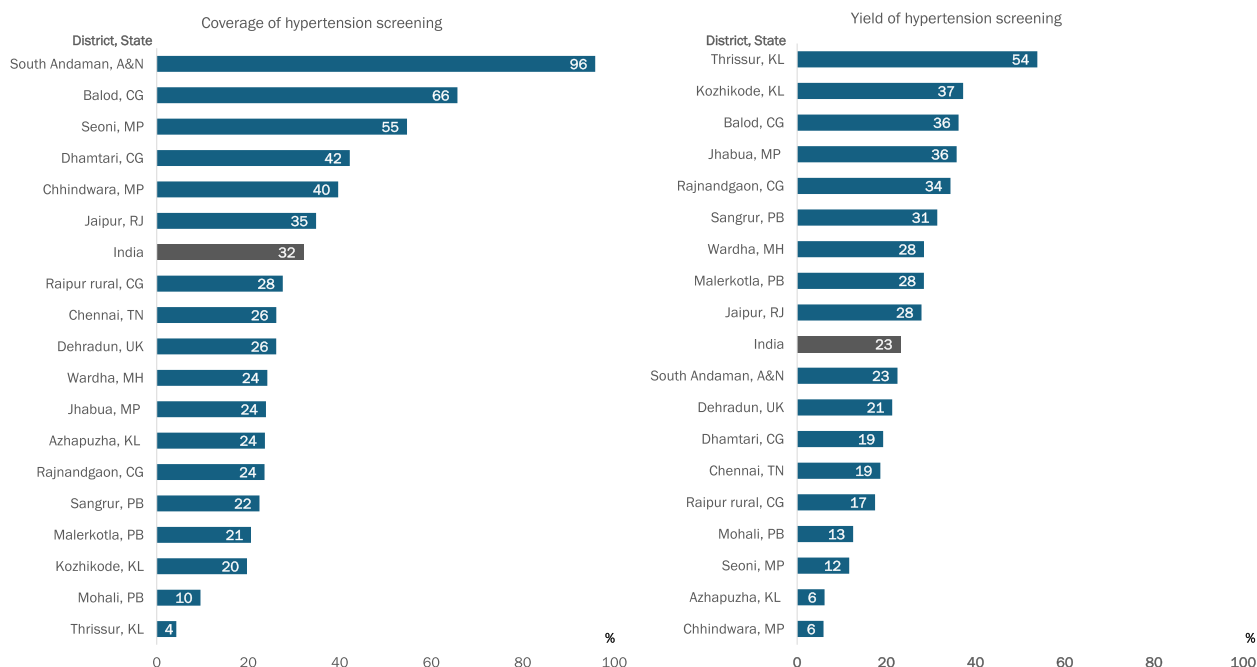
### Yield

Of the 13,157 individuals screened for hypertension, 3,050 (23.2%) were detected to have high blood pressure. The yield was higher in PHC, which was 25.1% (1475/5877), followed by DH (24.2%, 677/2801) and CHC (20%, 898/4479) (Chi-square  $\chi^2$ : 38.3,  $p < 0.01$ ). The proportion diagnosed among the men who were screened was 24.9% (1532/6153) (Chi-square  $\chi^2$ : 19.1,  $p < 0.01$ ). Yield was higher among individuals aged 60 years and above (29.3%, 1209/4126), followed by those aged 50 to 59 (26.7%, 739/2771) (Chi-square  $\chi^2$ : 226.3,  $p < 0.01$ ). Maximum yield was observed in Thrissur district (53.8%, 49/91), followed by Kozhikode (37.2%, 173/465), and the minimum was in Chhindwara (5.9%, 50/845) (Fig. 1, Supplementary file 3).

