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Editorial

Data Management for Improved Immunization Supply Chain in India

Snehil Kumar Singh[*] and Sanjay Gupta[**]

Each year, 26 million children are born in India; making it the largest birth cohort in the world. The goal of achieving over 90 per cent coverage for basic childhood vaccines lies in delivering millions of doses of vaccines to the remotest villages in India. In the race to deliver safe and potent vaccines to every child, it is programmatically critical that the country's massive vaccine supply chain (or 'cold chain') system keeps pace with the increasing demand. The vaccines delivered are temperature-sensitive, and have to be kept at a temperature range of 2°C to 8°C at the last mile. Maintaining the vaccine cold chain is crucial in ensuring that the Universal Immunization Programme (UIP) functions effectively.

The scale and geographical spread of ISC (Immunization Supply Chain) in India poses huge challenges. At this scale, reaching infants at over 9 million outreach sessions makes supply chain and logistics a complex management problem to address. Over the years, there has been a recognised gap in understanding and building capacity to monitor issues related to the vaccine cold chain and logistics. Additionally, many recent changes in the immunization ecosystem such as new vaccine introductions (pentavalent, rotavirus, pneumococcal, measles-rubella), expansion of cold chain assets, and cold chain network expansion, have triggered the need for strengthening in-country vaccine cold chain.

As a joint initiative of the MoHFW, NIHFW and UNICEF, the National Cold Chain and Vaccine Management Resource Centre (NCCVMRC) was established in 2013 with an aim of laying a foundation towards the effective management of cold chain and vaccine logistics and capacity building of immunization technical staff.

Quality and timely data are essential to every country's ability to strengthen access to vaccine services and improve their quality. India has a powerful management information system (MIS) which is able to analyse and act on vaccine cold chain data. This paves the way for improvements to be made to vaccine services and results in a well-executed UIP. A robust MIS enables visibility into the cold chain and tracks cold chain equipment (equipment type, functional status, etc.) and storage points (population served, power access, etc.) to support smooth functioning. This further allows the government to track and evaluate key performance indicators, and also expand cold chain points in states, plan equipment transfer, etc.

In India, the National Cold Chain Management Information System (NCCMIS) serves as a comprehensive web-based data-base for cold chain management (including equipment inventory) used for UIP, and is implemented across the country. NCCMIS manages vaccine cold chain data for more than 28,000 vaccines.

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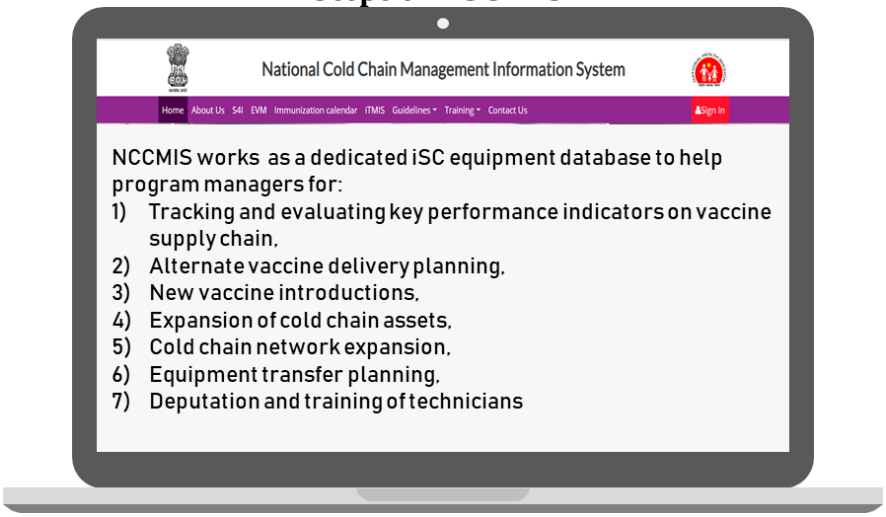
Storage facilities in the country, human resources, and a compiled inventory of more than 90,000 electrical cold chain equipment, tool-kits and spare parts across 36 states and UTs. NCCVMRC is the nodal centre for implementing NCCMIS. A dedicated management system like NCCMIS is helpful in a variety of ways, some of which include tracking and evaluating key performance indicators on vaccine supply chain (equipment breakdown rate, condemnation status, non-functional equipment status, etc.), alternate vaccine delivery planning, new vaccine introductions (pentavalent, rotavirus, pneumococcal, measles-rubella), expansion of cold chain assets, cold chain network expansion, equipment transfer planning, deputation and training of technicians, etc.(Figure 1).

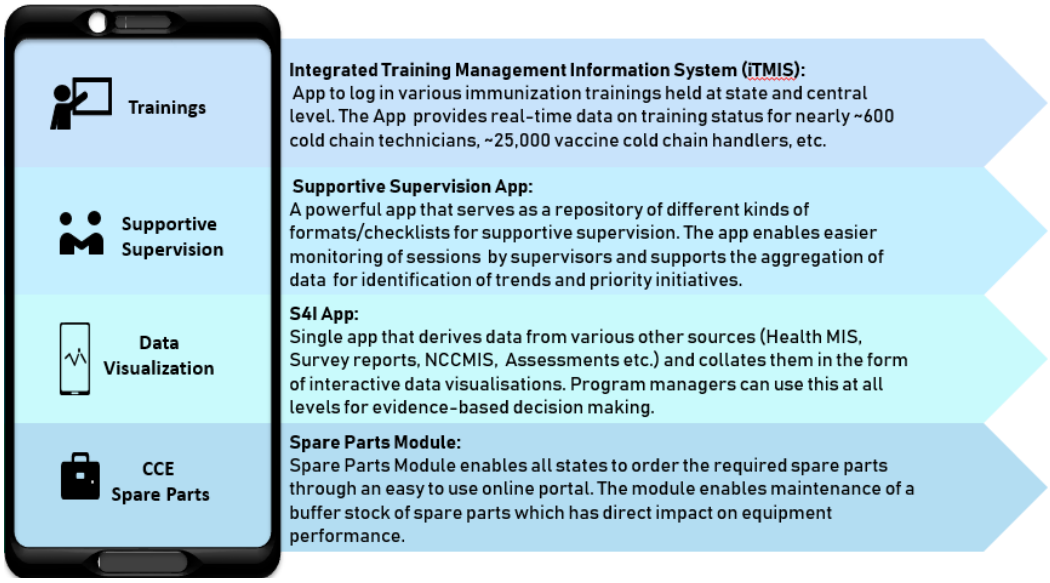
FIGURE 1
Scope of NCCMIS



In addition to NCCMIS, various other MIS systems have been introduced by NCCVMRC to migrate manual data management practices to a digital approach that supports systematic decision-making.

An online database has been developed to monitor and manage trainings delivered to the various cold chain staff. This Immunization Training Management Information System (iTMIS) is a dynamic database that provides a dashboard for quick overview and can be used to monitor training programmes, prepare training load and calendar, and rationalize and plan trainings. Second, having adequate spare parts is critical in ensuring timely repair and maintenance of cold chain equipment. An online Spare Parts Module (indenting system) has been developed by NCCVMRC that assists in maintaining a buffer stock of spare parts, directly affecting the equipment breakdown rate. Finally, the centre's Supportive Supervision app is a mobile application developed for monitoring and supervision at all facility/outreach levels for routine immunization, campaigns, and cold chain monitoring. The app provides real-time data access till sub-district level and data can be accessed by government and its partners through a user-friendly interface that is already in use in more than 29 states and UTs (Figure 2). The utilization can be gauged by the figure of monitoring more than 120,000 routine immunization sessions last year (2018-'19).

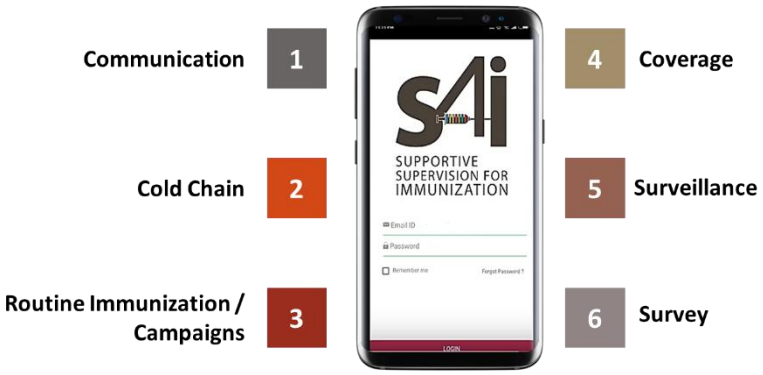
FIGURE 1
Different Digital Interventions at NCCMIS



Next in row is S4i application, hosted on NCCMIS (Figure 3). It's a one-stop dashboard for all immunization data. The pool of immunization data captured in India is tremendous. The country releases administrative and coverage data across many levels of the supply chain, covering all 28,000 vaccine storage facilities (cold chain points) and beneficiaries as well. However, using the same evidence for identifying gaps in one particular district or state can be challenging, as the data sources for identifying the same can be overwhelming and time consuming.

The S4i App provides an interactive dashboard that combines a multitude of data covering health management system information (HMIS), various survey reports data, NCCMIS data, assessments, etc. to allow programme managers to get familiar with and delve deeper into various iSC estimates at state, and district level.

FIGURE 3
S4i Features



Various digital interventions like NCCMIS, iTMIS, SS App and Spare Parts Module are a significant move in this direction, providing a firm digital backbone to India's massive immunization cold chain system. These apps are being developed and managed by NCCVMRC-NIHFW and making data ready to use which is, in turn, helping policy makers and programme managers to take real time informed decisions. Several programme related activities (cold chain expansion, new vaccine introduction, planning of programme studies, managing training, real time tracking of equipment and system performance, effective vaccine management assessment, programme monitoring, inventory management, etc.) are taking place based on the above mentioned e-platforms.

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Effect of Altitude on Cardio-Respiratory Parameters of Healthy College Students

Amitava Pal* and Arunangshu Sinha**

Abstract

Visit to high-altitude regions without acclimatization may develop problems related to high altitude disorders, which could be unpleasant and may even lead to fatal casualties. The present study was aimed at investigating the effect of altitude on cardio-vascular and lungs function performances. Thirty-two healthy volunteers were enrolled for this study. The cardio-respiratory parameters were measured at sea level and 2205 m altitude (Manali of Western Himalayas in Himachal Pradesh, India). Blood pressure, heart rate, and breathing rate were significantly increased at the high altitude as compared to the sea level. SBP and DBP were increased by 4.66% and 6.93% at the high altitude as compared to the sea level. Heart rate and breathing rate were increased by 20.76% and 14.75% at the high altitude. SpO_2 was decreased at the high altitude. Haemoglobin level was faintly increased at the high altitude. FVC, FEV1/FVC and FEF25-75% were significantly increased at the high altitude. FVC, FEV1/FVC and FEF25-75% were increased by 10.98%, 6.88% and 56.19% at the high altitude as compared to the sea level. Acute exposure to hypoxia may trigger autonomic mechanisms in the cardio-vascular and respiratory system caused increased blood pressure, heart rate, and breathing rate. Acute ascent to high altitude may cause an increase in lung function parameters due to the low air density, lessens airway resistance and consequently facilitates expiratory airflow.

Key words: High altitude, Lung function, Blood pressure, Arterial oxygen saturation.

Trekking at a high altitude is a popular recreation and each year approximately 140 million people worldwide visit high altitudes[1]. Studies on cardio-vascular and respiratory changes at high altitudes occupy an important position in high altitude medicine and cardio-respiratory physiology. At high altitude, the atmospheric pressure and air density decrease. In spite of this decrease in air pressure, the mixture of gases remains the same as at the sea level. Partial pressures of gases reduce as the altitude increases. This reduction in partial pressure of oxygen at high altitude causes depletion in oxygen absorption by cells and as a result, affects human performance. This, in the combination of low temperature, low humidity, increased solar radiations and presence of wind, in association with strong physical activities, imposes the human body important physiological adaptations affecting primarily the cardio-vascular and respiratory systems. To respond to this depletion, the respiration and heart rate increase at the high altitude. Therefore, upon arriving at a high altitude, many trekkers experience hypoxic-related sickness such as acute mountain sickness, high altitude cerebral edema (HACE), high altitude pulmonary edema (HAPE), and sleep disorders[2]. At a high altitude (9000 ft or above), most of the people develop signs and symptoms which are associated with acute mountain sickness. If acute mountain sickness is untreated, this may lead to life-threatening HAPE.

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Due to the advancement of technology, people visit the high-altitude regions without acclimatization. As a result, some of them are at risk of having physical problems related to high altitude disorders which could be unpleasant and may even lead to fatal casualties[3]. At a high altitude, hypoxemia triggers a series of pulmonary and cardio-vascular adjustments to maintain adequate oxygenation of different organ systems. In the heart, the major adjustments are an increase in the heart rate, cardiac-contractility, and cardiac-output[4-6]. At the vascular level, the main initial adaptive mechanisms to altitude-induced hypoxemia are pulmonary artery vasoconstriction, and peripheral and cerebral artery vasodilation[6,7]. The hypoxia-mediated stimulation of the cardio-vascular system reaches its maximum effects during the initial few days of exposure and thereafter, it establishes a new steady state condition.

Pulmonary function at high altitudes is affected by a mechanism which is not well-known yet. Some studies carried out on animals indicated that hypoxia in animal leads to respiration adjustment and increases lungs capacity. Moon and Camporesi[1] reported that at high altitude where air pressure decreases gradually, expiration becomes easier. Respiratory muscles' power and strength that play a major role in respiration may be affected by high altitude. Diaphragm tedium can occur also by inspiration increase which in turn, affects breathing and lungs function at high altitudes[8,9]. Schoene[10] reported that taking oxygen from the air to the lungs and bloodstream at high altitude decreases and the blood passing on lungs capillaries speeds up; which in turn, decreases the required time for oxygen equilibrium. This phenomenon is attributed to high altitudes and limited oxygen diffusion cross capillary-alveolus membrane, and consequently leads to hypoxemia[10]. Sharma and Brown[11] conducted a study on adult men at a high altitude for a few days and found that as altitude increases from 3450m to 5350m, forced vital capacity (FVC) shows a significant increase. Moreover, at the altitude of 5350m, forced expiratory volume in 1 second (FEV1) and maximal voluntary ventilation (MVV) increase considerably. However, in another study by Deboeck et al.[12] revealed that hypoxia decreases the strength and power of respiratory muscles and FVC shows a significant reduction consequently. Ventilatory studies at simulated altitude in hypobaric chambers have shown a decrease in FVC and sometimes decrease in FEV1 and forced expiratory flow at 25-75% (FEF25-75%)[13,14]. However, actual field and participant conditions during the course of a trek differ from those of chronic state or more controlled experiments where the effects of environmental and individual parameters have been neglected. Relatively few studies of ventilatory impairment at high altitude have been done because of logistic and technical difficulties. Most of the studies indicate that pulmonary parameters at high altitudes change due to reasons such as low density of air, less aerial resistance, and increment in pulmonary ventilation. These changes depend on participants, altitude and time of residence.

All these reasons call for a new study to find out the effect of acute change of altitude on cardio-vascular and respiratory parameters. Such a study can be designed as a base study to investigate the changes in cardio-vascular and lung function during climbing to high altitudes; and therefore, can fill this big gap somehow. So, this study aims at investigating the effect of high altitude on cardio-vascular and lungs performances.

