

## Color coding: a tool to enhance the quality of health care in low resource settings

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### Abstract

Color coding in health sector refers to the systematic process of displaying information using different colors for providing assistance in classification and identification. In the public health sector, where the aim is to improve the health indicators of the general population as a whole, application of color coding not only enables diagnosis of important health condition but even serves as a rationale to start an appropriate line of management. Multiple applications of color-coding have been identified in the health sector. However, the color-coded approach is not fool-proof and has its shortcomings. Moreover, most of these concerns can be resolved by proper sensitization of health professionals and adoption of a standardized color-coding approach universally. In conclusion, color coding in health care has the immense scope to ensure delivery of quality assured services, especially in low resource settings. Nevertheless, there is a crucial need to implement this approach universally to expand its range of benefits to both patients and healthcare professionals.

### Introduction

Color coding in health sector refers to the systematic process of displaying information using different colors for providing assistance in classification and identification.<sup>1</sup> Although, color coding finds utility in multiple sectors (electronics, navigation, military, *etc.*), in health care it is employed in different fields of medicine (both diagnostic and therapeutic) to ensure better differentiation, improvement in quality, systematic classification, thereby preventing medication errors and hence ensuring health promotion and augmenting patient safety.<sup>1,2</sup>

Acknowledging the enormous scarcity in the number of trained healthcare professionals (number of doctors/nurses per thousand population), especially in developing countries and in low-resource settings, color coding remains

an important tool to promote the extension of quality assured health care services in remote areas through the outreach workers.<sup>1</sup> In the public health sector, where the aim is to improve the health indicators of the general population as a whole, application of color coding not only enables diagnosis of important health condition but even serves as a rationale to start an appropriate line of management.<sup>1,2</sup> Furthermore, color coding has been used to minimize common diagnostic or therapeutic errors and even enhances parental understanding about different attributes related to health.<sup>3,4</sup>

The World Health Organization and even the program managers from different nations have advocated for the employment of color coded growth charts in detecting malnutrition and grading the same in under-five year children.<sup>1,4</sup> These growth charts not only assist medical practitioners in the diagnosis and follow-up, but even serve as an important educational tool to involve mother (both literate and illiterate) in the rehabilitation program of the child.<sup>1,4</sup> In addition, to screen large population of children with malnutrition, Shakir's tricolor tape has been utilized for measuring the mid-upper arm circumference. The red color on the tape (which fell in the less than 12.5 cm zone) marked danger, yellow or white color (12.5-14 cm) marked caution, and green color (more than 14.0 cm) is considered as normal. Children thus screened, can be subjected to further anthropometric measurements and other (clinical/biochemical) tests for specific nutritional deficiencies.<sup>5</sup> The biggest advantage of using the mid-upper arm circumference is that it is easy to conduct and can be used easily even by a village health worker.<sup>5</sup> In order to extend appropriate and adequate management of common childhood ailments (dehydration, acute respiratory infections, *etc.*), under the Integrated Management of Neonatal and Childhood Illness program, principles of color coding have been employed.<sup>1,6</sup> Thus, the health professionals have been trained to adhere to a standardized protocol and depending upon the clinical findings (history/clinical evaluation), children are categorized as pink (*i.e.* require urgent referral to higher center for admission and management); yellow (*i.e.* indicate initiation of treatment at the outpatient health facility); and green (*i.e.* home management).<sup>1,6</sup>

To ensure appropriate handling and management of victims when the quantity and severity of injuries exceed the operative capacity of health facilities, the triage approach has been employed.<sup>1</sup> Triage is a color coded approach under which patients are rapidly classified based on the severity of their injuries and the likelihood of their survival with prompt medical interventions.<sup>7</sup> It enables health professionals to take the best possible

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decision for the individual victim, within the available resources at times of disaster.<sup>1,7</sup> It generally employs four color codes, namely red tag (for critical patients demanding immediate action), yellow tag (for patients between critical and minor categories requiring urgent action), green tag (for ambulatory patients who need minor care), and black tag (refers to dead persons).<sup>1,7</sup>