**Table 2** Coverage and yield of hypertension by age group, sex and facility type (N=41,012)

Coverage by age and sex												
	DH*			CHC*			PHC*			Total		
Parameters	N	n	%	N	n	%	N	n	%	N	n	%
30–39	3,962	713	18.0	3,636	912	25.1	3,236	1,420	43.9	10,834	3,045	28.1
40–49	3,631	729	20.1	3,281	1,076	32.8	3,174	1,410	44.4	10,086	3,215	31.9
50–59	2,734	570	20.8	2,934	1,009	34.4	2,709	1,192	44.0	8,377	2,771	33.1
60&above	3,202	789	24.6	3,938	1,482	37.6	4,575	1,855	40.5	11,715	4,126	35.2
Female	6,971	1,439	20.6	6,949	2,360	34.0	7,157	3,205	44.8	21,077	7,004	33.2
Male	6,558	1,362	20.8	6,840	2,119	31.0	6,537	2,672	40.9	19,935	6,153	30.9
Grand Total	13,529	2,801	20.7	13,789	4,479	32.5	13,694	5,877	42.9	41,012	13,157	32.1
Yield by age and sex												
Parameters	N	n	%	N	n	%	N	n	%	N	n	%
30–39	713	123	17.3	912	105	11.5	1,420	252	17.7	3,045	480	15.8
40–49	729	145	19.9	1,076	172	16.0	1,410	305	21.6	3,215	622	19.3
50–59	570	167	29.3	1,009	227	22.5	1,192	345	28.9	2,771	739	26.7
60&above	789	242	30.7	1,482	394	26.6	1,855	573	30.9	4,126	1,209	29.3
Female	1,439	332	23.1	2,360	448	19.0	3,205	738	23.0	7,004	1,518	21.7
Male	1,362	345	25.3	2,119	450	21.2	2,672	737	27.6	6,153	1,532	24.9
Grand Total	2,801	677	24.2	4,479	898	20.0	5,877	1,475	25.1	13,157	3,050	23.2

\*DH District Hospital, CHC Community Health Centre, PHC Primary Health Centre



\*A&N: Andaman and Nicobar Islands; KL: Kerala; CG: Chhattisgarh; MP: Madhya Pradesh; PB: Punjab; MH: Maharashtra; TN: Tamil Nadu; RJ: Rajasthan; UK: Uttarakhand

**Fig. 1** Coverage and Yield of hypertension screening in primary and secondary care public health facilities of selected districts in India, 2022

### Missed opportunity for detection of hypertension

Based on the yield of hypertension screening, we estimated that 9,515 individuals would be detected to have high blood pressure if the screening coverage were 100%.

However, the actual number of individuals detected was found to be 3,050 (32.1%). We estimated that 16 individuals were missed from being diagnosed with hypertension for every 100 OPD attendees (Table 3).

**Table 3** Proportion of OPD attendees with a missed opportunity for detection of hypertension in the public health facilities of selected districts in India, 2022

Characteristic	Total number of OPD* attendees	Estimated no. of individuals with hypertension among OPD* attendees based on the yield of opportunistic screening	# of individuals detected with hypertension	# of individuals with missed diagnosis	Proportion of missed diagnosis among estimated hypertension	# missed diagnosis for every 100 OPD* attendees
<b>Age group (in years)</b>						
30–39	10,834	1708	480	1,228	71.9	11
40–49	10,086	1951	622	1,329	68.1	13
50–59	8,377	2234	739	1,495	66.9	18
60&above	11,715	3433	1,209	2,224	64.8	19
<b>Sex</b>						
Male	19,935	4964	1,518	3,446	69.4	17
Female	21,077	4574	1,532	3,042	66.5	14
<b>Facility type</b>						
PHC	13,694	3437	1475	1,962	57.1	14
CHC	13,789	2758	898	1,860	67.4	13
DH	13,529	3274	677	2,597	79.3	19
<b>District, State</b>						
South Andaman, A&N*	2203	507	475	32	6.3	1
Azhapuzha, KL*	2686	165	39	126	76.4	5
Balod, CG*	2199	796	523	273	34.3	12
Chennai, TN*	2277	425	111	314	73.9	14
Chhindwara, MP*	2131	126	50	76	60.3	4
Dhamtari, CG*	2176	420	177	243	57.8	11
Jaipur, RJ*	2174	606	211	395	65.2	18
Jhabua, MP*	2132	762	182	580	76.1	27
Kozhikode, KL*	2357	877	173	704	80.3	30
Malerkotla, PB*	2272	646	133	513	79.4	23
Mohali, PB*	2313	290	28	262	90.4	11
Raipur rural, CG*	2473	432	119	313	72.5	13
Rajnandgaon, CG*	2173	747	176	571	76.4	26
Sangrur, PB*	2169	681	153	528	77.5	24
Seoni, MP*	2132	249	136	113	45.3	5
Thrissur, KL*	2131	1147	49	1,098	95.7	52
Dehradun, UK*	2156	460	120	340	73.9	16
Wardha, MH*	2838	807	195	612	75.8	22
<b>Overall</b>	41,012	9515	3,050	6,465	67.9	16

