

## Evaluating the impact of using a color coded, levels of prevention-based monitoring strategy for hypertension control in adult females in North India

Priyanka Kumar<sup>1</sup>, Rupali Gupta<sup>2</sup>, Abhinav Pandey<sup>3\*</sup>

<sup>1</sup>PROFESSOR, Department of Community Medicine SRMS-IMS Bhojipura Bareilly,

<sup>2</sup>ASSISTANT PROFESSOR, Department of Community Medicine SRMS-IMS Bhojipura Bareilly,

<sup>3</sup>ASSOCIATE PROFESSOR, Department of Community Medicine SRMS-IMS Bhojipura Bareilly,  
[dr.Abhinav501@Gmail.Com](mailto:dr.Abhinav501@Gmail.Com)

**\*Corresponding Author-** Dr Abhinav Pandey

\*Associate Professor, Department of Community Medicine, SRMS-IMS Bhojipura, Bareilly, Pin code- 243202,  
[dr.abhinav501@gmail.com](mailto:dr.abhinav501@gmail.com)

---

### ABSTRACT

#### Background

Hypertension (HTN) is ranked as the third most important risk factor for attributable burden of disease in south Asia. It exerts a substantial public health burden on healthcare systems in India, as it is directly responsible for 57% of all stroke deaths and 24% of all coronary heart disease (CHD) deaths in India.

#### Objectives:

To evaluate the impact of using a color coded, levels of prevention-based monitoring strategy for hypertension (HTN) control in adult females in North India

#### Methods:

This 2-month quasi experimental study design was conducted in 2023 among adult women (N= 256) visiting in the OPD of UHTC of a private medical college. The intervention involved a training program using color coded levels of prevention-based approach to help HTN patient segmentation according to risk profiles. Educational sessions for the paramedical workers and the study subjects by the mentor faculty were delivered. A modality of the addressing the problem of HTN through the concept of spectrum approach was implemented. The patients in the intervention group received a color coded blood pressure (BP) record booklet.

#### Results:

The study yielded a spectrum of HTN in the hypertensive patients of the study area, as outcome variables. Point prevalence of hypertension was 39 % in women. Majority of the patients (62.5%) were aware of the signs and symptoms of HTN. One fifth of them were aware of various risk factors for developing hypertension.

Most of them (79%) had their blood pressure checked in the past year and knew the current blood pressure reading. Most of them (78%) were currently taking medication. Majority (65%) were interested in attending educational sessions related to hypertension management. More than half of the patients in segment did not have HTN (52 %; Health promotion); 39 % were at risk (Specific Protection; positive family history + obesity etc.). Few (14%) were newly diagnosed (Early Diagnosis/Treatment); One fourth had HTN related intervention or complications (Disability Limitation) and 4 % needed rehabilitation.

**Suggestions:** This was a small-scale study. A similar approach may be tried and evaluated on a large scale with proper Community based randomized controlled trial.

**Key Words:** Levels of Prevention, Hypertension Control, Color Coded Monitoring, Cardiovascular disease, Non-Communicable Diseases

**How to cite this article:** Kumar P, Gupta R, Pandey A. Evaluating the Impact of Using a Color Coded, Levels of Prevention-Based Monitoring Strategy for Hypertension Control in Adult Females in North India. *Int J Drug Deliv Technol.* 2026;16(13s): 804-809. DOI: 10.25258/ijddt.16.13s.87.

---

### Introduction

Cardiovascular disease (CVD) is the leading cause of death in women accounting for most non-communicable diseases (NCDs) deaths globally. The CVD prevalence increases with age.<sup>1</sup> The epidemiologic transition of 21<sup>st</sup> century, driven by urbanization, industrialization and life style changes of modernization (physical inactivity, tobacco use, unhealthy diet, obesity), result in a global rise in CVDs (stroke, myocardial infarction, atherosclerosis, and retinal detachment). In South Asia, HTN is an important

risk factor for disease burden, exerting a substantial public healthcare burden in India, being responsible for 24% of coronary heart disease (CHD) and 57% of stroke deaths.<sup>2,3</sup>

