Cardiovascular Disease (CVD) surveillance and health promotion in Industrial settings:
A module for CVD surveillance and health promotion

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1: Public health surveillance system

Public health surveillance is defined as "the ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding health-related events for use in public health action to reduce morbidity and mortality and to improve health." Comprehensive and accurate disease surveillance systems are critical to the success of efforts to reduce the burden of CVD. Such systems are particularly important in identifying emerging trends, such as the rise in prevalence of obesity, diabetes mellitus; regional and subgroup differences in the decline in myocardial infarction incidence; or the rise in hospitalizations for CVD etc . Comparison of trends across subgroups also helps to identify groups at particularly increased risk or that fail to benefit from overall improvements in prevention and treatment.

A carefully developed surveillance system will help in forecasting the challenges before the health system and determining priorities for addressing them efficiently. In addition, reliable and timely data can provide the basis for appropriate policy interventions in order to further aid both primary and secondary prevention. Surveillance will provide the data required for effective public policy, allocation of preventive resources, developing capacity, allocation of medical services, allocation of research resources and evaluation of control/prevention strategies.

Reliable surveillance data are essential for identifying public health priorities, tracking the progress of preventive efforts, and intensifying efforts in areas of special need. The key characteristics of reliable surveillance systems can be grouped into 3 areas: the validity of the data produced, the utility of the resulting information, and the feasibility of implementing the system itself. It is particularly important for the surveillance system to have sufficient flexibility and nimbleness to enable the incorporation of important new measures in a timely manner.

1.1 Need for cardiovascular disease surveillance system in India

The strategies, methods, tools and results of an industry-based surveillance system for CVD are presented in this module. Three aspects are addressed, the context in which the surveillance is applied; the theory supporting behavioural risk factor surveillance; the perspectives, goals, solutions and lessons learned from surveillance.

Cardiovascular disease (CVD) is the single largest cause for mortality and morbidity in the world. The overall burden continues to grow in both developed and developing countries, but there are distinct differences in pattern of growth between the two. Almost 2.6 million Indians are predicted to die due to coronary heart disease (CHD), which constitutes 54.1% of all CVD deaths in India by 2020. Additionally, CHD in Indians has been shown to occur prematurely, that is, at least a decade or two earlier than their counterparts in developed countries. Demographic and health transitions, gene-environmental interactions and early life influences of fetal malnutrition are the likely causes of increased CVD burden in India. However, we do not have a surveillance system to understand the trends in burden of CVD and its risk factors in India.

Surveillance needs at various levels may serve different purposes, but all components of the system should be designed to best inform the strategies for preventing CVD that are best implemented at that level. Surveillance data are also critically important at both the state and local level to develop, implement and evaluate any programme on CVD prevention and control. This is more important in India as ‘health’ is a state subject in the Indian federal system of governance. State and local public health agencies require relevant surveillance data, specific to their state or local area, to use in developing and seeking funding for targeted intervention programs, informing policy makers and guiding policy decisions, and planning and evaluating programs. For example, data are needed to inform state and local decision makers about the impact of current and future policies pertaining to school nutrition and physical education programs, tobacco taxes and other control policies, and, as well as other prevention programs. Because funding for CVD prevention programs is low relative to the public health burden of these diseases in most states and local areas, public health agencies must carefully prioritize their preventive efforts and continually evaluate ongoing programs to assess and improve their impact. State or local populations at particularly high risk for CVD can be identified and targeted for intensive interventions that may not be feasible or efficient on a broader scale. State and local public health agencies cannot design, implement, and evaluate such programs without relevant, reliable, accurate, and timely surveillance data.

At the national level, CVD surveillance systems should inform policies likely to be set nationwide and have an impact on CVD, such as agricultural subsidies, state tobacco taxes and other tobacco control policies, practice guidelines promulgated by scientific and governmental organizations, and drug or device safety issues addressed by other agencies. Nationally available data should also permit comparisons between countries, particularly because such comparisons can inform national health policy.

1.2: Advantage of settings based approaches for CVD surveillance and health promotion.

The surveillance data are needed to help countries develop, implement and evaluate their prevention and control programmes. In developing countries, all within an epidemiological mosaic where infectious and communicable diseases coexist, with limited capacity to conduct surveillance, low priority given by decision-makers, lack of resources, scarce utilization of information, competing priority between chronic, infectious diseases and risk factors surveillance, compiling relevant data on CVD risk factors and their outcomes from the general population is almost impossible.