Methodology

Study Participants and Study Design: This study was conducted in January 2016 at Manali of Western Himalayas in Himachal Pradesh, India. Thirty-two healthy volunteers (24 males and 8 females) aged18-21 years were randomly selected for this study from a total of 110 under-graduate students of Department of Physiology, Panskura Banamali College, West Bengal, India. All of them reside at the sea level (Midnapore and Howrah districts, West Bengal). Inclusion criteria were having no history of chronic systemic diseases (cardio-vascular disease, chronic obstructive respiratory disease such as asthma), no history of drinking, smoking, drug abusing. Exclusion criteria were any type of altitude diseases such as acute mountain sickness, gastroenteritis or motion sickness, or any unavoidable condition (such as injury in the mountain) and upper respiratory infection. None of them had climbed a high altitude during the six months period preceding the study. Prior to the data collection, the protocol was explained to the participants to obtain their understanding and cooperation, and informed consent was obtained from them.

The sea level study was carried out at Panskura, West Bengal (Altitude-7 m; barometric pressure-740 mm Hg). After recording different physiological parameters at the sea level, they set out on their journey to Manali (2205 m elevation) in the Western Himalayas, India. During their stay at the high altitude, the participants were confined to their dwelling units and did not undergo any type of physical exertion. All the participants were recommended to sleep on time at night and consumed a relatively fixed diet during the study period. At the high altitude, none of the participants exhibited any symptoms of discomfort or acute altitude sickness, and they were not taking any medication. All the tests were conducted by the same group of observers with the same set of equipment on both sites. Before commencement of the study, ethical approval and prior permission were obtained from the Institutional Ethics Committee, and the study was carried out in accordance with the Helsinki declaration and with the ethical standards of the committee.

Measurement of Study Variables: The physical dimension of the participants was taken from following standard technique and appropriate landmarks. Height was measured to the nearest 0.1 cm using anthropometer (Hindustan Minerals) and weight to the nearest 0.1 kg using a portable weighing machine (Libra).

The heart rate of the participants was determined by Pulse Oximeter and breathing rate was determined by counting chest wall movements. Blood pressure was measured by the auscultatory method, with the help of a sphygmomanometer (mercury type) and a stethoscope. Blood pressures of the participants were measured after taking rest in a sitting position for at least 15 minutes before measurement and again at least 10 minutes after the first reading. Arterial oxygen saturation (SpO_2) of the participants was determined by Pulse Oximeter. The haemoglobin status of the study participants was measured with a finger prick sample of capillary blood and analysed immediately using a digital haemoglobinometer.

Different pulmonary function parameters of the participants were determined by a portable PC-based spirometer. The participants were instructed to take maximum inspiration and blow into the pre-vent pneumotach as rapidly, forcefully and completely as possible for a minimum of 6 seconds followed by full and rapid inspiration to complete the flow volume loop. The best of the three trials were considered for data analysis. Calibration of the spirometer and all testing protocols were performed as outlined in the instruction manual of the spirometer.

Statistical Analysis: All data were expressed as mean±SD. The changes in different parameters from sea level to high altitude were analysed by the students' t- test. A P-value of <0.05 was considered statistically significant. The data were analysed using the statistical package for the social science (SPSS 20.0) software.

Findings

The physical characteristics of the participants have been shown in Table 1. Of the 32participants, 75% was male. The average age of male and female participants was 19.75±0.85 years and 19.5±0.93 years respectively. Average height, weight, and BMI of the male participants were 165.24±6.37 cm, 63±8.26 kg, and23.02±2.38kg/m^2 respectively. These were 157.9±3.28 cm,55±5.35 kg, and 22.03±1.63 kg/m^2 for the female participants. The result indicated that the mean values of BMI and all physiological parameters of both male and female participants were within the normal range, except the haemoglobin value of the females (Table 1 and Table 2).

TABLE 1
Physical Characteristics of the Study Participants

		Mean±SD	Min	Max
Age (year)	Male	19.75±0.85	18	21
	Female	19.5±0.93	18	20
Height (cm)	Male	165.24±6.37	156	176
	Female	157.9±3.28	152.8	161
Weight (kg)	Male	63±8.26	46	75
	Female	55±5.35	48	62
BMI (kg/m^2)	Male	23.02±2.38	18.9	26.57
	Female	22.03±1.63	20.56	24.59

SD: standard deviation; BMI: body mass index

Different physiological parameters were measured at the sea level (Panskura-7 m) and high altitude (2205 m), and the results are presented in Table 2. It is observed that both Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) significantly increased at the high altitude as compared to the sea level. SBP and DBP were increased by a mean of 4.66% and 6.93% (2.28% and 3.39% per 1000m increment) at the high altitude compared to the sea level. The results of the present study also showed that heart rate and breathing rate significantly increased at the high altitude as compared to the sea level. The heart rate and breathing rate were increased by 20.76% and 14.75% (10.16% and 7.22% per 1000m increment) at the high altitude respectively. SpO_2 of both sexes significantly decreased at the high altitude as compared to the sea level. SpO_2 at the high altitude was decreased by 0.77% (0.38% per 1000m increment). Haemoglobin concentration of both sexes increased with the elevation of altitude; however, the difference was not significant. The haemoglobin concentration of male and female participants was increased by 3.61% and 2.23% respectively at the high altitude as compared to the sea level.

TABLE 2
Mean±SD of Physiological Parameters at Sea Level and High Altitude

		Sea Level	Manali (2205 m Elevation)	% of Change	%Cchange /1000m
SBP (mmHg)	Male	119.08±5.57	124.5±7.83**	4.55	2.07
	Female	120.5±4.87	126.5±10.41**	4.98	2.27
	All	119.44±5.36	125±8.41**	4.66	2.12
DBP (mmHg)	Male	76.58±6.83	81.58±8.21*	6.53	2.97
	Female	77.5±4.11	83.75±3.77***	8.06	3.67
	All	76.81±6.21	82.13±7.36**	6.93	3.15
Pulse Rate (bpm)	Male	73.67±4.42	88.67±10.76***	20.36	9.26
	Female	74±3.38	90.25±4.86***	21.96	9.99
	All	73.75±4.13	89.06±9.57***	20.76	9.44
Breathing Rate (breath/min)	Male	19±1.77	21.71±1.97***	14.26	6.49
	Female	20±1.51	23.25±1.04***	16.25	7.39
	All	19.25±1.74	22.09±1.89***	14.75	6.71
SpO_2 (%)	Male	97.42±0.65	96.67±0.96***	-0.77	-0.35
	Female	97.5±0.93	96.75±1.28**	-0.77	-0.35
	All	97.44±0.72	96.69±1.03**	-0.77	-0.35
Hb conc. (gm/dl)	Male	13.3±1.03	13.78±1.12	3.61	1.64
	Female	11.65±0.53	11.91±0.56	2.23	1.02
	All	12.89±1.18	13.32±1.3	3.34	1.52

w.r.t. Sea level *p<0.05; **p<0.01, ***p<0.001
SBP: systolic blood pressure; DBP: diastolic blood pressure; SpO_2: arterial oxygen saturation; Hb conc.: haemoglobin concentration

FEV1/FVC and FEF25-75% were increased significantly at the high altitude as compared to the sea level (Table 3). FEV1/FVC and FEF25-75% increased by a mean of 6.88% and 56.19% (3.37% and 27.51% per 1000 m increment) respectively at the high altitude as compared to the sea level. FVC of female participants increased significantly at the high altitude as compared to the sea level. FVC also increased by a mean of 10.98% (5.38% per 1000m increment). FEV1 increased with the increasing altitude but the change was not significant.

TABLE 3
Mean±SD of Lung Function at Sea Level and High Altitude

		Sea level	Manali (2205 m elevation)	% of change	% change /1000m
FVC (lit)	Male	2.71±0.58	2.97±0.76	9.59	4.36
	Female	2.45±0.79	2.81±0.24*	14.69	6.69
	All	2.64±0.63	2.93±0.67	10.98	5
FEV1 (lit)	Male	2.62±0.6	2.82±0.61	7.63	3.47
	Female	2.39±0.81	2.63±0.13	10.04	4.57
	All	2.56±0.65	2.77±0.54	8.2	3.73
FEV1/ FVC (%)	Male	88.83±1.9	94.67±2.84***	6.57	2.99
	Female	89.25±1.58	96.25±1.58***	7.84	3.57
	All	88.94±1.81	95.06±2.65***	6.88	3.13
FEF25-75% (lit/sec)	Male	3.35±0.95	5.27±1.18***	57.31	26.08
	Female	3.17±0.79	4.87±1.34***	53.63	24.4
	All	3.31±0.9	5.17±1.21***	56.19	25.57

w.r.t. Sea level *p<0.05; **p<0.01, ***p<0.001
FVC: forced vital capacity; FEV1 forced expiratory volume in 1 second;FEF 25-75%: forced expiratory flow at 25-75%

Discussion

This study investigates the effects of temporary changes of altitude on cardio-vascular and ventilatory parameters under normal circumstances. Due to the standard environmental condition, sea level is a perfect scale for comparison of obtained results from different altitudes. Most of the previous studies investigated through simulated environments and the effects of environmental and individual factors were neglected. In fact, very limited research has been done in a real environment. The base level studies of the present investigation were performed at the sea level which can be considered as an advantage of this investigation over others. Different physiological parameters such as blood pressure, heart rate and breathing rate were significantly increased at the high altitude compared to the sea level. This is an agreement with the other observations[15-17]. Bhaumik et al.[17] reported that on arrival at the high altitude, heart rate value showed higher than the sea level value at rest. Singh et al.[16] noted that resting heart rate and blood pressure was higher at the high altitude. Acute exposure to hypoxia triggers autonomic mechanisms in the cardio-vascular and respiratory system. The first cardio-vascular response to hypoxia is an increase in heart rate, and in cardiac output and the arterial blood pressure[18]. Donegani[18] reported that after a few days of acclimatization, cardiac output reduces to normal values with still increased heart rate. In the same time, the systemic vascular resistances increase as a response of the adrenal medullary activity and the systemic arterial pressure increase. The increase of breathing rate may be due to the initial response to the reduced partial pressure of oxygen (PO_2) is the increase in depth and rate of breathing which results in an increase in alveolar ventilation[18]. This is brought about by hypoxic stimulation of the peripheral chemoreceptors, mainly the carotid bodies which sense the low PO_2 in the arterial blood. SpO_2 was decreased at the high altitude than that of the sea level. Similar to the findings of the present study, some other studies also showed that SpO_2 decreased at the high altitude[6,17,19]

In a study by Zhang et al.,[6] SpO_2 at the sea level was 97% whereas it was 90% and 84% at 3000m and 4000m altitudes.

Haemoglobin level was increased at the high altitude as compared to the sea level but the difference was not significant. In a study by Sawka et al.,[20] the decrease in plasma volume that occurs within several hours of altitude exposure increases red blood cell concentration. During the first several days of altitude exposure, the body's fluid balance changes in a direction that shifts fluid from the intravascular space to the interstitial and intracellular spaces. Sawka et al.[20] reported that after a week at 2300 m, the plasma volume decreases by about 8% whereas haematocrit and haemoglobin increase by about 4% and 10% respectively. Hannon et al.[21] stated that one week stay at 4300 m altitude decreases plasma volume 16 to 25% with concomitant increases in haematocrit (6%) and haemoglobin (20%).

FVC, FEV1/FVC, and FEF25-75% were significantly increased at the high altitude as compared to the sea level. These findings are in good agreement with Samara and Brown[11] findings. Shamara and Brown[11] found that at 3450 m and 5350 m altitudes, FVC increased by 9% and 21% respectively. Increase in FVC as a result of an increase in altitude, which is also seen in this study, may be due to the decrease airways resistance and low air density at the high altitude. FEV1 also increased at the high altitude; however, the change was not significant. Forte et al.[22] and Hashimoto et al.[23] also reported that FEV1 increased by climbing high altitude. They reported that this increase was due to that airways resistance decreases in low-density air. Another study by Mason et al.[24] have reported that FEV1 had no change at 5300m altitude in comparison to the sea level. FEF25-75% increased significantly as the altitude increased which was in agreement with the findings by Deboeck et al.[12]. Deboeck et al.[12] and Faramoushi et al.[25] have reported that the main reason for the increase of FEF25-75% with altitude was a reduction in airways resistance due to the decrease in surfactant. Faramoushi et al.[25] have stated that an increase in adrenalin at high altitude may affect respiratory apparatus resistance. Increased adrenalin at high altitudes may affect the reduction of respiratory apparatus function since an increase in this hormone causes a decrease in the regression of lungs plasticity and vasodilatation which in turn, reduces the resistance of air ways[26].

Different physiological parameters such as blood pressure, heart rate, and breathing rate were significantly increased with increasing altitude. SpO_2 was decreased at the high altitude. Haemoglobin level was faintly increased at the high altitude. Acute exposure to hypoxia may trigger autonomic mechanisms in the cardio-vascular and respiratory system caused increased blood pressure, heart rate, and breathing rate. The present study showed that acute ascent to high altitude causes an increase in lung function parameters which may be due to low air density, lessens airway resistance and consequently facilitates expiratory airflow.

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Medical Value Travel in India– Issues and Challenges

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Abstract

In India, medical tourism has witnessed a phenomenal expansion in the past few years. The key competitive advantages of India in medical tourism stem from low-cost treatment, excellent reputation in advanced health care services like cardio-vascular surgery, organ transplantation, etc. and diversity of attractive tourist destinations available in the country. India stands among top 5 in the world with skilled professionals and good hospitals for treatment at an affordable cost. This paper discusses the current scenario related to medical tourism in India. It highlights challenges before the Indian medical value travel industry.

Medical Tourism, now also known as 'Medical Value Travel,' can be defined as "The act of travelling to other countries to obtain medical, dental and surgical care at ease and with affordability of traveler's choice". Medical Value Travel in the global context is showing a rising trend in the Third World countries because of affordability, cost, facility and expertise from First World countries and also from some Third World countries like Cuba, Argentina, Mexico, etc.[1]

Presently, it has emerged as the fastest growing segment in India. Many people travel to India to avail the opportunity of world class health services offered by the most advanced medical facilities in complete private and at affordable costs. India is a growing destination for medical tourism as about 1.3 million medical tourists visit India every year for their treatment. Today, India ranks among the top five countries in the Medical Value Travel sector in the world[2]. Medical Value Travel is a new form of tourism increasingly becoming popular in today's world, and India has emerged as a popular destination for providing Global Standard of health care at affordable costs[3]. It encompasses primarily on bio-medical procedures combined with travel and tourism. The key selling points of Indian Medical Tourism industry are combination of high quality specialist facilities, competent English speaking medical professionals, cost-effectiveness besides attraction of tourism. Quality care with relatively at cheaper costs as compared to western countries, package deal of cheap services of tourism and hospitability sectors are the biggest attraction. The hospital industry in India stood at Rs. 4 trillion (US$ 61.79 billion) in 2018 and is expected to reach Rs. 8.6 trillion (US$ 132.84 billion) by 2022. Standards of Medical treatment in hospitals provided to patients have significantly improved in India with 22 hospitals accredited by the Joint Commission International (JCI) and International Organization for Standardization (ISO). The cost of medical treatment in our country is on an average 1/8 to 1/5 of the West. The number of foreign tourists coming to the country for medical purposes increased by 50 per cent from 130,000 in 2015 to 200,000 in 2016. This number was expected to double in 2018 with several new initiatives like easier visa facilities for medical tourists.