HTN control can result in a sizable reduction of such mortality. Still, awareness, treatment and control of hypertension is suboptimal in Indian women (25-42%). Appropriate lifestyle changes are an important first step in preventing hypertension, the leading cause of CVD. Still, only a few population-based studies have been conducted involving HTN control / prevention

\*Author for Correspondence: [Dr.Abhinav501@Gmail.Com](mailto:Dr.Abhinav501@Gmail.Com)

strategies in India. Only 10- 25 % Indian HTN patients have their BP under control.<sup>4</sup> Adherence to HTN treatment is poor everywhere (25 - 38 % in India). Apparently, the current public health BP control strategies are not working for Indian HTN patients. The low awareness and treatment levels among HTN patients reflect a knowledge, attitude, and practice gap among patients. These findings have enormous public health significance and a matter of serious concern for policy makers.

To address this issue, at community level, a simple approach needs to be adopted, which is health care worker friendly, e.g., a color coded client segmentation/ risk profiling approach for hypertensive patients in tandem with the current focus of health care providers on individualized patient centered approach.<sup>5-10</sup> This will help convince HTN patients to take the treatment prescribed by the concerned physician.

Against this context, the present study was planned to pilot test this approach in the urban health training centre (UHTC) of a private medical college.

**Objectives-**To evaluate the impact of using a color coded, levels of prevention-based monitoring strategy for hypertension (HTN) control in adult females in North India

#### **Material and Methods-**

This 2-month quasi experimental study design was conducted in 2023 among adult women (N= 256) visiting in the OPD of UHTC of a private medical college.

All adult women participants were briefed about the study. HTN awareness sessions were administered by a team of interns / postgraduate students led by the first author, a public health expert regarding the BP measurement and its control by diet, exercise, physical activity and medication by using a color coding approach to help patient segmentation according to risk profiles.

First a baseline assessment of the study population was done. This focused upon basic socio-demographic data of the adult women, their health status and blood pressure reading, risk profile, treatment seeking behaviour etc. The team members' knowledge regarding application of the concept of spectrum of HTN was tested through appropriate tools. They were trained to use this approach. A proforma was developed to record the intervention sessions and impact.

Then the educational sessions for the paramedical workers and the study subjects by the mentor faculty were delivered in batches of 5-7 women at an appropriate venue and time.

A modality of the addressing the HTN through the concept of spectrum approach was implemented. The patients in the intervention group received a color coded BP record booklet. The corresponding color coded areas are divided into 5 areas. The green area covered blood pressure reading up to a maximum of 120/80 mm Hg, the yellow area included systolic

reading over 120-129 mmHg and diastolic reading less than 80mmHg + any apparent HT risk factors, like a positive family history. The blue color covers, systolic 130--139 mmHg and diastolic less than 89 mmHg+ a clinical diagnosis of HT by a physician. Orange color depicts systolic 140 and more than 140 and diastolic more than 90 + some evidence of complications of HT. The red color covers systolic more than 180 and more than 120+ History of any invasive procedure for complications of HT, e.g., stent, pace maker, kidney transplant, dialysis etc.

Color plastic glasses (tumblers), were distributed as gifts to the patients, so that an interest is generated among them. Also, this way, they would remember the color coded segmentation.

Those who were given green glass, were asked to stick to their usual routine and carry out daily physical activity; those with yellow glass were to follow life style modification and keep a watch on their BP through regular monitoring; blue ones were to continue with regular physical / laboratory check-up, treatment, along with life style modification; Orange ones were to follow strict adherence to medication along with life style modification and salt reduction + consultation for invasive procedures; Red ones needed rehabilitation related to the invasive procedures and routine follow up. We also distributed leaflets to our study subjects for awareness regarding hypertension prevention and control.

Results and feedback of the participants were documented. Data entry and tabulation was done. Appropriate statistical analysis was done using Excel sheet. Percentage, mean, median, mode, standard deviation, Paired t-test etc was used.

#### **Ethical aspects-**

Permission of authorities and respondent's consent was taken for the study. Permission was obtained from the Institutional Ethics Committee (IEC), SRMS IMS, Bareilly. Informed consent after explaining the study protocol was taken before enrolling the women into the study. Privacy and confidentiality were maintained with the data. Participants were told that they were free to can leave the study at any point of time without quoting any reason.