\* A&N Andaman and Nicobar Islands, KL Kerala, CG Chhattisgarh, MP Madhya Pradesh, PB Punjab, MH Maharashtra, TN Tamil Nadu, RJ Rajasthan, UK Uttarkhand, OPD Out-Patient Department

#### Time taken for BP measurement and estimation of the minimum number of human resources required for Hypertension screening

The overall median (IQR) time taken for measuring BP for one individual was 63 (57–72) seconds. The median time taken for BP measurement for one individual at

PHC, CHC, and DH was 63.5, 63.5, and 58 s respectively. The median (IQR) number of OPD attendees in PHC, CHC, and DH was found to be 55 (30–117), 108 (89–200), and 300 (200–667), respectively. The median (IQR) hours for which OPD functions at all the facility types was found to be 5 (4–6) hours. Therefore, the minimum



number of dedicated human resources required for measuring all eligible OPD attendees was one at PHC/CHC and two at DH. It is important to note that human resources dedicated to BP measurement will not be able to do any other tasks during OP hours (Supplementary file 4).

### Barriers and facilitators

Out of the 89 nurses interviewed, 74% reported the lack of staff nurses, and around half of the nurses reported that engaging in multiple program activities, lack of time, and the absence of a dedicated NCD corner were reasons for not screening all eligible OPD individuals for hypertension. Medical officers of the facilities documented similar challenges. In addition to the challenges faced by nurses, 49% (40/89) of medical officers reported that the lack of hypertension drug availability led to low screening of individuals attending OPD. Half of both the medical officers and the nurses reported that the low screening for hypertension among individuals attending the OPD was due to their low awareness of the need for hypertension screening (Table 4).

### Discussion

We documented the missed opportunity for hypertension diagnosis based on the coverage and yield of opportunistic screening at the government health facilities in 18 districts. We estimated the human resources required for blood pressure measurement based on the OPD load and time taken for BP measurement per patient. We found that only one-third of the eligible individuals attending OPD were screened for hypertension.

Among those screened, one-fifth were diagnosed with hypertension. Our study documented the yield of hypertension screening was higher among men than women. The higher yield among men may be due to the higher prevalence, as is well documented in many national surveys and studies across India [18]. In a community-based study conducted in Karnataka, India, males (19.1%) had a higher prevalence of hypertension than females (17.5%) [19]. Another similar study found that the prevalence of hypertension was higher among men (29.3% males and 15.3% females), consistent with our results [20]. We observed that the yield increased with advancing age groups, which is consistent with findings reported in previous literature in India [21, 22]. A study in India revealed that 18% were diagnosed with hypertension among those aged 30–39 years and 69% among the elderly population (>60 years) [20]. We did not observe much difference in the yield of hypertension screening among PHCs and DHs. Similar studies conducted in PHC settings in Karnataka and Puducherry showed that 19.3% (62/327) and 17.9% (58/324) of the individuals screened

for hypertension had high BP, respectively [14, 23], which falls within the range of yield observed in the current study.

Based on the coverage and yield of hypertension screening among the eligible attendees, we estimated that nearly two-thirds were being missed from getting detected with hypertension out of the expected. The missed opportunity was higher among men as compared to women. The lower coverage of hypertension screening coupled with a higher disease burden among men may be the likely explanation for the higher missed opportunity for detection among this group of individuals. Similarly, we observed that missed opportunities for the detection of hypertension were higher among those in the younger age groups. The phenomenon may again be explained due to the lower screening coverage among the younger age groups. A nationwide analysis in the Philippines estimated that 10.7% of individuals had a missed opportunity for hypertension diagnosis despite visiting a health facility in the past one year [24]. A study on Global Ageing and Adult Health (SAGE) documented the missed opportunity for hypertension diagnosis across six low-middle-income countries worldwide among those aged 50 years and above in 2007–10. The missed opportunity was higher in Ghana (37%), followed by India (32.6%), South Africa (31.1%), China (26.4%), Mexico (17.6%) and Russia (11.8%) [10]. We need to exercise caution while comparing the data from community-based surveys with the facility-based surveys. The Philippines study included individuals over 50 years of age, and the survey was community-based. They defined missed opportunities based on whether hypertensive individuals were undiagnosed despite having an outpatient visit to a health facility in the past 12 months, with health visit history collected through interviews. In contrast, the present study estimated missed opportunities based on health facility registers. Nonetheless, our study and the literature are consistent in concluding that a large proportion of the population can be identified for hypertension if opportunistic screening is implemented well.