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By 2022, India is expected to rank amongst the top three healthcare markets in terms of incremental growth in the healthcare sector. Information technology market is expected to grow 1.5 times from the current $ 1 bn, the diagnostics market is expected to grow at a Compound Annual Growth Rate(CAGR) of 20.4 per cent to reach $ 32 bn from $ 5 bn in 2012. During 2015-20, the in-patient market is expected to grow at a CAGR of 13 per cent.

This clearly shows that India is the fastest growing sector in Medical Tourism[1-4]. The industry received 170,000 foreign patients from 87 countries during 2016-'17. Number of doctors increased to 841,104 in 2018 from 827,006 in 2010. The healthcare industry of India stood as the 4th largest employer in 2018 as the sector employed a total of 319,780 people. From the ancient times, India has been also famous for traditional treatment /indigenous therapies by providing Ayurvedic, Unani, Homeopathy and Naturopathy advantage of medicine not only to Indians, but also to foreigners.

Current Medical Value Travel Scenario in India

India is increasingly becoming a popular option for medical tourists across the globe. It encompasses primarily and predominantly medical procedures combined with travel and tourism.. According to GATs (General Agreement on Trade and Services), medical tourism is the second mode of trade in health services. In this mode, patients leave their country to obtain health care services with high quality treatment at an affordable price.

Medical Value Travel is poised to be the next success story after Information Technology (IT). According to Mckinsey-CII study, industry's earning potential is estimated at Rs. 5000 to Rs. 10000 crore additional revenue in the next few years. Thus, medical tourism can contribute Rs. 10000 crores additional revenue for up market tertiary hospitals in the next four years and will account for 3 to 5 per cent of total health care delivery market.

As a part of medical tourism, India is recognized as the cradle for test-tube babies and is also popular for surrogacy services. Besides, India offers high-tech cardiac, paediatric, dental, cosmetic and orthopedic services as well as traditional Indian healing system i.e. AYUSH. However, Medical Tourism does not cater to emergency services. Services provided are knee-joint replacement, hip replacement, bone-marrow transplant, by-pass surgery, etc. Cost comparisons of certain specialized surgeries in India, USA, Thailand and Singapore are shown in the Table 1 below:

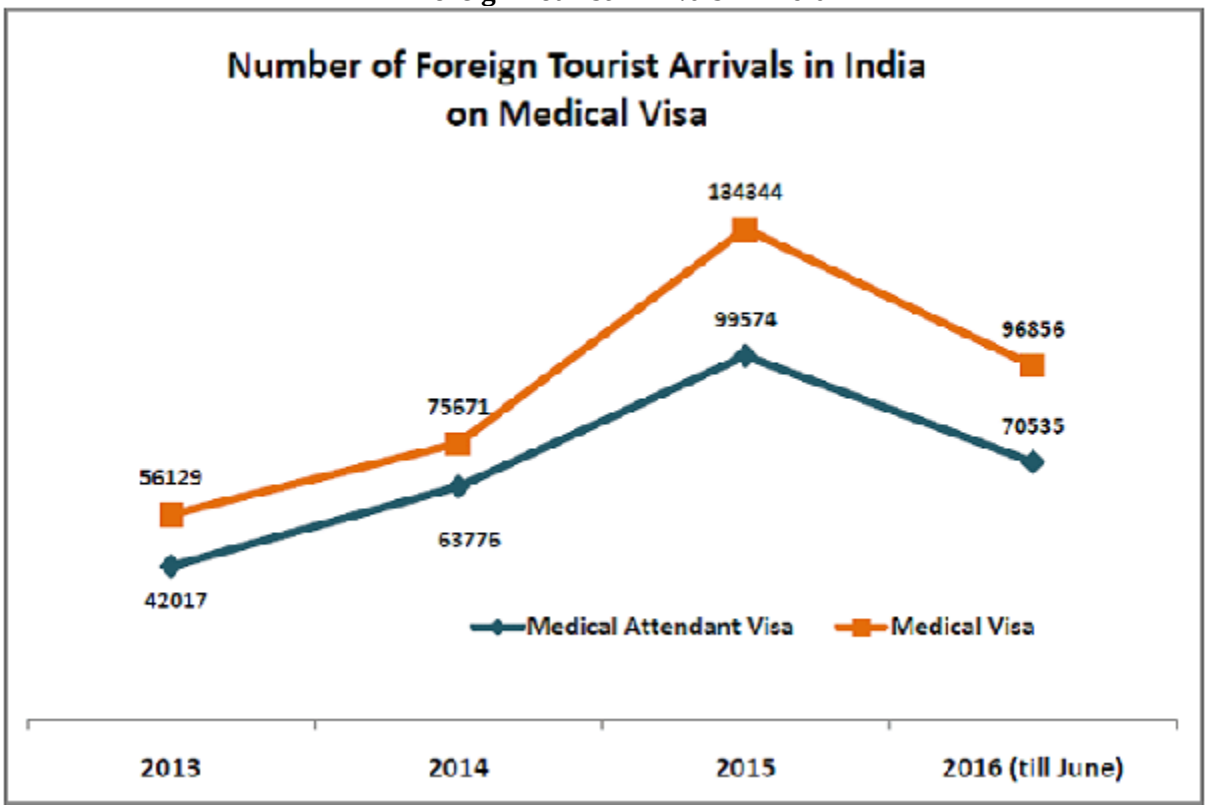
TABLE 1
Cost Comparison between India, USA, Thailand and Singapore
(Approximate figures in US$)

Procedure	US	India	Thailand	Singapore
Heart By-pass	1,30,000	10,000	11,000	18,500
Heart Valve Replacement	1,60,000	9,000	10,000	12,500
Angioplasty	57,000	11,000	13,000	13,000
Hip Replacement	43,000	9,000	12,000	12,000
Hysterectomy	20,000	3,000	4,000	6,000
Knee Replacement	40,000	8,500	10,000	13,000

India is also famous for indigenous therapy like Yoga besides allopathic treatment. In our country, health tourists not only gain cure, but also enjoy the benefits of scenic beauty, spas, and pleasant weather in various tourist spots. Every year, thousands of foreigners come here for treatment because Indian hospitals provide world class services at lower costs as compared to the developed countries. Foreign Tourist Arrivals (FTAs) in May 2018 were 6,06,043. FTAs during the period January-May 2018 were 44,82,064 as compared to 41,21,377 in January-May 2018 registering a growth of 8.8 per cent. The percentage share of Foreign Tourist Arrivals (FTA) in India during May 2018 among the top 15 source countries was highest from Bangladesh (27.80%) followed by USA (15.14%), UK (6.98%), China (3.09%), Sri Lanka (2.73%), Malaysia (2.67%), Japan (2.52%), Canada (2.40%), Australia (2.38%), Germany (2.32%), Singapore (2.16%), Nepal (1.95%), France (1.93%), Afghanistan (1.72%) and Republic of Korea (1.61%).

Presently, health care in western countries has become very expensive not only for minor surgeries but also for major surgical procedures as compared to developed countries like the USA or the UK. Surgical procedures like heart surgeries or angioplasty comes at a fraction of cost in India, as shown in Table 1. Some foreigners visit India for the first time or frequently for surgical procedures. Some of them come on vacations with major agenda of medical care in their travel plans. Foreign medical tourist arrival growth is depicted in the Graph 1.

GRAPH 1
Foreign Tourist Arrivals in India



Government and private hospitals are committed to the goal of making India as a world leader in Medical Industry at an affordable cost. The difference in cost savings between different countries is depicted in Table 2.

TABLE 2
Showing Average Range of Savings for Different Countries

How much can you save? (average range of savings for the most traveled destinations)	
Brazil	20-30%
Costa Rica	45-65%
India	65-90%
Malaysia	65-80%
Mexico	40-65%
Singapore	25-40%
South Korea	30-45%
Taiwan	40-55%
Thailand	50-75%
Turkey	50-65%

http://www.patientsbeyondborders.com/medical-tourism-statistics-facts

Issues in Medical Value Travel

As a developing country, India is facing some issues to become a suitable tourist destination with competent Medical Tourism industry. These are as under:-

a) Lack of high-tech Infrastructure facilities like connectivity, lack of coordination between public and private sectors.

b) Poor essential services like round the clock electricity supply and lack of potable water supply especially in some rural and tribal areas of the country. Few north-eastern states are yet to develop good communication system.

c) Many of the peripheral hospitals including few secondary and tertiary hospitals lack trust of foreign patients, hygienic food and lack of proper hospitality services as compared to international standards.

d) Presently, Government of India has not laid down any regulation on Medical Tourism, Taxation anomalies etc.

e) Some of the problems/difficulties faced by international/national insurance companies are:
   i. Poor travel facilities and complex Visa procedures.
   ii. Lack of community participation.
   iii. Lack of participation by Local Bodies/Banks/Self Government.
   iv. Lack of concern of appropriate authority.
   v. Language barriers.
   vi. Poor accessibility to health facilities.

f) Specific Issues include:-
   a) Lack of Quality, accreditation of some of Indian hospitals and service providers.
   b) Lack of Orientation/Training of Doctors, Nurses and Para-medial staff of few health facilities. Communication problems including inter-personal communication[3]

Challenges before the Indian Medical Value Travel Industry

There are some major constraints including non-availability of adequate infrastructure, accessibility to exact destinations, suitable accommodation and trained manpower in large numbers. Poor hygienic conditions, incidents of touting and harassment are some other factors contributing to poor experience of visitors. Some factors like lack of hospitals, lack of community participation, involvement of rural sector, complex VISA procedures, lack of good interpreters are some of the impediments for medical tourism.

Major challenges for Medical Value Travel in India are poor doctor-patient relationship, problems concerning the Insurance Sector, recuperation period for patients who avail treatment abroad, poor electricity/water supply, dietary problems, lacunae of standards followed by various hospitals, inequalities in medical services provided by the Government and private hospitals, brain-drain from the Government sector to the private sector. The Government of India has made several plans to improve the status of Medical Tourism by removing political instability, bureaucratic roadblocks and lawlessness, political instability and taxation anomaly, etc. Still more improvement is required in this regard[2].

Benefits of Medical Value Travel

Development of medical tourism will offer various benefits such as:

A good revenue generation including earning of foreign exchange.

Generate employment opportunities for local people.

i. More foreigners will be attracted for medical tourism in India, if the treatment services are good.
ii. Medical professionals will develop better expertise.
iii. Professional training centers will be established to train various categories of professionals including nurses and support staff.
iv. Pharmaceutical industry will get boost in terms of research, development and revenue earning.
v. Even remote areas of India with good infrastructure facilities will become centers of Medical Tourism.

SWOT Analysis

SWOT analysis was undertaken by a few research workers on Medical Value Travel (Medical Tourism) and the findings are:

Strengths include quality services at an affordable cost, availability of dedicated professionals including super-specialists e.g. cardio-vascular surgeons, transplant surgeons, etc. and the international reputation of hospitals and doctors and diversity of tourism destination.

Weakness include lack of government support, low co-ordination between various players in the industry i.e. airlines operators, hotels and hospitals owners, less number of accredited hospitals.

Opportunities for medical value travel will further an increased demand for health care services with the aging population, fast-paced life-style for wellness tourism and alternative cures. Shortage of supply in National Health System, demand from countries with underdeveloped health facilities and demand for old-age homes for elderly people.

Threats include strong competition from other South-Asian countries namely Thailand, Singapore, Malaysia and Indonesia.

Conclusion

Of late, India has shown tremendous growth in Medical Value Travel by providing high quality medical care to a large number of foreign patients seeking health care. However, there is a need to develop more infrastructural facilities, better transportation system and hospitality services to facilitate better medical tourism, including accreditation by world bodies. India is in an advantageous position to tap global population in the medical tourism sector in days to come. Moreover, medical tourism can contribute to a great extent to the country's economic growth in the future.

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Factors Affecting Health Insurance Enrolment Decision of Construction Workers in Punjab: A Cross-Sectional Study

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Abstract

In India, a significant percentage of the population employed in the informal sector, often faces health insecurities. In order to improve the health of these workers, we need to develop a health insurance. In the present paper, an attempt was made to identify the factors which affect the enrolment of construction workers in health insurance. The results of the factor analysis revealed that income constraint, comprehensive coverage, lack of awareness about the need to buy health insurance, social obligations, procedural formalities and complications, future contingences other than health, liquidity constraint, money loss, lack of trust, preference for government schemes and linkage with government hospitals were the various perceptions associated with the health insurance enrolment among the construction workers. The present study can help the government to design a health insurance package as per the actual needs of these workers.

Key words: Health Insurance, Enrolment, Perception, Association, Construction Worker.

Two-fifths of the GDP in India originates from the informal sector and about 90 per cent of the families depend on this sector for their livelihood[1]. One of the major insecurities of these workers and their families is the frequent incidence of illness, need for medical care and hospitalization[2,3]. The disappearance of free health care (mostly primary health care) had resulted in the loss of a form of social protection for a large portion of the population especially working in the informal sector[4]. However, a single hospitalization event can account for a loss of 20 to 60 per cent of the annual per capita income of the workers employed in informal sector. The escalating cost of health care is beyond the reach of workers employed in the informal sector[5]. This can lead to a tremendous burden on poor household and indebtedness, sometimes resulting in liquidation of their assets[6].The health insurance can protect the poor households against the risk of catastrophic health care spending[7]. The government of India has introduced various health insurance schemes for the poor in the past but most of the schemes had not served the desired objectives due to faulty design and implementation issues. On 1st April 2008, Rashtriya Swasthya Bima Yojana (RSBY) was introduced to provide protection to BPL families from the health shocks but it has not achieved the desired benefits as planned[6].

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However, community-based health insurance (CBHI) schemes provides the benefits of preventive care, through ambulatory and inpatient care; and financed through the patient collection, government grants and donations. But, CBHI schemes in India suffered from the poor design, fragile management and adverse selection issues[8]. The government sponsored health insurance schemes (GHISs) covers the secondary and tertiary care procedures[9]. The centre or the state funds these schemes by paying a certain premium to the insurance company, or in some cases, an autonomous body formed by the government itself, which then provides insurance coverage for a set of predetermined procedures and medical conditions to the eligible population. The government-sponsored health insurance schemes (GSHISs) introduced explicit entitlements, improved accountability, leveraged private capacity but their financial sustainability is a major concern for the stakeholders[10]. However, Ayushman Bharat National Health Protection Scheme, one of the biggest government-sponsored health schemes in the world was launched in 2018 with an aim to provide healthcare services to 10 crore poor families in urban and rural areas, and cover ₹5 lakh per family per year. Despite of the fact that many schemes have been run by the government from time to time for the low income people, still the penetration of health insurance is very low in India[11.]