#### **Results**

Majority of respondents were married (75%), literate (72%), and homemakers (58%), with a mean age of 38.yrs, (range 18 -75 yrs). Overall, 39% of the respondents were diagnosed with hypertension (31% of - for less than a year, 27% for 1-5 years, 23% for 5-10 years, and 19% for over 10 years).

Mean systolic BP of the respondents was 127 mm Hg, (range 80 – 190), while mean diastolic BP was 80 mm Hg, (range 48 – 164). Most (78%) of them were currently taking medication for HTN. Some (34%) reported a positive family history; 5.5% mentioned being diagnosed with other chronic health conditions,

including diabetes mellitus, hemiparesis, and thyroid issues.

More than half of the respondents (52%) experienced chronic stress. For coping mechanisms, spending time with loved ones (22%) and engaging in hobbies or activities (12%) were among the most prevalent strategies adopted by the respondents. More than a quarter of the respondents (25%) reported being diagnosed with anxiety or depression, with approximately 37.5% currently receiving treatment or therapy.

Majority of respondents (63%) were aware of the signs and symptoms of HTN. Family history (22%), poor diet (22%), obesity (21%), and a sedentary lifestyle (20%) were the most frequently recognized risk factors. A significant majority (73%) of them reported being aware of these methods. Most respondents (79%) had their BP checked in the past year; all of them knew their current BP reading.

Many respondents (46%) indicated that they visit a healthcare professional only when they are sick, which could potentially lead to missed opportunities for preventive care and early detection of hypertension. Majority (64.5%) reported having received counseling or education about hypertension, with more than half (83.63%) of them reporting a positive role of such counseling in managing their hypertension.

Majority of the responders (68%) reported having family and friends to manage their hypertension, which may improve health and treatment outcomes. Most responders (83%) had local medical facilities and resources. Financial (37%) and transportation (30%) problems were the biggest barriers to hypertension control healthcare access.

Majority (65%) of the respondents wanted to learn about the ways to self-manage HTN, with 39% following HTN dietary guidelines; 47% respondents reduced salt and weight to cure HTN; 38% had trouble managing their HTN, which may require additional support.

The level of prevention-based color-coded stratification data of the respondents showed that 57 (one fifth or so) respondents were apparently free of any evidence of HT; 99 (39%) were at risk of developing HT; 36(14%) diagnosed HT cases were without any apparent complication, while 53(21%) were having some complications. Eleven (4%) most serious respondents needed rehabilitation.

The verbatim and subjective responses received from the study population are given below –

1. Overall, the respondents were, in general very happy with the special attention at UHTC.
2. For the first time, anybody from the health care team at UHTC, discussed individually with them about lifestyle modification etc.
3. Most of the women liked the communication technique used by our team through level of prevention-based color-coded stratification of the respondents.

4. The idea of giving them small gifts, as per their level of prevention-based color-coded stratification of the respondents, clicked with them instantly.

5. For example, the women, who were told that their BP was normal and that rest of the people had some or other problem; that they are in the GREEN band; that they can continue to be like this through maintenance of healthy lifestyle, were the happiest of all.

6. Similarly, at-risk women with family history of HT also realized the importance of specific protection through regular monitoring+ LSM

7. For women having some complications (Disability Limitation / Rehabilitation segment), we adopted an approach of moral support, since they were already under treatment through apex hospital / super specialist.

8. For known case of HTN (under treatment) and hidden case diagnosed during the campaign (Early Diagnosis/Treatment segment) focus was put on adherence with the prescribed treatment; regular monitoring+ LSM and referral as per the need.

9. The health education efforts used in the study, e.g., PowerPoint based sessions supported by pamphlet distribution, one to one, as well as group discussion were appreciated by the respondents.