### Color Coding

In the arena of family welfare, cycle-beads (string of color-coded beads that represent each day of the woman's menstrual cycle) have been introduced as a temporary contraceptive measure, and is based on the standard days method.<sup>8</sup> This cycle-bead consists of four color beads, namely red color beads – signifies the first day of menstrual cycle; blue/brown color beads – refers to days when women is not likely to get pregnant even with unprotected sex; white color bead – most likely days on which women can get pregnant and thus should not have unprotected sex; and dark brown color beads – to indicate if the women menstrual cycle is shorter than 26 days.<sup>8</sup> It is an extremely useful tool especially for illiterate women, requires no medical supervision, and has no local or systemic side effects unlike other con-

traceptive measures.<sup>8</sup> Among the multiple interventions implemented under the National AIDS Control Program, one of the key interventions is to supply pre-packed color coded kits for the management of sexually/reproductive tract infections (STI/RTIs).<sup>9</sup> The rationale behind these color-coded kits is to allow syndromic management of STI/RTIs, especially in primary health care centers with an absence of specialist doctors, and at the same time it reduces unnecessary referrals. Seven kits have been proposed, namely kit 1 (grey color – for urethral or anorectal discharge and cervicitis), kit 2 (green – vaginitis), kit 3 (white) and kit 4 (blue) for non-herpetic genital ulcerative disease; kit 5 (red – genital herpetic ulcer), kit 6 (yellow – lower abdominal pain), and kit 7 (black – scrotal swellings).<sup>9</sup> The diagnosis for these conditions is established by the trained medical officer posted in the respective peripheral health centre.<sup>9</sup> The principles of patient-wise color coded box have also been employed in the treatment of tuberculosis under the Revised National Tuberculosis Control Program in India. In adults, red color box (category I for newly diagnosed tuberculosis patients), and blue color box (category II for previously treated patients) has been recommended for the treatment.<sup>10</sup> In addition, color-coded box is available for even pediatric TB (for weight band 6-10 kg - yellow color box, for weight band 11-17 kgs – orange color box, and pink and grey color box as prolongation pouch).<sup>10</sup> In fact, even for the treatment of leprosy, color coded monthly strips are available depending upon the type of leprosy (Paucibacillary – green color or Multibacillary – pink color).<sup>1</sup> These color-coded treatment regimens allows untrained community worker/patients themselves to administer treatment (after the diagnosis of the disease has been established by trained laboratory technicians), without the need for daily supervision.<sup>1,10</sup>

The Ministry of Environment and Forests has recommended the use of color-coded bags to ensure safe management and handling of biomedical waste and thus prevent hazards to both man and the environment.<sup>1,11</sup> Four color-coded bags are in use to allow safe disposal of the waste, namely yellow bag (for human anatomical waste, animal waste, microbiological waste, and solid wastes); red bags (for microbiological waste and solid waste – tubes/blood or fluid soaked wastes); blue bag for sharp wastes; and black bin is for discarded drugs, incineration ash, and solid chemical waste.<sup>1,11</sup> The principles of color-coding have also been employed to assess the potency of the vaccines and whether they can be used during an immunization session.<sup>12</sup> As maintenance of cold-chain is a key component in the immunization program, to enable health workers to check the potency of vaccines at the site of

immunization, most of the vaccines contain a vaccine-vial monitor (VVM).<sup>12</sup> The VVM consists of an inner square and an outer circle (viz. inner square is light in color than the outer circle).<sup>1</sup> Thus, as long as inner square color remains lighter than the outer circle, vaccine can be used. However, if either the color becomes similar or the inner square is darker than the outer circle, then the vaccine should not be used.<sup>12</sup>

In addition, color-coding has been used in different ways in heterogeneous settings, such as to assess the efficacy of antenatal care;<sup>13</sup> color-coded stratification for ordering radiological tests to bring about a reduction in the number of tests (red, amber, and green test can be authorized by a consultant, registrar/consultant, and by interns/residents respectively);<sup>14</sup> uniform hospital color codes for conveying different emergency situations to hospital staffs without panicking the patients;<sup>15</sup> to improve the safety of multiple infants;<sup>16</sup> color coded anesthetic drugs for preventing accidental syringe swapping;<sup>17</sup> intravenous color coded cannula;<sup>17</sup> gas cylinders;<sup>18</sup> color coded wrist bands for identification of specific alerts like allergies;<sup>19</sup> periodontal instruments;<sup>20</sup> asthma inhalers;<sup>21</sup> drug packaging;<sup>22</sup> for sensitization sessions on electrocardiograms;<sup>23</sup> to monitor the use of medicines beyond their expiry date;<sup>24</sup> radiological scans and other dye-based investigations;<sup>25</sup> etc.

However, the color-coded approach is not fool-proof and has its shortcomings like presence of limited number of identifiable colors in contrast to the numerous pharmaceutical products available; inaccurate color coding; untrained health professionals; and association of certain colors with specific meaning like red for warning, black or white for death, and therefore it should be used cautiously to avoid confusion.<sup>18,26,27</sup> Moreover, most of these concerns can be resolved by proper sensitization of health professionals and adoption of standardized color-coding approach universally.<sup>23,26</sup>

## Conclusions

In conclusion, color coding in health care has the immense scope to ensure delivery of quality assured services, especially in low-resource settings. Nevertheless, there is a crucial need to implement this approach universally to expand its range of benefits to both patients and healthcare professionals.

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