Health insurance can protect the poor and informal sector workers against the catastrophic health care payments. But, enrolment of health insurance is very low in India as compared to other countries. There are many factors which hinder the enrolment of the poor and informal sector workers in health insurance. The knowledge and awareness of the various health insurance schemes is not adequate in the country[12].There exists a lack of clarity of the health insurance coverage, exclusion and claim process which hinders its enrolment[13]. On the other hand, it was exhibited that lack of trust on health insurance schemes and fund administration had reduced the penetration of health insurance amongst the lower income groups[14]. The informal sector or lower income groups had a low and irregular income and want health insurance schemes which are accessible, affordable and managed by local bodies and NGOs[15]. The workers employed in the informal sector would like to enrol in the comprehensive health insurance plan which includes hospitalization, maternal care and out-patient care[16]. A study was conducted to examine the health insecurities of workers employed in the informal sector in Delhi. The study found the fact that besides quality improvements in the public health care system, health insurance for the out-patient care should be considered in order to protect the informal sector households from health related contingencies[1,14]. A higher enrolment in the health insurance can be achieved by increasing the customer services[17]. The subscription of health insurance was also influenced by narrow policy options, lack of availability and accessibility of services, lack of illness, low salary, lack of reliability and availability of funds, poor coordination between the companies and hospitals[18].

In another study, it was observed that the basic reason for not to join health insurance schemes was lack of trust on the scheme, fund administrators and government policies[19]. However, the main obstacle in Indian health insurance is to provide better coverage and health services at lower costs[20]. It was also reported that households who perceived their families had a good and fair health, were not likely to pay for the health insurance[21].

Objectives

The major insecurities of the construction workers are the frequent incidents of illness, need for medical care and hospitalization. The health risks and resulting catastrophic financial losses are probably the significant threats to their income. Health insurance can affect the construction workers through its effect on the provision of health services (cost, quality and access). But, most of these workers were not aware of the various health insurance schemes designed for them. Keeping this mind, the objectives of the present study were to:

i. identify the perception of the construction workers towards health insurance; and
ii. examine the association of those perception factors with the enrolment of health insurance.

Methodology

In the present study, construction workers employed in the urban informal sector of Punjab were included. The present study was based on primary data. It was planned to give true representation to three belts of Punjab, viz., Majha, Doaba and Malwa. Hence, one district having higher proportion of urban population from each of three belts was selected[22].The sample size in the study was 210 construction workers. An equal number of 70 workers were selected from each of the three districts. Further, from each district, seven major clusters were identified where the construction workers assembled for the work; and thereafter, from each cluster, a sample of 10 respondents were approached randomly.

For the collection of data, a structured questionnaire was prepared. A total of 36 variables were identified on the basis review of literature, personal interviews with construction workers, discussion with insurance agents and discussion with the experts. These variables were measured on five point Likert scale ranging from 1=strongly disagree to 5 = strongly agree. The enrolment of health insurance was measured with a binary response (1=willing to enroll for health insurance, 0=otherwise).

Firstly, factor analysis was done to identify the factors which affect the enrolment of health insurance of informal sector workers. The Cronbach alpha value for the study was 0.823, indicating a high degree of reliability. These variables in the study were associated with a particular phenomenon are highly correlated amongst themselves. The value of KMO was 0.694 and it was found significant. Moreover, the overall significance of correlation matrices had been tested with Bartlett test (approx. Chi-square = 2049.00 and significant at 0.000) at 210 degree of freedom which also supported the validity of factor analysis. With all these statistics, factor can be applied for the present study. A loading, which is sufficiently high to assume that a relationship exists between the variable were considered. To determine the minimum loading necessary to include an item in its respective constructs. It was suggested that variables with a loading greater than 0.30 is considered significant[23]. A factor loading greater than equal to 0.30 was considered appropriate for the present study. The principal component analysis (Factor Analysis) produces components (Factors) in descending order of their importance and factor loadings which explain the relative importance of different variables in explaining variance in the phenomenon. Secondly, Probit regression was done to find out the association of the identified factors with enrolment decisions. The Probit regression is used when the dependent variable is binary.

The dependent variable in the Probit regression assumes 1 if the respondent willing to enrol for health insurance and 0 otherwise. Whereas, the independent variables were all the factors identified from the factor analysis. Frequency and percentages were also calculated wherever found necessary.

Findings

From Table 1, it was found that 99.5 per cent of them were male and majority of them were below 30 years, 79 per cent of the the respondents were married. It was observed that 34.3 per cent of them were illiterate, 26.2 per cent above primary-up to secondary, 25.2 per cent primary, 10 per cent with no formal education and only 1 per cent was graduate. However, 81.4 per cent of the respondents had an annual income of₹ 50,000-₹ 1,00,000, 9.5 per cent ₹ 1,00,000-₹ 1,50,000, 8.6 per cent below ₹ 50,000 and only 0.5 per cent ₹ 1,50,00- ₹ 2,00,000.

TABLE 1
Demographic Profile of Construction Workers

Characteristics (N=210)	**Percentage**
Gender	
Male	99.5
Female	0.5
Age	
Up to 30 years	36.7
31-40 years	23.3
41-50 years	18.6
51-60 years	16.2
60 and Above	5.2
Marital Status	
Single	21.0
Married	79.0
Education	
Illiterate (No education)	34.3
No Formal Education (but can read and write)	10.0
Up to Primary	25.2
Above Primary, up-to Secondary	26.2
Senior Secondary School	3.3
Graduate	1.0
Annual Income	
Up to ₹50,000	8.6
₹50,000-₹1,00,000	81.4
₹1,00,000-₹1,50,000	9.5
₹1,50,000-₹2,00,000	0.5

Note: Primary Data collected from three districts of Punjab (Amritsar, Jalandhar and Ludhiana).
Source: Author's Calculation Based on Primary Data.

Table 2 depicts that 13 factors had eigen value of more than one. These factors explained 65.285 per cent of the total variance which exceeded the 60 per cent threshold used in social sciences[13]. The first factor consists of four variables and named as income constraint, factor two consists of four variables and known as comprehensive coverage, factor 3 constitutes four variables and known as lack of awareness about need to buy health insurance, factor 4 includes five variables and deals with social obligations. Factor 5 consists of three variables and named as procedural formalities and complications, factor 6 consists of two variables and named as future contingencies other than health, factor 7 again consists of two variables and named as lack of information; factor 8 consists of two variables and named as prefer to invest money in other areas, and factor 9 consists of three variables and named as liquidity constraints. Factor 11 consists of three variables and named as lack of trust, factor 12 consists of one variable and named preference for government company while factor 13 consists of one variable and named as linkage with government hospitals.

TABLE 2
Perception of Construction Workers Towards Health Insurance

Factor	Percentage of Variance	Factor Interpretation	Variable included in the Factor	Loading
F_1	6.5%	Income Constraint	Low salary restricts me to buy health insurance	0.8
			I have irregular income, how can I buy	0.8
			I don't feel the need to buy it	0.4
			I have small amount of cash, how can I insure	0.4
F_2	6.3%	Comprehensive Coverage	I will buy if the whole family will be covered	0.7
			If it covers all the hospitalization expenses , then I can prefer	0.7
			I will prefer, if all diseases will be covered	0.7
			I will avail health insurance, if government contributes	0.4
F_3	6.2%	Lack of Awareness about Need to Buy Health Insurance	If I will not fell ill, then I will not get anything	0.7
			I give importance to current need over future problems	0.6
			I am already availing free health care facilities from government hospital	0.6
			If it is provided by NGO then I will think	0.6
F_4	6.2%	Social Obligations	I need to save money for future, how can I buy it	0.6
			My elders take decisions on my part	0.6
			I will buy health insurance if my friends/ relatives/colleagues will buy	0.5
			I have to meet social obligations, I cannot afford	0.5
			I would prefer to invest rather to insurance	0.5

F_5	5.1%	Procedural Formalities and Complications	No doctor/health facility easily accessible	0.8
			Difficulty in availing health care services in hospitals	0.6
			Difficult to approach health insurance agent	0.6
F_6	4.9%	Future Contingencies Other than Health	I want to enjoy present instead of securing future	0.7
			I don't like to buy it	0.6
F_7	4.8%	Lack of Information	No one suggested about health insurance	0.8
			I never heard about health insurance	0.8
F_8	4.8%	Prefer to Invest Money in other Areas	Family members less prone to disease	0.7
			Saving in other area in order to meet health care needs	0.6
F_9	4.1%	Liquidity Constraints	I have low risk tolerance capacity	0.7
			Everyone cannot pay in cash for health insurance	0.4
			I know little about the health insurance	0.4
F_{10}	4.1%	Money Loss	No agent approached me, to sell health insurance	0.7
			Health insurance will not yield any return, rather it is a money loss only	0.4
F_{11}	4.0%	Lack of Trust	I do not trust insurance agents	0.7
			If someone suggest about it, then I can buy	0.5
			Health insurance must be cheap and affordable	0.4
F_{12}	3.9%	Preference for Government Company	If provided by the government company, then I can think	0.6
F_{13}	3.7%	Linkage with Government Hospitals	I will avail the policy if government hospitals are linked with the scheme	0.8

Source: Author's Calculation Based on Primary Data.
Note: Primary Data collected from three districts of Punjab (Amritsar, Jalandhar and Ludhiana).

Association of the factors with enrolment of health insurance is presented in Table 3. Probit regression was employed to examine the association of perception factors with health insurance. The Pseudo R^2 value was 0.230 and thus, indicates a goodness fit. Out of 13 factors, only four factors were found to be significantly associated with enrolment of health insurance. The significant factors were income constraint, future contingencies other than health; prefer to invest money in other areas and linkage with government hospitals.

TABLE 3
Probit Regression Analysis of Association of Perception Factors with Health Insurance Enrollment Decisions

Factors	**Coefficient (Std. Error) `**	**Marginal Effects**	**p-value**
Income Constraint	-0.6*** (0.11)	-0.1	0.0
Comprehensive Coverage	0.1 (0.1)	0.03	0.2
Lack of Awareness about Need to Buy Health Insurance	-0.1 (0.10)	-0.04	0.18
Social Obligations	-0.1 (0.1)	-0.03	0.2
Procedural Formalities and Complications	0.02 (0.1)	0.007	0.8
Future Contingencies Other than Health	-0.2*** (0.1)	-0.08	0.006
Lack of Information	0.02 (0.11)	0.006	0.8
Prefer to Invest Money in other Areas	-0.2** (0.1)	-0.07	0.01
Liquidity Constraints	0.04 (0.10)	0.01	0.7
Money Loss	0.04 (0.1)	0.01	0.6
Lack of Trust	0.1 (0.1)	0.03	0.2
Preference for Government Company	-0.10 (0.11)	-0.03	0.3
Linkage with Government Hospitals	-0.2** (0.104)	-0.06	0.04
Constant	0.7*** (0.1)	-	0.0
Model Summary			
Pseudo R^2	0.23		
Log pseudo likelihood	-93.7		
Prob> chi^2	0.0		
LR chi2(13)	56.02		
No of Observations	210		

Source: Author's Calculation Based on Primary Data.
Note: (1) Primary Data collected from three districts of Punjab (Amritsar, Jalandhar and Ludhiana).
(2) ***Significant at 1%, **Significant at 5%, *Significant at 10%

Probit regression identified inverse relationship between the enrolment of health insurance and income constraint. It was found that respondents who faced income constraint were less likely to enrol for health insurance. The marginal effects of income constraint revealed that with a unit increase in income constraint, the probability to enrol for health insurance will decrease by 17.8 per cent. Future contingencies other than health were inversely associated with health enrolment. The results of the marginal effect described that with a unit rise in the future contingencies other than health, the probability to join for health insurance will decreases by 8.2 per cent. There exists an inverse association between enrolment of health insurance and preference to invest money in other areas. This factor was found significant at 5 per cent level. The marginal effects descried that with a unit rise, the preference of investing money in other areas would decrease the probability to enrol for health insurance by 7.6 per cent. The coefficient of linkage with government hospitals was negatively associated with health enrolment. With a unit rise, linkage of health insurance with government hospitals will decrease the probability to enrol for health insurance by 6.2 per cent. This can be associated with the fact that in India, public hospitals often provides poor quality yet the poor want to avail of private healthcare facilities.

Conclusion

In the present study, an effort was made to identify the various factors associated with the enrolment of health insurance among the construction workers. It was found that income constraint, comprehensive coverage, lack of awareness about the need to buy health insurance, social obligations, procedural formalities and complications, future contingences other than health, liquidity constraint, money loss, lack of trust, preference for government schemes and linkage with government hospitals were the factors which affect the enrolment of informal sector workers in health insurance. Out of the 13 perception factors, four were significant to influence the enrolment decisions of the construction workers. The Probit regression coefficients stated that all the four variables were inversely related to health insurance enrolment decisions. Due to low and irregular nature of income, construction workers would not able to pay the premium at once. While designing health insurance policies, specifically for the poor, flexibility should be introduced in the payment of the insurance premium. The workers should be allowed to pay the premium as per their convenience as it could be on monthly, quarterly, bi-annually or on yearly basis. This could raise the penetration of health insurance among them. Lower income group respondents also reported many social obligations. If timely health insurance would be provided to them, they could be saved from health related insecurities. This study could be helpful to the government to understand the underlying perceptions of informal segment towards enrolment of health insurance, and design a health insurance package as per the actual need of these workers.

Recommendations

The study clearly portrayed that workers employed in the informal sector hold different perceptions towards health insurance. In order to increase enrolment, the need is to give a clear understanding of the concept of health insurance, and its potential benefits to workers employed in the informal sector. A major awareness campaign needs to be launched through government and private media to sensitize the informal sector towards health insurance. The awareness campaigns are not one time activity but should be conducted on a regular basis. In order to increase the outreach of health insurance in the informal sector, insurance companies should involve the local government, cooperatives, non-governmental organizations, micro-finance institutions and other grass root organizations.

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An Assessment of Health Communication Activities through Project Implementation Plan (PIP) for the Period 2012-2017

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Abstract

Within the broad national parameters and priorities of NRHM and NUHM under NHM, states have the flexibility to plan and implement state-specific action plans. The State Project Implementation Plan (PIP) spells out the key strategies, activities undertaken, budgetary requirements and key health outputs and outcomes. Although health communication has been identified by various agencies including the World Health Organization as an essential part of public health, it continues to be neglected in professional, medical or allied education. As a result, there is a serious dearth of trained professionals on the field and in the campaigns that are run in India. Therefore, due to the lack of methodical approach, most have failed to make the desired impact. This study was focused on health communication strategies, communication tools used to disseminate information and capacity building exercise of states and union territories in India. Findings of the study suggests that utilization of available communication tools must be judicious and appropriate, focus shall be on conduction of training activities and proper absorption of funds for increasing the demand for healthcare in India and eliminating the dearth of trained professionals in the field of health communication.

Key words: Health Communication, PIP, NHM

The Union cabinet approved the launch of National Health Mission (NHM), with National Rural Health Mission (NRHM, 12 April 2005) and National Urban Health Mission (NUHM, 1 May 2013) being its sub missions. Aim of NHM (NUHM + NRHM) is to provide accessible, affordable and quality care to the rural and urban population, especially the vulnerable groups[1]. Under NRHM, the EAG (Empowered Action Group) states as well as the North Eastern states, Jammu and Kashmir and Himachal Pradesh have been given special focus.

Within the broad national parameters and priorities under the NRHM and NUHM, States have the flexibility to plan and implement state-specific action plans. The State Project Implementation Plan (PIP) spells out the key strategies, activities undertaken, budgetary requirements and key health outputs and outcomes[2]. The State PIPs aggregate the district/city health action plans, and include activities to be carried out at the state level.