10. All the women were also assured about continuation of these efforts beyond the intervention period of the project.

11. Majority of them were interested in attending educational sessions or programs related to HTN management.

## Discussion

It is estimated that at least one in four adults in India has HTN, but, only about 12% of them have their BP under control. In our study also, the point prevalence of hypertension was 39% in women. Thus, our findings are in tandem with the scenario elsewhere in India (30–35% global/ 29–33%, in India).<sup>11-14</sup> Almost one third of them were recently diagnosed (< 1 year). This indicated consistent incidence of HTN in the community. One fifth of them were chronic (> 10 years) since diagnosis. Majority of the patients in our study (62.5%) were aware of the signs and symptoms of HTN. One fifth of them were aware of various risk factors like age, family history, sedentary lifestyle, poor diet, obesity, smoking, stress etc. Majority (73%) were familiar with the methods for measuring BP. Most of them (79%) had their BP checked in the past year and knew the current reading. Most of them (78%) were currently taking medication. One third of them visited a healthcare professional for general check-ups annually, while 46% did so only when sick. Many (38%) found it difficult in managing their HTN.<sup>14</sup> Majority (65%) were interested in attending educational sessions or programs related to HTN management.

All these findings reflect a favorable ambience towards HTN control in the community.

In addition, majority (65%) of the respondents had received counseling or education about HTN from a

healthcare professional; most (84%) reported a positive outcome of the same. Many of them (39%) were currently following a specific dietary guideline for managing HTN or reducing salt intake / or monitoring weight (47%). This reflects a reasonably satisfactory support from the existing health care system (UHTC of a private medical college) for ensuring optimal health care of the community at large.

Majority (68%) of the respondents reported having a support system (family, friends) that helped them in managing their HTN. This kind of social capital pays rich dividend in handling stress etc. Our data shows that 52% respondents experienced chronic stress while only 39 % were diagnosed with HTN despite the link between the two. Major sources of stress were reported as work (20%), family (38%) or financial (28%). Various efforts were done by them to cope with stress, viz., Meditation or mindfulness practices (10.5%), spending time with loved ones (22%) - Engaging in hobbies or activities- (12%); seeking professional help (counseling, therapy) - (6%). One fourth respondents had been diagnosed with anxiety or depression with 38% currently receiving a psycho-therapy.<sup>14</sup> Good access to healthcare facilities was reported by 83% of them while barriers like a lack of transportation (30%) and financial constraints (37%) were also mentioned by some of them.

Present study used the color coding-based client segmentation comprehensive care program for HTN control in a community setting of UHTC of a private medical college. This involved application of an individualized patient care approach by providing them with different colored cards on which HTN related advice is written as per the level of prevention needed.

Color coding is a systematic process of displaying information using different colors for providing assistance in classification and identification. Color coding system is used in many diagnostics and therapeutic modalities. Risk profiling through color coded client segmentation based public health approach is very useful to educate the community to deal with the problem of HTN and averting deaths due to acute hypertensive disorders.

In low-income settings, use of color coding in health systems have enhanced quality health care services by field workers, to classify ailments based on colors, diagnosing the disease and starting the appropriate treatment, ensuring better compliance. This has managed to improve existing poor health indicators. It also minimizes the human errors in diagnosing and therapeutic modalities.<sup>5-10</sup>

In addition to this, in our study, a level of prevention approach was applied simultaneously as per the color coded stratification of the respondents, i.e., health promotion (green) for the respondents whose BP is normal; specific protection (yellow) for at risk non-hypertensive respondents participants with BP at borderline (SBP = 121-139 mm Hg and/or DBP = 81-89 mm Hg), early diagnosis and treatment (blue) for previously non-hypertensive participants with first time

BP reading of SBP >140 mm Hg/or DBP >90 mm Hg; disability limitation (orange) for known hypertensive patients who were subjected to any cardiological intervention like stent etc. or those with complications and rehabilitation (red) for survivors of HTN related intervention or complications.

In this study, more than half were eligible for being slotted in health promotion segment (52%); 39 % were at risk, i.e., to be put under specific protection (with a positive family history + obesity etc.). Newly diagnosed were 14. They were advocated early diagnosis/treatment. One fourth had HTN related intervention or complications where disability limitation was applicable and 4% needed rehabilitation. The color-coded approach has been in use in our health system since long. This system has been useful in many ways. There are, in fact, many examples of the use of color coding system to tackle various public health problems, viz., The growth chart recommended by the WHO for early identification of malnutrition in under-five children; Shakir's tape for rapid screening and identifying children with malnutrition in larger population groups; Introduction of Integrated Management of Neonatal and Childhood Illness program (IMNCI) for the management of childhood illnesses; Triage in disaster situations to quickly categorize affected victims based on the severity of their injuries; safe period calculations by women; syndromic management of sexually/ reproductive tract infections under National AIDS Control Program (NACP); segregation of biomedical wastes as per the BMW 2016 rules; the vaccine vial monitor (VVM) (a heat sensitive strip on the vaccine vials) is also based on the principles of color coding; color coded anesthetic syringes for prevention of drug swapping; gas cylinders; color coded wrist bands for identification of specific alerts like allergies etc.