Another key aspect of our study is that we estimated the time required for measuring blood pressure as just over a minute. Using this, we estimated that, on average, a PHC or a CHC would require one staff member, and a DH would require two staff members just for measuring BP. The operational guidelines of the NP-NCD program employ one staff nurse position at the NCD clinics in CHC and DH. However, there is no dedicated staff nurse at PHCs for opportunistic screening. Also, the operational guidelines of the NP-NCD program envisage several roles for the nurse apart from BP screening; the staff nurse should also perform multiple other duties, including screening for other NCDs, measurement of BP and

**Table 4** Perceived barriers to implementing opportunistic screening and potential solutions for improvement, suggested by staff nurses and medical officers in the public health facilities of the selected districts in India, 2022

Reasons	Staff nurse response (N = 89)	%	Medical officer response (N = 89)	%
<b>Human resource related</b>				
Lack of HR	66	74.2	65	73.0
Lack of time	48	53.9	40	44.9
Too many programmes running at the same time	46	51.7	39	43.8
Difficulty in documentation	39	43.8	31	34.8
Lack of supervision/monitoring	30	33.7	20	22.5
<b>Logistic and materials related</b>				
Lack of space for NCD corner	47	52.8	45	50.6
Lack of drug availability	43	48.3	44	49.4
Data entry portal issue	34	38.2	34	38.2
Lack of IEC	26	29.2	28	31.5
Poor internet connectivity	24	27.0	20	22.5
Lack of budget/delay in receiving	22	24.7	22	24.7
Lack of electronic devices for data entry	19	21.3	21	23.6
Non-availability of BP apparatus/logistics	16	18.0	21	23.6
Lack of tables/chairs	12	13.5	10	11.2
<b>Patient related factors</b>				
Lower awareness	62	69.7	65	73.0
Increased waiting time/inconvenience	51	57.3	52	58.4
Other disease priorities	42	47.2	43	48.3
Perceived low risk of hypertension	39	43.8	42	47.2
Shortage of medicines issued	34	38.2	38	42.7
Unavailability of health personnels	44	49.4	37	41.6
Reluctance for BP screening	28	31.5	33	37.1
Lower satisfaction in treatment/management	25	28.1	23	25.8
<b>Facilitator of opportunistic screening</b>				
Increase in dedicated NCD staff	72	80.9	71	79.8
Increase in overall human resources of facility	59	66.3	67	75.3
Ensure uninterrupted quality drug supply	47	52.8	48	53.9
Designated space—NCD corner	51	57.3	46	51.7
Training for hypertension screening	50	56.2	43	48.3
Ensure availability of adequate number of functional BP apparatus	37	41.6	38	42.7
Availability of IEC	42	47.2	32	36.0
Motivation and support from medical officers	36	40.4	23	25.8

blood sugar for patients on regular follow-up, and documentation. Such constraints may be the likely reason for the lower screening coverage observed in the present study [25].

To overcome the challenges in staff availability for hypertension screening, the program may consider options like task-sharing among other staff at the NCD clinics and sanctioning dedicated NCD staff nurses at the PHC level [26]. In addition, the program can also consider involving volunteers during OP hours to measure BP or use a standalone arm-in BP apparatus, which could also serve as a potential solution [27].

### Barriers and facilitators

In our study, the key stakeholders of opportunistic screening indicated that a lack of staff nurses, multiple responsibilities for the NCD staff nurse under the program, the absence of a dedicated NCD corner, low awareness among beneficiaries, and the lack of hypertension drug availability as barriers to opportunistic screening for hypertension. The nationally representative study on the preparedness assessment for implementing NCD programs in India also documented that 15% (81/537) of PHCs lacked medical officers. It also found that 69.6% (374/537) of medical officers in PHCs and 76.1%



(316/415) of staff nurses in CHCs have not received relevant training for NCD care. Only one-third of primary care facilities and one-fifth of secondary care facilities were observed to have adequate drugs for hypertension care [28]. Similarly, a health preparedness assessment in Myanmar documented that 25% (5/20) of facilities lack adequate drugs for hypertension care [29]. In our study, the lack of dedicated human resources was documented as a barrier, often resulting in staff being assigned to multiple programs within the hospital/ health facility. This multitasking likely reduces the attention and resources available for NCD screening, potentially compromising NCD-related services. The program may consider task-sharing to alleviate the burden of responsibilities on the staff nurse. In addition, the limited availability of hypertension medications may lead the health staff to be reluctant to conduct NCD screening, as diagnosing more patients without accessible treatment options can discourage patient follow-up. This issue is especially critical in low-resource settings, where patients often lack alternative access to medications. Consequently, inadequate drug supply reduces the likelihood of timely management for identified cases, weakening the overall effectiveness of NCD control efforts in healthcare facilities. Forecasting the drug requirement for hypertension and ensuring good supply-chain management practices can also prevent health facility drug stockouts [30]. Such measures can help improve screening coverage and thereby reduce the detection gap for hypertension.