Effective communication can increase the demand for appropriate health services and decrease the demand for inappropriate health services. Collaborative relationships are enhanced when all parties are capable of good communication[3]. Health communication is a way of promoting health behaviors and attitudes, and sustaining them over a period of time. It is aimed at positive health outcomes that the target population can relate to and comply with. The field is gaining recognition in part because of its emphasis on combining theory and practice in understanding communication processes and changing human behaviour[4].

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Although health communication has been identified by various agencies, including the World Health Organization as an essential part of public health, it continues to be neglected in professional, medical or allied education. Exposure to certain type of health communication can enhance the relevance and lead to behavioral change[5]. It has a lot of scope and is indeed, one of the most effective and proactive types of public health interventions. Yet health communication is considered trivial. Hence, it is extremely neglected in the Indian context. As a result, there is a serious dearth of trained professional on the field and in the campaigns that are run in India. Therefore, due to the lack methodical approach, most of these campaigns have failed to make the desired impact. Health promotion needs to be related with all the policies; and if utilized efficiently, will lead to positive health outcomes[6].

The PIP gives detailed information on communication activities to be carried out during the financial year along with other requirements to carry out these activities. There are limited studies which tried to assess the health communication activities proposed by the states in their PIP; and how these activities have changed after the inception of NUHM. Thus, this study is an attempt to determine the communication tools and training activities used over the period of last five years and to form a comparative analysis of various activities undertaken with respect to health communication.

Methodology

This study is based on secondary data extracted from the National Health Mission (NHM), State Programme Implementation Plans (PIPs) for all the 29 states and 7 union territories of India. A cross-sectional study design was adopted and data for the last five years (2012-2018) were extracted from the NHM website for each state and union territory of India between March and May 2018. From each year's PIP, strategies and action plan specific for health communication was extracted and segregated into 4 headings namely- Communication Material, Strategy, Training Plan and Budget. All the states and union territories having the Project Implementation Plan (PIP) were included in the study. It was found that a few states didn't have any action plan with respect to Health Communication; or PIPs for some financial years were not available for the financial years under the study. These years were excluded during the analysis of health communication activities of the particular states. All data were analyzed and evaluated to finally recommend the areas of improvement in Health Communication activities for each state.

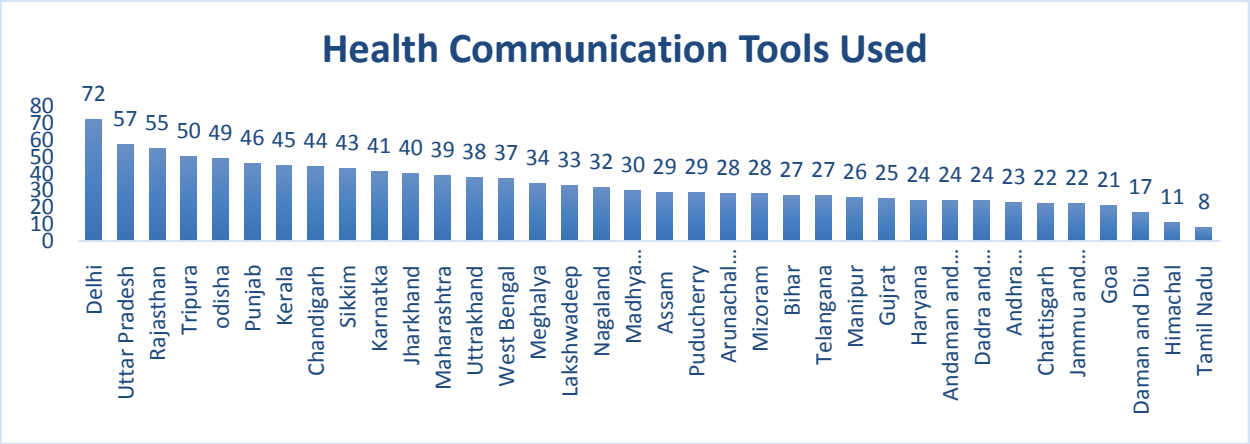
Findings

It was seen that though the states and union territories had a health communication plan for the financial year under study (2012-2018) but discrepancies were noted in PIP of Tamil Nadu state. It had not detailed out its strategy and communication tools to be utilized. Tamil Nadu, of course, has mentioned under what national programmes and for which health conditions, they will carry out the communication activities but no clear plan and strategies were mentioned.

Across India under NHM, a total of 155 communication tools were used over the last five years out of which utilization by each individual state is less than 50%. With Delhi using 72 tools (46.45%), the highest among the states, and Tamil Nadu using only 8 (5.16%).

As mentioned, Tamil Nadu might be using more tools but as research is based on plan laid out by the state in their PIP, no clear mention of tools used, is there which might result in the discrepancy observed.

FIGURE - 1



Training/capacity building activities also see a declining trend with only 4 states (Arunachal Pradesh, Jharkhand, Rajasthan and Sikkim) and 1 union territory (New Delhi) carried out training activities in all the 5 years under the study. Again, Tamil Nadu lags in this field as PIP does not bring out communication activities clearly. Apart from Tamil Nadu, Himachal Pradesh and 4 other union territories (Chandigarh, Daman and Diu, Lakshadweep and Puducherry) have not mentioned any training activity during the years of the study period.

FIGURE - 2

It was also observed in the study that there was minimal change in the Health Communication Strategies after the inception of NUHM with most of the states following similar action plans as proposed under the NRHM wherein even budgetary requirements are also not proposed for Health Communication. Apart from traditional channels for health communication like mass media, local folk music and festivals were also strategically included to spread awareness about different health programmes and benefits.

To generate a demand for healthcare, inter-personal communication through health workers is the most widely-used strategy for raising awareness in the local community.

Every state proposed budgetary requirement for the financial year describing the broad categories under which the funds will be required. For health communication, budgetary requirements were put in Section B10 of Mission Flexi pool under the NRHM and section 4.6 under the NUHM as IEC/BCC activities. It was noted that most of the states and union territories were not able to utilize even 50% of the total funds allocated during the 5 years of the study period. Data on budget utilization for previous year was extracted from the sheet of the next financial year. During the duration of the study, most of the states had not updated PIP for the financial year 2018-2018; thus, utilization of funds for the financial year 2016-2018 was excluded during the final budget calculations. Few states and union territories were also excluded as data for these states were not sufficient for analysis. After exclusion of all the variables mentioned above, Tamil Nadu showed utilization of 84.7% fund allocated closely followed by Maharashtra (82.6%). West Bengal and Rajasthan showed the lowest with 9.1% and 13.9% utilization respectively. Nagaland had more expenditure than funds allocated for the activities; and thus, there was overutilization (131.8%).

FIGURE - 3

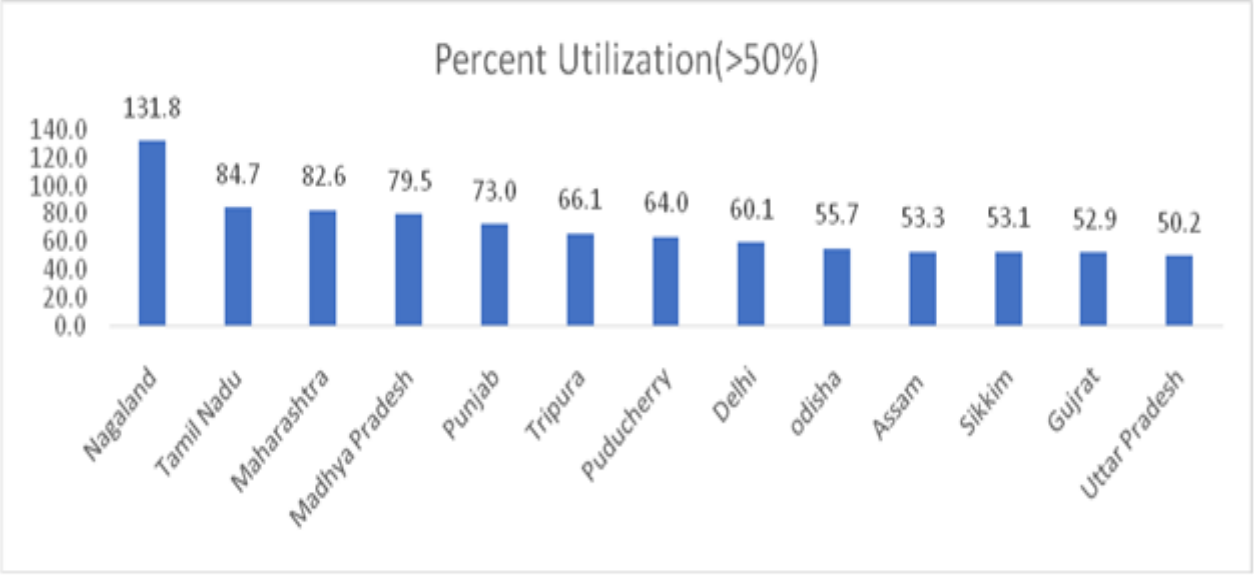
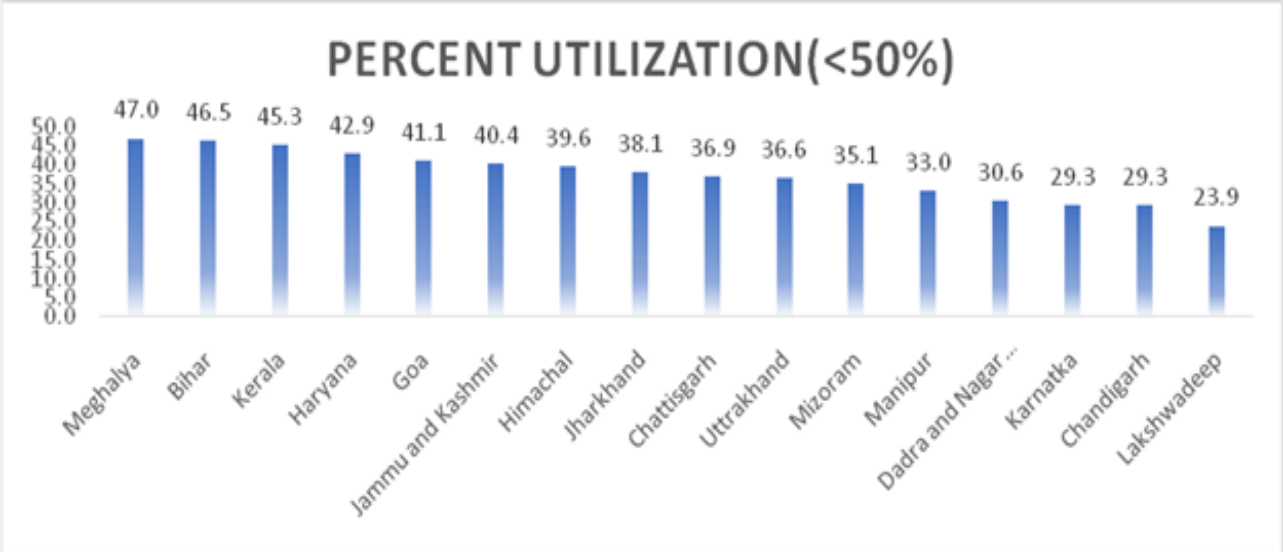


FIGURE - 4



Discussion

Findings after analysis of PIP have brought out that there is constant effort from the Central (GoI), and state and union territory governments to increase the penetration and reach of health programmes to improve health care seeking behavior or the health status of population in general with special focus on the disadvantaged communities and in difficult terrains. Behavior change or health communication activities are crucial to bring about the desired change.

During the analysis of data, it was observed that many states and union territories did not have focus on carrying out training/capacity building of staff in consistency with the WHO finding wherein it was observed that there is a dearth of trained professionals in the field of health communication. Similarly, Hosein (2014) observed that programme managers in the public sector have a very limited understanding of communication and its role in achieving the behavioral results[7]. We should work to address the capacity building needs of different professionals and communities to effectively disseminate information and enable community members to actively participate[8]. Also, research/evidence-based activities for health communication were carried out only in few states where they did primary research before carrying out the communication activities. This could be replicated in other states to carry out primary research-based activities which will help to formulate specific strategies those are beneficial for the local communities. It was observed that states and union territories primarily follow national guidelines for carrying out communication activities and have not come up with an action plan that is specific to the region / community / endemic or local diseases prevalent in the states. Unutilized fund may be channelized to conduct primary research to generate a clear picture about the communication needs and strategies of the population. Furthermore, this study brought out that across different financial years, 155 communication tools were used but no state/ union territory was using all the tools. They can rethink and reanalyze and may further increase their arsenal with respect to communication tools to be used.

This will also help in better utilization of funds by each state. Furthermore, it is the duty of the particular state and union territory to make sure that the health communication activities achieve the objectives among the most vulnerable and disenfranchised segments[9].

Conclusion

The study findings conclude that there is a definite need for improvement in the health communication field, wherein states are required to increase their focus only towards this segment as the plans, activities to be carried out are already well-laid in PIPs for most of the states and union territories. Weaker performing states can further increase their capacity building programme for health personnel to be at par with other states and union territories.

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Knowledge and Practices of Vaccine and Cold-Chain Handlers on Temperature Maintenance of Cold-Chain in Government Health Facilities in a District of Delhi

Gaurav Kumar* and Sanjay Gupta**

Abstract

Knowledge and practices of Vaccine and Cold Chain Handler's (VCCH's) is important in ensuring appropriate temperature in Immunization Supply Chain (ISC). ForISC assessment, WHO-UNICEF developed a standard Effective Vaccine Management (EVM) tool in 2010which gives comprehensive picture of ISC including temperature monitoring.This study was conducted to ascertain knowledge and practices of VCCH's in context of temperature maintenance of cold chain in government health facilities (HF's) in a district of Delhi using EVM tool. Sample size and site selection was done using WHO EVM site selection tool. Total of 61 VCCH's interviewed in 29 HF's and District Vaccine Store (DVS).In DVS, VCCHshave adequate knowledgebut last three years temperature records were not found. In HF's, knowledge of heat and freeze sensitive vaccine was correct in 36 (61%) of VCCH. In 4 (13.8%) of the assessed HF's, manual recording was not done. None of sites including DVS had complete twice daily manual temperature recording (No monitoring done on holidays and weekends).

Key words: Temperature monitoring, Cold Chain, EVM, ISC

For effective implementation of immunization programme, the Immunization Supply Chain (ISC) system needs to be significantly robust. As per WHO, ISC system comprises the people, data, assets, and processes that manage the data collection, forecasting, ordering, distribution, storage and delivery of vaccines[1].For continuous improvement ISC system in any country, assessment of vaccine and cold chain management is required, as it would help find out different lacunae, identify strong and weak areas and hence lay out implementable improvement plan. To set a standard WHO and UNICEF developed web based tool called Effective Vaccine Management (EVM) in the year 2010 applicable for any country. EVM assesses the ISC at four different levels: (i) Primary or National level includes national and state vaccine stores; (ii) Sub-National level includes the regional and divisional vaccine store; (iii) the lowest distribution point includes the District Vaccine Stores (DVS); and (iv) Service Delivery Point includes Health Facilities (HFs). The tool has around 350 structured questions to assess nine different criteria of ISC. One of the criteria is 'Temperature maintenance' and questions in context of knowledge and practices of VCCH on temperature maintenance in ISC were used for this study[2].