Easy interface and color codes are recognized by not only by health care professionals but also by mothers or caretakers irrespective of their educational status.

Such color coded system can also be used for risk profiling of chronic hypertensive patients for averting cardiovascular deaths. Thereafter, appropriate management is planned accordingly via color coded OPD/health cards using standard risk prediction charts.

Proposed color coding-based client segmentation comprehensive care program can be done for HTN control in a community setting. For better understanding of the patients, interpretations and recommendations/instructions on these color-coded health cards are done in an easy language.

Such color-coding system in chronic disease has tremendous potential to ensure health service delivery of good quality, especially in poor-resource settings and where disease burden is high from chronic diseases.

Universal implementation of standardized color-coding approach can benefit patients and healthcare professionals both in a sustainable way.

Asymptomatic high-risk chronic patients are difficult to identify by the common public. Sometimes, for the critical patients, precious time is lost because their previous records are not available/produced (and are considered unimportant).

In advanced countries, where the electronic health record systems are fully functional, it is just a matter of seconds where all patient details are available through a computer keyboard click. In countries like India, the use of technology in health care is limited, the culture and language are diverse, and healthcare resources are scarce. Here, color coding system for identifying / labelling the high-risk patients suffering from NCD may be an alternative for quick identification/triage of these patients. This may not only save time but also it can save lives by prioritizing care of such patients in busy emergency OPDs in the hospitals. The same color coding system is useful in community health where the high-risk patients are followed up by the peripheral health workers who have limited medical knowledge and scarce healthcare equipment.

The patterns of keeping the records of the HTN cases are illustrated in table 1-2, reflecting the approach implemented in the study.

### Limitations

However, the color-coded approach is not fool-proof. It may have shortcomings like incorrect color coding; initial cost of making color coded health cards, untrained health professionals; and association of certain colors with specific meaning like red for warning, black or white for death. Therefore, it should be used cautiously to avoid confusion. Moreover, most of these concerns can be resolved by proper sensitization of health professionals' universal adoption of standardized color-coding approach.

### Conclusion

Present study successfully used the color coding-based client segmentation comprehensive care program for HTN control in a community setting of UHTC of a private medical college. By and large, the respondents were, very happy with the communication technique used by our team through level of prevention-based color-coded stratification of the respondents. Most of the women liked the special attention they received through individual discussions at the UHTC. This involved application of an individualized patient care approach by providing them with different colored cards on which HT related advice is written as per the level of prevention needed.