In order to achieve the goal of obtaining national CVD incidence and outcomes data, new data strategies and strategies to optimize existing systems need to be implemented. The need to create surveillance systems that go beyond data release and generate useful, relevant and accessible information has been widely recognized. To reach this goal the design and implementation of surveillance systems should consider not only technical issues but aspects that guarantee their sustainability and utility are more important (the utilization of surveillance data for resource allocation and planning of health programs and interventions). Technical, management and political approaches involving new partnerships, new ways to involve different stakeholders in the process, new methods and tools, ways to overcome resource restrictions and to improve surveillance effectiveness, have to be achieved. The new strategies should make surveillance socially more responsible, relevant and effective; not only for reporting, but also for its contribution to produce the needed health changes.

1.3: Establishment of sentinel surveillance system in Indian industrial population and the lessons learned

Sentinel surveillance is a monitoring method that employs a surrogate population for a public health problem, allowing estimation of the magnitude of the problem in the general population. In this method selected population samples chosen to represent the relevant experience of particular groups. This method is cost effective and is suitable in low resource settings. The advantage of such a system is that the reporting biases are minimized and feedback of information to the providers is maximized. The system will provide more valuable information and detailed information than the traditional notification system. Several carefully chosen sentinel sites are required in each region to obtain a nationally representative data. Ideally these surveillance sites should be attached to public health training institutions so that critical decisions can be made about the choice of risk factors to be measured and when to include disease endpoints.

1.31: Benefits of initiating CVD sentinel surveillance programmes in industries.

- Most the industries have a Pre-existing health care infrastructure, which makes them suitable for developing a sentinel surveillance system without much investment on building infrastructure and man power. Another advantage is that we can assure the follow-up and treatment for participants with high risk.

- They form a stable surrogate community for surveillance unlike general population where continuous monitoring of risk factor will be more expensive.

- Defined and accessible target population. The target population is well defined and accessible for intervention.

2.0: Preparatory steps

Ten medium-to-large industries (defined as industries employing 1500-5000 people) in the organized sector were selected from different sites spread across India, from both public and private sectors, based on their willingness to participate in the study and proximity to an academic medical institution. Ten medical colleges designated as study centres were twinned to each of these selected industries. Faculty members from various departments (Medicine, Cardiology, Preventive Medicine, and Biochemistry) constituted the study team in each medical college. At each study site, the team was headed by a Principal Investigator (PI) and supported by a biochemical investigator (BI) from the medical college and an Industrial Medical Officer (IMO) who represented the industry. They were assisted by a research team comprising of medical and non medical staff. They acted in concert with the medical officers and other health personnel in each industry to conduct the field study and establish the regional database.

2.10: Baseline evaluation

2.11: Health survey of staff/personnel in the setting

All the employees and their family members between the ages of 10-69 were eligible to be included in the surveillance. At each participating centre, detailed data were obtained from randomly selected 800 employees and their eligible family members. We expected a total of 2400 individuals from each centre to participate in this study with at least 200 individuals in each decile starting from 10-19 years till 60-69 years. Since we did not collect blood samples from individuals aged 10-19 years (due to ethical reasons) we have not included their data in this report. From the remaining 2000 individuals we chose 1000 individuals per centre aged 20-69 years by stratified random sub-sampling for adequate representation of all age deciles and sex groups. If a particular stratum did not attain the requisite number in the initial randomization, that stratum was purposively over sampled to include additional eligible participants to attain the required cell size. Thus we expected 20000 individuals from 10 centres to provide demographic and clinical data and 10000 individuals to provide biochemical data.