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As per MoHFW recommendations, all UIP vaccines are to be stored at 2 to 8^0 Celsius at district and sub district level except OPV and Rotavirus vaccine at DVS (can be stored in deep freezer at -15 to 25^0 Celsius).[3]

The vaccines which are freeze sensitive and never to be exposed below zero degree are DTwP or DTwP-hepatitis B-Hib(pentavalent); Hepatitis B (Hep B); Hib (liquid); Inactivated Polio Virus (IPV); Pneumococcal; Rotavirus (liquid and freeze-dried) and Tetanus, DT, Td.

The vaccines, which are heat sensitive, are divided into six groups (Group A to Group F) from most sensitive to least sensitive. These are as follows:

- Group A: Oral Polio Virus (OPV); Varicella Zoster Virus
- Group B: Influenza
- Group C: Inactivated poliovirus (IPV); Japanese encephalitis (freeze-dried); Measles or measles-rubella or measles-mumps-rubella (freeze-dried).
- Group D: Cholera; DTaP-hepatitis B-Hib-IPV (hexavalent); DTwP or DTwP-hepatitis B-Hib (pentavalent); Hib (liquid); Measles (freeze-dried); Rotavirus (liquid and freeze-dried); Rubella (freeze-dried); Yellow fever (freeze-dried)
- Group E: Bacillus Calmette-Guerin (BCG); Human papillomavirus (HPV); Japanese encephalitis (JE); Tetanus, TD, Td
- Group F: Hepatitis B; Hib (freeze-dried); Meningococcal A; Pneumococcal[4]

WHO has recommended that temperature should be monitored twice a day, even on Sundays and holidays. The temperature records should be kept safe for a period of at least three years. The temperature recording format designed should have space for entering alarm event. WHO recommended temperature recording format is shown in the following figure.

Temperature monitoring chart for temperature logger devices

Cold room/refrigerator number : ILR # 1 | Start date: <dd/mm/yyyy> 03 Oct 2015

Equipment model: : MFR 123 | Location: Erewhon HC

Key: FI = freeze indicator (status OK or X)

Temperature chart

Day		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20		21		22		23		24		25		26		27		28		29		30		31	
°C		am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm
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FI (x or OK)																																																														
>+8 °C alarm		Once every 24 hours, enter high alarm status and maximum temperature recorded by the continuous temperature monitoring device																																																												
Alarm or OK		OK		OK		OK		OK		OK		OK		OK		OK		OK		OK		OK		OK		OK		OK		OK		OK																													
Maximum °C		+7.5		+6.5		+6.3		+4.5		+5.2		+3.3		+3.0		+1.8		+0.2		−0.8		−0.5		+5.2		+5.4		+5.3		+6.1		+5.5		+6.1																													
<−5 °C alarm		Once every 24 hours, enter low alarm status and maximum temperature recorded by the continuous temperature monitoring device																																																										
Alarm or OK		OK		OK		OK		OK		OK		OK		OK		OK		X		X		OK		OK		OK		OK		OK		OK		OK																													
Min °C		+5.8		+5.4		+4.8		+3.5		+3.6		+2.8		+1.7		+0.8		−0.5		−1.5		−1.3		+0.9		+3.5		+3.8		+3.6		+4.6		+3.9																													
Initials:		JWL	JWL	JWL	JWL	JWL	JWL	FC	FC	FC	FC	FC	FC	FC	FC	FC	FC	FC	FC	JWL	JWL	JWL	JWL	JWL	JWL	JWL	JWL	JWL	JWL	JWL	JWL	JWL	JWL	JWL	JWL																											

Province: Jazir | Month: October | Remarks: Thermostat incorrectly adjusted by temporary health worker. Corrected on 12 Oct

District: District 9 | Year: 2015

Health centre: Erewhon | Supervisor: AG

The various temperature recording / monitoring devices used are:

- Integrated digital thermometer: A permanent temperature monitoring device that is built into cold rooms, freezer rooms, refrigerators and freezers. Temperature sensors monitor the temperature constantly, and the temperature is displayed digitally outside the room or refrigerator/freezer.

- Thirty-day electronic temperature logger: A device placed with vaccines, primarily for use in refrigerators. The device logs the temperature and displays alarm violations for the last 30 days. One of the technological innovation for continuous temperature monitoring in India is electronic-Vaccine Intelligence Network (e-VIN). It is implemented with support of United Nations Development Programme (UNDP). E-VIN provides real time information on temperature across different cold chain points and vaccine stocks. Till 2018, it was implemented across 11 states.

- Stem Thermometer: These devices provide instantaneous temperature reading. For this reason, WHO no longer recommends them as the primary monitoring device. They remain useful as a back-up device because they do not require a power source.

- Stem Thermometer: These devices provide instantaneous temperature reading. For this reason, WHO no longer recommends them as the primary monitoring device. They remain useful as a back-up device because they do not require a power source.
- Dial Thermometer: WHO no longer recommends bimetallic dial thermometers for any purpose because they lose their calibration over time, especially if they are dropped.
- Vaccine Vial Monitor (VVM): VVM enables the health worker to identify whether a vaccine vial is heat damaged or not.There is outer circle bluish in colour and inside square which is white. The start colour of the square is never snow-white, it always has a bluish-grey tinge. From then on, until the temperature and/or duration of heat reaches a level known to degrade the vaccine beyond acceptable limits, the inner square remains lighter than the outer circle. At discard point, outer circle and inner square become same colour. Beyond discard point, square colour is darker than the outer[5].

- Checking vaccines for cold damage (freezing):- DPT, TT/Td, IPV, HepB, PCV and Penta vaccines lose their potency if frozen. Moreover, the risk of adverse events following immunization, such as sterile abscesses, may increase. Discard the vial if it is frozen or it contains floccules after shaking.
  Shake Test is not applicable for IPV.

Shake -- Test Test vial

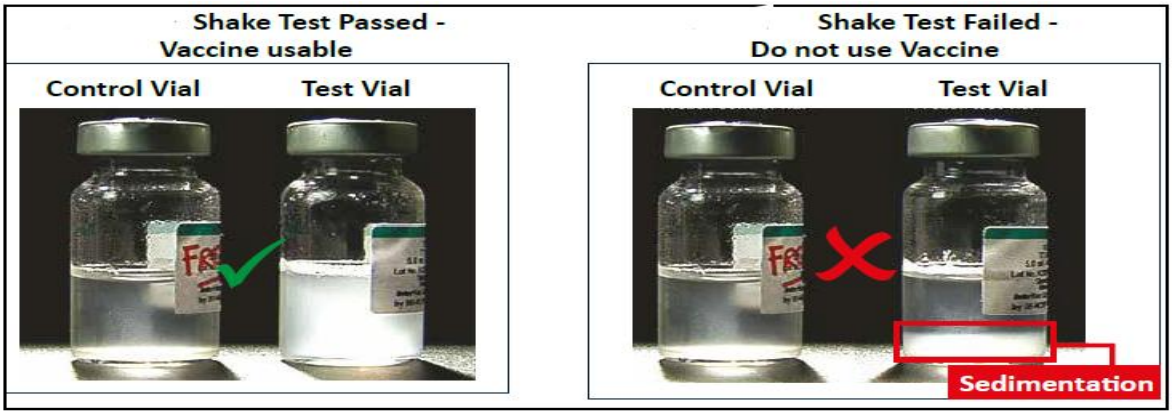
- Take a vaccine vial you suspect that may have been frozen – This is "TEST" vial.

Shake -- Test Control vial

- Take a vaccine vial of the same antigen, same manufacturer, and same batch number as the suspect vaccine vial you want to test.
- Freeze solid this vial at -20°C overnight in the DF, and this is the 'CONTROL' vial and label accordingly to avoid its usage.
- Let it thaw. Do NOT heat it.
- Hold the Control and the Test vials together between thumb and forefinger, and vigorously shake the vials for 10-15 seconds.
- Place both vials to rest on a flat surface, side-by-side and observe them for 30 minutes.
- Compare for rate of sedimentation.

- If the sedimentation rate in the 'Test vial' is slower than in the 'Frozen vial', the vaccine has not been damaged, it has passed the shake test. Use the vaccine batch – it is not damaged.

- If the sedimentation rate is similar in both vials or if sedimentation is faster in the 'Test' vial than in the 'Frozen' vial, the vaccine is damaged, it failed in shake test.



The EVM Global Data Analysis 2009-2015 by WHO regarding the temperature monitoring shows:

- Apart from European (EUR) and Americas Region (AMR), few countries meet the EVM standard for temperature monitoring, at any level.
- In EUR, more than 50 per cent of assessed countries meet the standard at LD and/or SP levels.
- Very few of the national (PR) stores assessed in most regions meet the EVM standard for temperature monitoring[6].

National EVM India 2013 was 54 per cent for these criteria with major findings as follows:

- Good quality thermometer were not available in all the visited centers
- Temperature monitoring was not done on Sundays and holidays
- Booklet for manual temperature recording was not available at all the centers.
- Continuous temperature monitoring system was not working well in more than 70 per cent of visited sites.
- Functioning alarm system was not available at many of the visited sites.[7]

National EVM India 2018 was 72 per cent for these criteria with major findings as follows:

- Temperature recorder traces/logger not matching with the manual temperature log books (more than ± 2 degree C difference) in more than 70 per cent of the assessed stores.
- Stores temperature log books and alarm events formally NOT reviewed in more than 50 per cent of the assessed stores.
- Out of the total stores assessed for alarm events, documentation of alarm events was found only in 20 per cent of the assessed stores[8].

The knowledge and practices of VCCH's in temperature maintenance in government HFs of Delhi had never been assessed using standard EVM tool except those of state vaccine store during National EVM Assessment 2013. So, this study was proposed with an objective to ascertain the knowledge and practices of VCCHs on temperature maintenance of cold chain in government health facilities in a district of Delhi.

Methodology

It was a cross-sectional descriptive study. Out of the 11 revenue districts in Delhi, one of them was selected by simple random sampling. The sampling unit for the study were HF's which were storing and maintaining the vaccines in Cold Chain. These are also called Cold Chain Points (CCP's). All VCCHs in the selected HFs were part of the study. The number of HF's / CCP's in the selected district to be assessed was determined using sample size reference table available in WHO-UNICEF EVM site selection tool version 1.7[8]. For determining the sample size 90 per cent Confidence Interval and 10 per cent precision level was used. For identification of the HF to be assessed, probability proportional to target population was used as suggested in the WHO-UNICEF EVM site selection tool. Total sites identified for assessment using the site selection tool were 22. During data collection in these 22 identified HFs, it was found that majority of them were using the domestic refrigerators for vaccine storage and ice packs preparation, which are not recommended by WHO. Moreover, the state government was distributing ILR's to the selected district during data collection for this study, so purposively additional 7 more HF's were assessed to get a better picture on knowledge and practices of VCCHs on temperature maintenance. So, a total of 29 HFs were assessed. Along with these HFs, the District Vaccine Store (DVS) was also assessed. The total number of VCCH in the selected sites were 61.

WHO-UNICEF EVM tool version 1.0.9 was used for the data collection and analysis. The tool was downloaded from the EVM website (https://extranet.who.int/evm/). The basics of the EVM tools were learned through online EVM training course under guidance of nodal officer of National Cold Chain and Vaccine Management Resource Centre (NCCVMRC). The EVM course was pursued on EVM e-learning website. The tool has comprehensive structured questionnaire for assessment of ISC. Questions in context of knowledge and practices of VCCH on temperature maintenance in the tool were used for the present study. Both primary and secondary data were collected. The primary data were collected through demonstration and interview of VCCHs. Secondary data were collected through temperature records available at the CCPs / HF. The data were collected in between 12th December 2018 to 09th March 2018.

Findings

The score for EVM criteria "Temperature" was below WHO-UNICEF recommended standard of 80 per cent both at DVS level and HF level (77% and 48% respectively). There were total of 43 functional electrical CCE's for vaccine storage in the assessed sites (21 small ILR's + 1 small Deep Freezer + 21 Domestic Refrigerator). The details of available temperature monitoring device in different types of CCE's is presented in table No 1.

TABLE 1
Temperature Monitoring Devices available in Different Vaccine Storage Equipment

Thermometer	Functional Equipment for Vaccine Storage (n=43)			Total No. of thermometer available in the CCE's, N=43(%)
	ILR (n = 21)	Domestic Refrigerator (n= 21)	Deep Freezer (n=1)	
Dial Thermometer	0	6	1	7 (16.3%)
Stem Thermometer	21	11	0	32 (74.3%)
Digital Thermometer	0	2	0	2 (4.7%)
Continuous Temperature Recorder / 30 day refrigerator logger	0	0	0	0 (0%)
No temperature recording device	0	2	0	2 (4.7%)

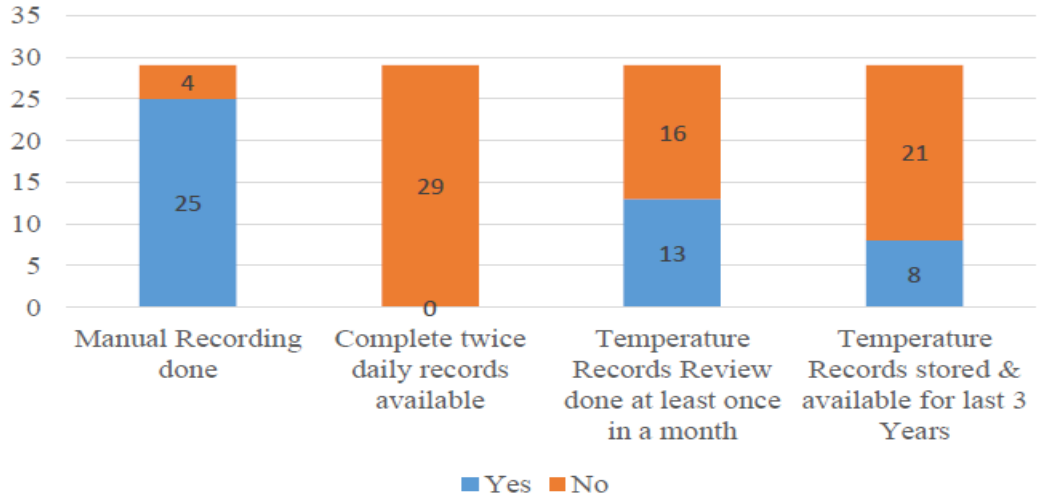
Standard temperature recording format having the space for entering alarm event was not available at any of the assessed site.

There were 2 VCCHs in DVS (1 primary who is directly responsible ISC and 1 secondary VCCH who looks after ISC in absence of primary VCCH). The VCCHs in the DVS had correct knowledge for temperature ranges for vaccine in the schedule, heat and freeze sensitive vaccines, and Vaccine Vial Monitor (VVM). There were 59 VCCHs in the visited 29 HFs (one primary VCCH in each HFs, some have no secondary VCCH, some have 1 or 2 secondary VCCH). Out of 59 VCCH, 58 (98.3%) of them were aware of correct temperature range for the vaccine in schedule, 36 (61%) of them were aware of the heat and freeze sensitive vaccines and 52 (88.1%) of them have correct knowledge of how to read VVM.