### Strengths

To our knowledge, the present study is the first large-scale study to document the country's real-time coverage of opportunistic hypertension screening. Also, the study documents missed opportunities for hypertension diagnosis across different types of healthcare facilities within the public sector health system. The current study also estimated the human resources needed for hypertension screening at each facility type. This approach provides valuable insights for policymakers and stakeholders, enabling them to comprehend better the challenges in implementing opportunistic screening and human resource requirements.

### Limitations

Our study had a few limitations. As per NPNCD guidelines, eligible individuals need to be screened for hypertension every year. The individuals attending OPD might have been screened for hypertension during previous visits in the same or different facility in the past one year. Since this information is not captured, those individuals who were previously screened were not excluded from the study. Hence, there is a possibility of underestimation

of coverage of screening in the present study. In referral centres like DH, individuals might directly visit specialists for a consultation where they might have been screened for hypertension. However, the information of individuals who were screened at places other than at the NCD clinic is unavailable and, therefore, not captured in the current study, which may underestimate screening coverage at DH. The facilities with higher coverage may have a higher number of staff nurses and may follow task-sharing principles or other methods that were not captured as part of the study. Though the selection of districts was convenient, the districts provide a fair representation of the Northern (Punjab, Uttarakhand, and Rajasthan), Central (Madhya Pradesh and Chhattisgarh), Western (Maharashtra), and Southern (Kerala, Tamil Nadu, and Andaman & Nicobar Islands) parts of India.

### Conclusion and recommendation

We conclude that out of every 100 eligible OPD attendees, approximately 16 individuals missed the opportunity to have their hypertension detected despite visiting a healthcare facility. We also estimated that at least one dedicated staff member would be needed for BP screening at PHCs and CHCs, and two would be needed at district hospitals. Considering that hiring regular staff would pose a huge financial burden on the program, we recommend that innovative measures like task-sharing among the staff at NCD clinics and utilizing volunteers or trainee nurses for BP measurement could serve as potential solutions.

### Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-025-22284-4>.

Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Supplementary Material 4.

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### Authors' contributions

Conceptualization: MG, AR, PG, SM, SMN, RN, PK; Data curation: MG, AR, PG, SM, SMN, RN, PK, KS, MKR, SR, PKG, AB, SY, AR, MJA; Formal analysis: MG, AR, PG, SM, SMN, RN, PK, KS, MKR, SR, PKG, AB, SY, AR, MJA; Investigation: MG, AR, PG, SM, SMN, RN, PK, KS, MKR, SR, PKG, AB, SY, AR, MJA; Methodology: MG, AR, PG, SM, SMN, RN, PK; Project administration: MG, AR, PG, SM, SMN, RN, PK, KS, MKR, SR, PKG, AB, SY, AR, MJA; Supervision: MG, AR, PG, SM, SMN, RN, PK; Validation: MG, AR, PG, SM, SMN, RN, PK; Visualization: MG, AR, PG, SM, SMN, RN, PK, KS, MKR, SR, PKG, AB, SY, AR, MJA; Writing – original draft: MG, AR, PK, AV, DSP, IS, JM, KKJ, MBN, MMM, MM, PS, RG, RN, RCO, RB, SSG, SKN, SKC, VKD made equal contributions in conceptualization, methodology, data collection and drafting the analysis. All authors reviewed the manuscript.

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## Data availability

Data will be shared upon reasonable request to the corresponding author.

## Declarations

### Ethics approval and consent to participate

We obtained ethical approval from the institutional ethics committee of the ICMR-National Institute of Epidemiology, Chennai (Ethics approved ID: NIE/IHEC/A/202201–04). We obtained administrative permission from state and district-level stakeholders to conduct the study. Informed consent was obtained from the staff nurse and medical officers for observation and interview. We abstracted the deidentified data from the OPD and NCD registers of the eligible individuals who attended OPD. Our study was conducted in compliance with the ethical principles outlined in the Declaration of Helsinki, as well as applicable national guidelines, ensuring the protection of participants' rights, safety, and well-being.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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