**Source of funding:** WINCARS; Prajjwalika scheme

### References

1. Mackay J, Mensah G. Atlas of Heart Disease and Stroke. Geneva: World Health Organization; 2004.

2. Gupta R. Trends in Hypertension Epidemiology in India. *J Hum Hypertens* 2004;18: 73-8.
3. Patel SA, Winkel M, Ali MK, Narayan KM, Mehta NK. Cardiovascular Mortality Associated with 5 Leading Risk Factors: National and State Preventable Fractions Estimated from Survey Data. *Ann Intern Med* 2015;163: 245-53.
4. Hypertension Study Group. Prevalence, Awareness, Treatment, and Control of Hypertension among the Elderly in Bangladesh and India: A Multi-centre Study. *Bull World Health Organ* 2001;79: 490-500.
5. Taylor NJ, Davison M. Inaccurate Color Coding of Medical Gas Cylinders. *Anaesthesia* 2009; 64:690.
6. Webster CS, Merry AF. Color Coding, Drug Administration Error and the Systems Approach to Safety. *Eur J Anaesth* 2007;24:385-6.
7. Fong JS. Color Coding Complications. *Hosp Health Netw* 2007;81 :8.
8. Khan AA, Mahmood SE, Khan MS, Ahmad A, Kashyap S, Arfin I. Risk Factors for Cardiovascular Disease among Adults in Rural Lucknow: A Community-based Study. *Natl J Physiol Pharm Pharmacol* 2022; 12:2020-5.
9. Bhattacharya S, Bera OP, Singh DK, Hossain MM, Tripathi S, Boora S, et al. Color Coding-based Client Segmentation Approach: A Neglected Yet Powerful Tool to Tackle non Communicable Diseases in High Burden and Low Resource Setting Countries- A Primary Care Approach. *J Family Med Prim Care* 2020; 9: 5846-9.
10. Bhattacharya S, Saleem SM, Singh DK, Marzo RR, Singh A. Color Coded Client Segmentation (CCCS) Public Health Approach to Educate the Community to Deal with Problem of Hypertension: A Pilot Study. *J Educ Health Promot* 2021; 10:41.
11. Patel V, Chatterji S, Chisholm D, Ebrahim S, Gopalakrishna G, Mathers C, et al. Chronic Diseases and Injuries in India. *Lancet* 2011;377: 413-28.
12. Geldsetzer P, Manne-Goehler J, Theilmann M, Davies JI, Awasthi A, Vollmer S, et al. Diabetes and Hypertension in India: A Nationally Representative Study of 1.3 Million Adults. *JAMA Intern Med* 2018; 178:363-72.
13. Prenissl J, Manne-Goehler J, Jaacks LM, Prabhakaran D, Awasthi A, Bishops AC, et al. Hypertension Screening, Awareness, Treatment, and Control in India: A Nationally Representative Cross-sectional Study among Individuals Aged 15 to 49 Years. *PLoS Med* 2019;16: e1002801.
14. Kumar P, Kumar R, Agrawal N, Khan AA, Arun R, Singh A. Unraveling the Spectrum of Hypertension among Adult Women in an Urban Area of North India through Level of Prevention based Color-coded Stratification. *Indian J Cardiovasc Dis Women*. 2024;9: 22-7.

Colour Coding	Interpretation	Recommendations
	<b>Normal Blood Pressure</b>	<ul style="list-style-type: none"> <li>• Health promotion efforts to be continued.</li> <li>• Follow the same lifestyle.</li> <li>• Focus on good nutrition, yoga, meditation, physical activity and proper sleep.</li> </ul>
	<b>Borderline</b>	<ul style="list-style-type: none"> <li>• You are having high chances to get hypertension.</li> <li>• This might be due to your family history, lifestyle, mindset, job, etc.,</li> <li>• Go for regular checkups.</li> <li>• High time to start dietary measures like salt reduction, inclusion of fruits and vegetables in the diet and physical activity (minimum half hour a day)</li> </ul>
	<b>Newly diagnosed</b>	<ul style="list-style-type: none"> <li>• You have newly diagnosed hypertension</li> <li>• First try lifestyle modification, change in diet, reduce weight.</li> <li>• Start yoga, meditation, chill out.</li> <li>• Get other investigations done</li> </ul>

**Table-1 Color coding used for hypertensive patients**

**Table 2: A sample of the level of prevention-based color-coded stratification approach for addressing the HTN problem**

Name *	Special features	HTN Spectrum / level of prevention	Coding	Action
Rashmi	Known case (Under treatment)	Early Diagnosis/ Treatment	Yellow	Adherence; Monitoring+ LSM
Sudha	Hidden case (Diagnosed today)	Early Diagnosis/ Treatment	Yellow	Monitoring+ LSM +refer
Seema	Family history of HT	Specific Protection	Blue	Monitoring+ LSM
Nuzhat	Normal BP; No risk factors	Health Promotion	Green	Monitoring+ LSM
Kiran	Obese	Specific Protection	Blue	Monitoring+ LSM
Chandrika	Kidney affected (shrunken)	Disability Limitation	Orange	Treatment through Apex hospital / super specialist + LSM etc
Veena	Stent put in after mild heart attack	Rehabilitation	Red	LSM + Nursing care + Treatment through Apex hospital / super specialist

\* These names / details are fictitious (for illustration purpose only)