In DVS, VCCH was doing the manual temperature recording but not maintaining complete twice-daily everyday record. Temperature records were reviewed periodically by the primary VCCH. Last three years temperature records were not available with primary VCCH. The VCCH demonstrates the correct way of reading the temperature from available temperature recording device.

In HF's, findings for practices of primary VCCH are presented in Figure 1

FIGURE 1
Practices of Primary VCCH at HF level

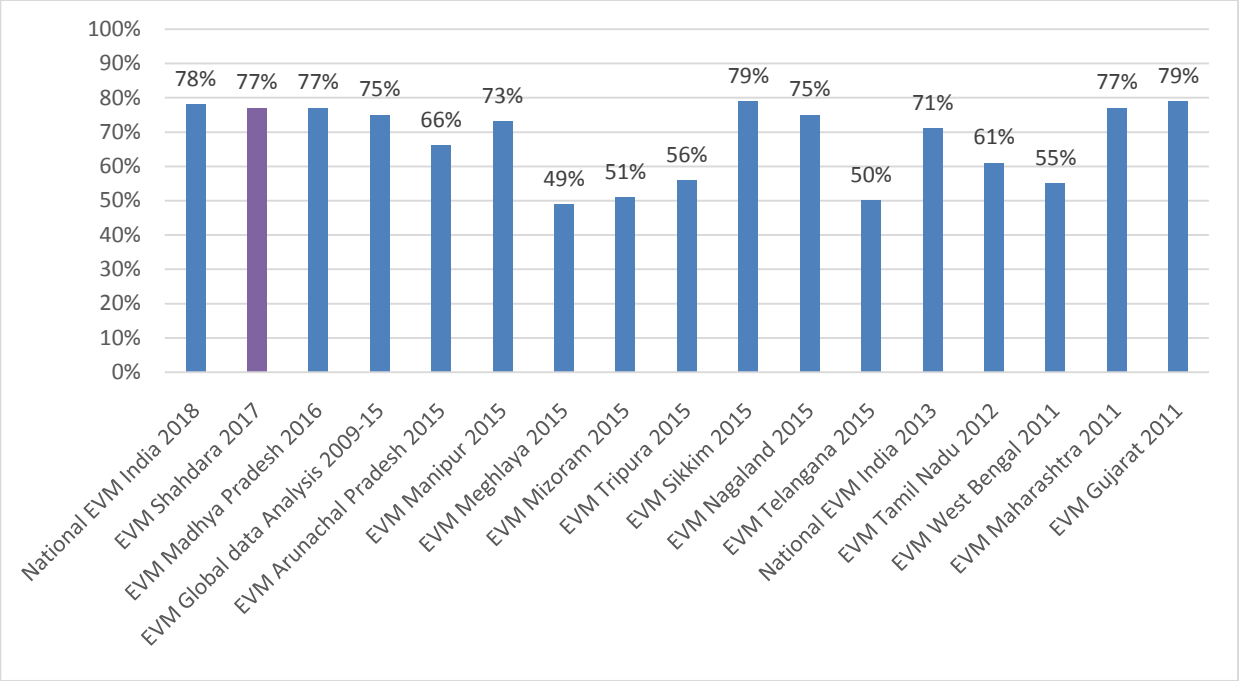


None of the primary VCCH's in HF's were maintaining the complete twice daily monitoring of temperature and in 4 (13.79%) HF's there was no manual temperature recording by the VCCH. In the assessed district, there was no monitoring of temperature on Sundays and Holidays. The correct way for reading the temperature from available recording device was demonstrated by 42 (71.2%) out of 59 VCCH's.

Discussion

Comparison of the score for the criteria "Temperature" at DVS level is presented in Figure 2

FIGURE 2
EVM score for Criteria Temperature at DVS Level in Different EVM Studies



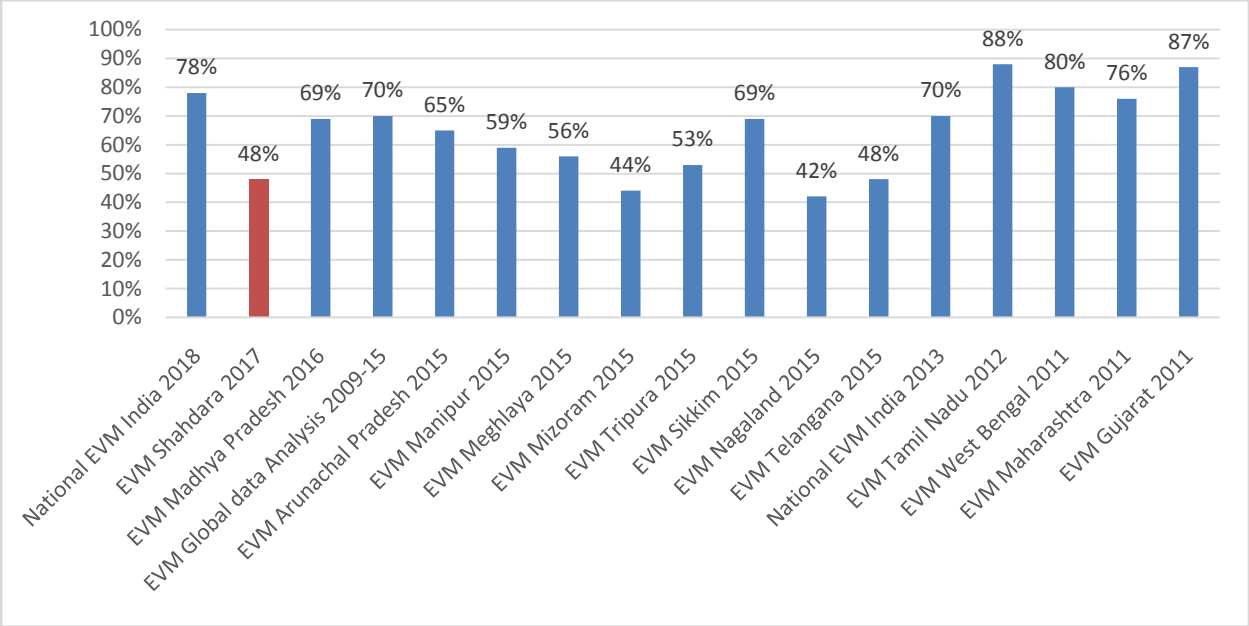
At DVS level, the score for criteria "Temperature" in the assessed district of present study, National EVM India 2013[7], EVM Global data analysis[6], EVM of Madhya Pradesh 2011[10] and 2016[11], EVM Manipur 2015[12], EVM Sikkim 2015[13], EVM Nagaland 2015[14], EVM Gujarat 2011[15] and EVM Maharashtra 2011[16] were more than 70 per cent but none of these EVMs had met the recommended score.

The scores in the assessed district were better in comparison with EVM West Bengal 2011[17], EVM Tamil Nadu 2012[18], EVM Meghalaya 2015[19], EVM Mizoram 2015[20], EVM Tripura 2015[21] and EVM Telangana 2015[22].

In the assessed district, it was found that temperature monitoring not being done on Sundays and Holidays, there was non-availability of continuous temperature recorder and records not being maintained for the recommended duration of 3 years. The findings especially twice daily temperature monitoring being not done and lack of cDTR were in line with findings of the National EVM 2013[7]. Incomplete manual records were also found in EVM Mizoram 2015[20], EVM Arunachal Pradesh 2015[23], EVM Madhya Pradesh 2011[10]& 2016[11], EVM Meghalaya 2015[19], EVM Gujarat 2011[15] and EVM Maharashtra 2011[16].

Comparison of score for the EVM criteria "Temperature" at HF level is presented in Figure 3

FIGURE 3
EVM Score for Criteria Temperature at HF Level in Different EVM Studies



In HF's, the score for this criteria was below 50 per cent in the assessed district. Similar scores were found in EVM Mizoram 2015[20], EVM Nagaland 2015[14] and EVM Telangana 2015[22]. In EVM West Bengal 2011[17], EVM Tamil Nadu 2012[18] and EVM Gujarat 2011[15], the criteria had met the recommended standard.

National EVM India 2013[7], EVM Global data analysis[6] and EVM's of Madhya Pradesh 2011[10]& 2016[11], Arunachal Pradesh 2015[23], Sikkim 2015[13] and Maharashtra 2011[16] had not met the recommended standard but scored more than 65 per cent.

The main reasons for the poor performance of criteria "Temperature" in HFs of assessed district were absence of complete twice-daily temperature monitoring and no monitoring in 13.8 per cent of the visited HF's. The temperature records were not reviewed in 55.7 per cent of assessed HFs. Similar findings were observed in EVM Mizoram 2015[20] and EVM Nagaland 2015[14] where incomplete temperature records were found in all HF's with no temperature records review. The temperature records were found to be reviewed at HF level in EVM's of West Bengal 2011[17], Tamil Nadu 2012[18]and Gujarat 2011[15]. Standard temperature recording format was found available in all HF's during EVM assessment of Tamil Nadu 2012[18] while in the assessed district of present study the standard temperature reporting format was not available in all HFs.

Last three years temperature records were not available in 72.4 per cent of HFs. Similar findings were observed in EVM assessment of Meghalaya 2015[19], Nagaland 2015[14], Manipur 2015[12], Arunachal Pradesh 2015[23], Mizoram 2015[20], Gujarat 2011[15] and Maharashtra 2011[16].

Conclusions and Recommendations

Temperature maintenance was not up to the recommended WHO- UNICEF EVM standards. It requires the upgradation of knowledge of temperature ranges and correct way of taking the readings. The practice of manual monitoring the temperature twice daily needs to be improved with proper monitoring and supervision. It is recommended to

- Ensure temperature monitoring on Sundays and holidays. Concerned administrative authority should delegate this responsibility to a regular employee in writing.
- Standard temperature recording format to be made available from district headquarters, NHM (National Health Mission) in all vaccine stores.
- Stem thermometer availability should be ensured at all the Cold Chain Points.
- Continuous temperature recorder / 30-day refrigerator logger are of paramount importance for the cold chain maintenance. These should be procured and installed at each level of vaccine stores. E-VIN already being implemented in several states, may be expanded in Delhi too to provide the real time information on temperature across different cold chain points.
- Develop supportive supervision for cold chain and vaccine management (Supportive Supervision Checklist developed by the MoHFW, GoI in collaboration with UNICEF, can be used for cold chain supervision in the district)

The ethical committee of NIHFW had granted clearance for this self-sponsored study which is free from any conflict of interest.

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Strengthening the Sustainable Development Goals by Interlinking Household Energy Issues- A Review

Vaishali Bhole*

Abstract

Recently adopted Sustainable Development Goals (SDGs) by the United Nations are important for ensuring food, water and energy security in a way that does not undermine sustainable development for future generations. Household energy is closely linked to many of the SDGs, though there is one goal exclusively on energy. Nearly half of the deaths among children under five years of age from acute lower respiratory infections (ALRI) across the world are due to Household Air Pollution (HAP) resulting from burning of solid fuels. According to WHO report 2016, 3.8 million people die every year globally from HAP. Also, fuel gathering consumes a considerable time of women and children, limiting other productive activities and taking children away from school. 'Energy poverty' limits other opportunities for socio-economic development. Additionally, non-renewable harvesting of biomass also contributes to deforestation and climate change. This leads to the slowing down of SDGs attainment. Improved energy services can reduce child mortality rates, improve maternal health, and reduce the time and transport burden on women and young girls so that they have more time for education and other productive works. This will also reduce the pressure on fragile ecosystems. This review attempts to study the linkages between household energy issues and other non-energy SDGs for achieving the SDG7 (Energy) targets.

Key words: Sustainable Development Goals, Household Energy, Household Air Pollution, Biomass Fuels, Health.

The Sustainable Development Goals (SDGs), also known as the Global Goals, are a universal call for an action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. These goals are built on the success of the Millennium Development Goals (MDGs), while including new areas such as climate change, economic inequality, innovation, sustainable consumption, peace, justice, etc. The goals are interconnected and therefore, success of one will simultaneously include tackling issues associated with another goal. The 17 SDGs cover everything from energy, climate, water, food, ecosystems, health, poverty, jobs and innovation among several other objectives[1]. This represents a major step forward from the MDGs, which were silent on a number of these dimensions, notably energy. Energy is dealt with primarily by Sustainable Development Goal # 7 (SDG7), whose overarching aim is to 'Ensure access to affordable, reliable, sustainable and modern energy for all'.

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The proportion of households relying mainly on solid fuels for cooking has decreased from 62% (95% CI: 58, 66%) to 41% (95% CI: 37, 44%) between 1980 and 2010. Yet because of population growth, the actual number of persons exposed has remained stable at around 2.8 billion during three decades[2,3]. As per the the Indian National Census 2011, around 780 million people are estimated to be using solid cooking fuels out of which nearly 99% is biomass[4]. Globally, 3.8 million deaths were attributed to household air pollution (HAP) in 2016, almost all in low and middle income countries. LMIC and the IHME ranked HAP as the 8th leading mortality risk factor globally in 2016 and, combined with ambient air pollution, the leading environmental risk factor. It was the 10th leading risk factor for disability-adjusted life-years (DALYs), a measure of the years of healthy life lost[5]. National exposure models developed for solid fuel using household estimates daily average PM 2.5 (particulate matter less than 2.5µm in aerodynamic diameter) exposures of 337, 204, and 285 µg/m^3 for women, men, and children, respectively[6] (greatly in excess of the current World Health Organization (WHO) air quality guideline (WHO-AQG) values[7]. Together, the exposure and disease burden estimates provide a compelling argument to intensify the momentum on intervention efforts for reducing HAP levels[8].

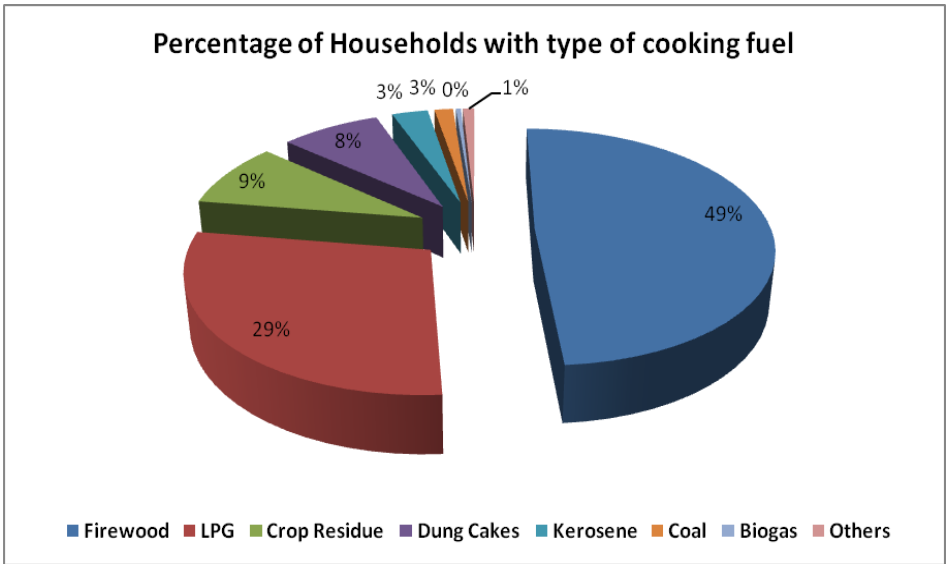
Cooking with solid fuels on open fires or traditional stoves result in high levels of HAP comprising a range of health-damaging pollutants. According to WHO, nearly two million deaths occur due to HAP out of which 27% from Acute Lower Respiratory Infection (ALRI), 20% from chronic obstructive pulmonary disease (COPD) and 8% from lung cancer. In high-mortality developing countries, this neglected health risk is to blame for 3.7% of all deaths, making it the most lethal killer after malnutrition, unsafe sex and lack of safe water and adequate sanitation[8].

Most of the countries have already declared the 17 SDGs and their 169 targets to be 'integrated and indivisible'[9]. While addressing energy access issues, household energy is often neglected in energy policies and poverty alleviation strategies. Linkages, notably between the energy and 'non-energy' SDGs, are still not well understood[9]. Household energy is intimately associated with many of the SDGs, and improvements in access to cleaner energy can make contributions to achieving them. This paper tries to study the linkages between SDGs and household energy to make the inter-linkages understandable and help all the SDGs attainable.

Cooking Fuel Use Scenario

Over the last 25 years, economic development and modernization have allowed households in wealthier parts of the world to switch over to cleaner fuels such as petroleum products (e.g. kerosene, LPG) and electricity. 1.3 billion people do not have access to electricity, around 3 billion people cook and heat their homes using open fires and simple stoves burning biomass (wood, animal dung and crop waste)[10] . Most of rural households burn these solid fuels in inefficient earthen or metal stoves, or use open pits in poorly ventilated kitchens resulting in very high concentrations of household air pollutants. In India (Fig. 1), the latest census data shows that nearly 70 per cent of the households utilize some or other type of biomass for their day to day cooking needs[4].

FIGURE 1
Proportion of Households Using Different Fuels for Cooking [Census of India, 2011]



Linkage between Household Energy and the SDGs

The inter-linkages between the SDG 7 (Clean Energy) and the rest of the SDGs is crucial for vulnerable people to meet diverse basic services such as access to drinking water and sanitation, health care, education, with important contribution to reduce poverty in all its dimensions. Access to energy implies an increased security contributing to reducing the incidence of violence to women and inequalities between sexes. Equally important, energy use efficiency would decouple economic growth with a significant impact on the environment and at the same time, would improve economic growth. There is an increasing role for women in promulgating clean energy infrastructure development, particularly in rural areas in the Asia-Pacific region which has contributed to new opportunities for economic growth (SDG 8) and greenhouse gas emission reduction. Understanding the linkages between the SDGs will help achieve these goals. Understanding the inter-linkages between household energy issues will help achieve the following other Sustainable Development Goals (SDGs).

Goals 1 and 2 (No Poverty and Zero Hunger)

One of the targets established to measure progress in achieving SDG 1 and 2 is to end poverty in all forms and dimensions by 2030 by increasing the food production without increasing the intensity of water and energy use and environmental degradation. Particularly the poverty-reduction target can only be met if the number of people relying almost entirely on traditional biomass for cooking and heating is reduced to less than 1.85 billion. Yet, according to the International Energy Agency (IEA)'s reference scenario, this number has increased from 2.40 billion in 2002 to 2.55 billion in 2015 and further will increase to 2.63 billion in 2030[11].

Therefore, to accomplish the poverty-reduction target in the light of population growth, governments were required to extend the use of non-polluting or less polluting cooking and heating fuels to an additional 700 million people by 2015. A concerted effort from stakeholders in different sectors at the local, national and international level is required enhance the use of non-polluting fuel in households.

The use of solid biomass fuels for cooking is the largest source of HAP in the world. In many rural regions of developing countries, households depend on biomass fuels such as firewood, dung, and agricultural residues for their basic energy needs of cooking and heating.

Energy underlies all economic activity, thus, represents a pre-requisite for economic development. With respect to household energy, dependence on polluting and inefficient fuels and appliances is both a cause and a result of poverty. Poor households often do not have the resources to obtain cleaner, more efficient fuels and appliances. On the other hand, reliance on simple household fuels and appliances limits opportunities for economic development, continuing a vicious cycle of poverty and reliance on polluting, inefficient fuels[12,13]. Based on the strong link between income and access to energy services- whether at the global or national level, the IEA predicts that this goal can only be achieved if "Governments act decisively to accelerate the transition to modern fuels and to break the vicious cycle of energy poverty and human under-development in the world's poorest countries." Modern energy access is critical to enhance agricultural yields/productivity, decrease post-harvest losses, and mechanize agri-processing; all of which can aid food security[14,15].

Goal 3 (Good Health and Well-being)

Around 3 billion people cook using polluting fuels such as and crop waste) and coal on open fires or in simple stoves. Close to half of deaths due to pneumonia among children under 5 years of age are caused by particulate matter (soot) inhaled from household air pollution[16]. There is ample evidence that HAP due to burning of solid biomass fuels causes health hazards for women as well as children under 5 years of age when they happen to be with their mothers during cooking[17]. These studies quote pieces of evidences from different parts of the world. Reducing exposure to HAP will make a significant contribution to reducing child morbidity and mortality. Exposure of the developing embryo to HP may contribute to perinatal mortality and low birth weight, a major risk factor for a variety of diseases during childhood[18]. The chemical most responsible for retarding intra-uterine growth is believed to be carbon monoxide (CO). Carbon monoxide results from the incomplete combustion of biomass and fossil fuels. When inhaled, it combines with the haemoglobin in the blood to form carboxyhaemoglobin (COHb)– a molecule that does not readily release oxygen to the body. Kitchen fires and kerosene wick lamps are a major cause of burns for infants and toddlers. Adverse pregnancy outcome is the other effect shown to be associated with the use of biomass fuel, including low birth weight that itself is a risk factor for Acute Respiratory Infections (ARI) and prenatal mortality. In rural Guatemala, babies born to women using wood fuel were 63 gm lighter than those born to mothers using gas and electricity, after adjustment for socio-economic and maternal factors[19].

The stress and health impacts due to fuel wood collection and transporting long distance were examined by some researchers. Lori studied women's labour allocation for other family work[20]. Some recent work from South Asia highlights the physical stress that women undergo as the main protagonist of the fuel-wood cycle[21-23]. They focused mainly on respiratory symptoms and the stress in terms of distance travelled by women to collect fuel wood. Parikh (2011)[24] presented a case of Himachal Pradesh in India to establish the linkages among gender, energy use, hardships and health issues. Women especially become victims of a different health hazard due to firewood scarcity[25,26]. In Nepal, a high incidence of uterine prolapse among women is likely to be linked to carrying heavy loads of wood soon after childbirth[27.]

WHO estimates that 22% of all COPD is caused by exposure to household smoke from biomass fire. Incidence of cough, phlegm, breathlessness, wheezing and eye irritation are also significantly higher in households using biomass fuels as compared to those using gas for cooking[28]. It is believed that the toxins from biomass fuel smoke are absorbed and accumulate in the lens of eyes resulting in its opacity i.e. cataract[27].

Several studies show that exposure to household air pollution increases the risk of tuberculosis (TB). With approximately 1.6 million deaths every year, tuberculosis is one of the leading global causes of death. Exposure to nitrogen dioxide, sulphur dioxide and particles can pave the way for infection by bacteria or viruses by damaging the respiratory system's mechanical and immune defense. It increases the susceptibility of lung to pulmonary TB. Persons living in households burning biomass reported pulmonary TB more frequently than persons using cleaner fuels with an odds ratio of 2.58 after adjustment for socio-economic conditions[28]. Smoke from biomass fuels is known to contain several carcinogens and toxic elements.

Goal 4 (Quality Education/Achieve Universal Primary Education)

Resource collection is predominantly a female activity[23,29-32] and is carried out by women belonging to both poor as well as wealthier households[29]. However, women are not the only members in the household involved of the collection of fuel. Children are often active participants. School attendance may be negatively affected by the scarcity of natural resources and the resulting increase in the hours devoted to collection show that children from the most environmentally degraded districts of central and southern Malawi are less likely to attend school[31,33]. With less time spent on fuel collection and lost due to ill health, children will have more time available for school attendance and homework[34]. Better lighting facility allows children to study beyond the daylight hours and without putting their eyesight at risk. Fuel collection imposes a serious time burden on women. Alleviating this drudgery and reducing cooking time through more efficient devices will free women's time for productive endeavours, adult education and child care.

Goal 5 (Gender Equality)

The biomass fuel chain viz. gathering, transportation, processing and combustion is predominantly managed by women where they work as gatherers, processors, carriers or transporters; and also as end-users or cooks[23]. Thus, they suffer health hazards at all the stages[24]. Insufficient access to modern energy and existing patterns of energy use, processing, and collection affect women and men differently. Because of their socially determined gender roles, women and girls assume a higher proportion of the burden of unavailable energy services and inefficient energy use. Women and children often have less access to forest areas in the case of forest reserves and private plantations[36]. The first stage in the chain is the 'search and collection or gathering of biomass' that involves activities like walking up to woods, fields and surrounding areas that have the potential of inflicting bruises, snake bites and insect bites. Involving women in household energy decisions will also contribute to gender equality and women empowerment. Access to energy would expand the number and range of opportunities for women; for example, enabling women to work from home and thereby generating an independent source of income.

Goal 7 (Clean Energy)

Solid fuels are still in widespread use in developing countries and it appears that intervention efforts are not achieving their desired goals. Providing clean household energy solutions in the effort to tackle household air pollution in developing countries can also mitigate the global climate change and help to achieve several of the sustainable development goals[35]. Governments should also seek technical and financial assistance, both locally and externally, to expand LPG production facilities and distribution networks; and to harness their renewable energy potential[38]. These actions will help achieve important sustainable energy and consumption, and climate change targets (SDG 7.1, 7.2, 7.a, 7.b, 12.a and 13.a).

Goal 13 (Climate Action)

Traditional stoves typically have low efficiency. As a result, a large percentage of the fuel energy is lost as products of incomplete combustion. These include the gas methane which has a greenhouse effect many times greater than carbon dioxide (CO_2)[36]. Environmentally sound technologies, such as energy-efficient devices based on renewable sources, can substantially reduce harmful impacts on the environment and human health. Also, substituting fossil fuel energy by renewable in any country of the world, whether rich or poor, will benefit those in poverty by reducing their exposure to climate-related extreme events and other environmental disasters. Earlier Brazil and more recently, India have substantially expanded the use of liquefied petroleum gas (LPG) in their household energy mix, using their own resources, having a major impact on their national energy picture[38]. The net climate impact of such approaches as compared to current biomass stoves can be seen in near future[38]. LPG can be seen as a transition fuel for clean household energy.

Goal 17 (Partnership for the Goals)

Development agendas and partnerships must recognize the fundamental role that clean household energy practices play in economic and social development. The enhanced global partnership for sustainable development, led by governments, can be a vehicle for strengthening international cooperation for implementation of the 2030 agenda. Multi-stakeholder partnerships and resources, knowledge and skill of the private sector, civil society, the scientific community, academia, philanthropy and foundations, Parliaments, local authorities, volunteers and other stakeholders will be important actors to mobilize and share knowledge, expertise, technology and financial resources[39,40]. This, in turn, may complement the efforts of governments, and support the achievement of sustainable development goals, particularly in developing countries.

Finally, effective promotion and dissemination of improved cook stoves are also recommended. This requires the formation of country alliances for clean cook stoves to seek the engagement of all stakeholders including manufacturers and users and provide a platform for sharing ideas, addressing concerns and collectively setting sector-wide goals and targets. An important forest conservation target (SDG 15.2) will be promoted through implementation of this recommendation.

Conclusion

As household energy is intimately associated with many of the Sustainable Development Goals, improvements in access to cleaner energy can make contributions in achieving other SDGs as well. Addressing household energy issues by including it in the National programmes and policies will help achieve other SDGs such as no poverty and hunger, wellbeing and health, quality education, gender equality, clean energy, climate change and partnership for goals. Nevertheless, reducing levels of household air pollution could contribute to the achievement of most of the SDGs.

TABLE 1

Inter-linkages between the Targets of SDG7 (Energy) with Other Non-energy SDGs

SDG	Supporting Literature	Interlinkage Identified	Significance
Goal 1 No Poverty	Kammen (2010); Pachauri et al. (2012) Cameron, C. et al.(2016) Casillas, C. E. & Kammen, D. M(2010)	Access to modern energy forms (electricity, clean cook-stoves,) is fundamental to human development since the energy services made possible by them help alleviate chronic and persistent poverty. Modern energy access can also help to free up resources (e.g. men, money). To accomplish the poverty-reduction target in the light of population growth, governments need to extend the use of non -polluting or less polluting cooking and heating fuels to an additional 700 million people by 2015.	High
Goal 2 Zero hunger	Smith et al. (2013); Smith, P. et al. (2014) Acheampong, M et al (2018)	Modern energy access is critical to enhance agricultural yields/productivity, decrease post-harvest losses, and mechanize agri-processing - all of which can aid food security. The introduction of best-practice production methods, such as rice intensification, in non-bio energy agriculture can reduce energy demand in the agricultural sector.	Medium
Goal 3 (Good Health and Wellbeing)	Siddique, A.R Ezzati, M., Kammen(2002) Boy, E. et al.(2002)	Access to modern energy services, including renewables, can contribute to fewer injuries and diseases related to traditional solid fuel collection and burning and to the utilization of kerosene lanterns. Promoting most types of renewables and boosting efficiency greatly aid the achievement of targets to reduce local air pollution and improve air quality Utilization of biomass and bio fuels will improve, household air quality significantly	Very High
Goal 4 (Quality Education/Achieve Universal Primary Education)	Mahat. I(2006) Nankhuni, F. and Findeis, J. (2003). WaguraNdiritu, S. and Nyangena, W. (2010).	Improved access to electric lighting can improve women's safety and girls' school enrollment. Cleaner cooking fuel and lighting access can reduce health risks and drudgery, which are disproportionately faced by women. Access to modern energy services has the potential to empower women by improving their income-earning, entrepreneurial opportunities, autonomy and reducing drudgery. Participating in energy supply chains can increase women's opportunities and agency and improve business outcomes	Very high
Goal 5 (Gender Equality)	Parikh, J Cooke, P. (1998b).	Access to modern energy will make women free of processing, and collection of solid fuel and will free them number and range of opportunities for women, for example enabling women to work from home and thereby	Hugh
Goal 7 (Clean Energy):	PMUY 2016 Smith 2018	Providing clean household energy solutions in the effort to tackle household air pollution in developing countries can also mitigate global climate change and help to achieve several of the sustainable development goals.	Very high
Goal 13 (Climate Action):	IPCC (2011); Jose Goldemberg et al Riahi, K. et al.(2015) Riahi, K. et al.(2018)	Development agendas and partnerships must recognize the fundamental role that clean household energy practices play in economic and social development. The enhanced global partnership for sustainable development. Providing universal access to modern energy services by 2030 is fully consistent with the Paris Agreement	Hugh
Goal17(Partnership for the Goals)	UN2015 (Kalfagianni and Pattberg 2011;	Institutionalized interactions between global and local actors, which aim to achieve common goods such as SDGs. Political will, coherent governance, and strong formal partnerships between public sector, private sector and civil society actors are key ingredients in achieving goals such as the SDGs	High

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