2.12: Measurement

Written informed consent was obtained for every study participant. Blood was collected after an overnight fast of 10-12 hours. Blood pressure (BP) was measured using automated BP monitoring equipment (Omron MX3). The prescribed procedure for measuring blood pressure, as detailed in the instruction manual of the Omron MX3, was followed. A standard stadiometer was used to measure the height and an electronic weighing machine was used to measure the weight. A standard tape measure was used for measuring waist circumference (WC) while subjects were lightly clothed. Measurement of WC was taken at a level midway between the lower rib margin and iliac crest in centimeters (cm) to the nearest 0.1 cm. Weight measurement was taken (to the nearest 0.1 Kg) without shoes or any heavy outer garments, with the subject standing still on the weighing scale and weight equally distributed on each leg. Height was measured (to the nearest 0.1 cm) in conjunction with weight measurement, without shoes and with the subject in an erect position against a vertical surface, and with the head positioned so that top of the external auditory meatus was level with the inferior margin of the bony orbit.

2.13: Laboratory Techniques and biochemical standardization

The Department of Cardiac Biochemistry at All India Institute of Medical Sciences (AIIMS), New Delhi was responsible for biochemical standardization at each site and coordination of the biochemical component of the surveillance program. Glucose was analyzed by means of glucose oxidase method (GOD-PAP, Randox). Cholesterol estimation was by CHOD-PAP and triglycerides by GPO-PAP method (Randox). HDL was estimated by the precipitation method using phosphotungstate/Magnesium chloride. The method entails precipitation of Apolipoprotein B (Apo B) containing lipoproteins followed by estimation of cholesterol in the supernatant by enzymatic method. All estimation kits and quality control materials, required for analyses by the centers, were sent from the coordinating lab, to minimize variation. Both internal and external quality assessment procedures were conducted at all participating laboratories regularly along with validity checks to ensure accurate and consistent results. For quality assurance, different levels of internal quality controls were run with each batch of samples. The inter and intra assay coefficient of variation of the individual laboratory was less than 2 and 3 % respectively for glucose and cholesterol estimations, and less than 2.5 and 3.5% respectively for triglycerides and HDL- cholesterol (HDL-c) estimations. For external validation, lyophilized samples were sent from the coordinating laboratory once in a month to all the participating laboratories. Ten percent of samples selected randomly from all the centers were also re-analyzed in the coordinating lab as an additional quality assurance measure. The coefficient of variation (CV) was less than 5% at all instances, except for HDL-c measurements at one of the centers (Bangalore). The HDL-c from this centre was re-analyzed at the coordinating center.

2.14: Methods for data analysis and reporting

A simple data entry interface was developed for data entry for each important variable. Further, these interfaces were merged together by another computer application. The data entry interfaces were enabled with 'data limits' and automatic 'validity checks'. I.e., if a variable exceeds the normal limit, the application will give a warning signal and the data entry person will be asked to review the data once again and confirm the entries. Further, all variables were checked after the complete data entry by running the 'frequency function'. Distributions graphs and box plots were developed for each variable using special statistical softwares like SPSS for windows and SAS 9.o for windows. As a standard practice a source data verification of 10% of data entry was also done to understand the quality of data. All possible errors were double-checked with the source CRF and amendments made accordingly. The data were then analyzed using the same statistical software.

The data was presented as mean/prevalence distributions in men and women across various age groups. Please check the following article for more details of presentation of preliminary results.

Bulletin of the World Health Organization 2006; 84: 461-469

3.0: The need for health promotion Interventions

The *Global Burden of Disease* study demonstrated that chronic diseases are leading cause of death in many regions of the world and that most adults in developing countries have non-optimal blood pressure, high blood glucose and abnormal blood cholesterol levels. Elevated blood pressure, blood sugar and blood cholesterol are established risk factors of Cardiovascular Disease

(CVD). Further, the relationships of these risk factors with CVD are direct and continuous from relatively low levels. Additionally, tobacco consumption in developing countries is alarmingly high. All these risk factors are modifiable through simple lifestyle changes.

Risk factors for CVD operate in a continuum and an arbitrary threshold value for such parameters does not make sense as risk reduction benefits across the range. In addition, majority of events arise in a population from the middle of the distribution (of a risk factor) than from its high end. Further CVD risk factors cluster together and individuals having multiple risk factors experience higher risk than the added contribution of individual risk factors. As a rule the absolute risk of a major CVD event is dependent on the overall risk profile contributed by co-existent risk factors operating in a continuum. The implication is that a small reduction in the population parameters will result in a large reduction in CVD related morbidity, mortality, and disability. Additionally, to achieve greater benefits, intervention programs should address multiple risk factors at the same time.

The strategies for community based programmes should be designed to influence individual behavior change at multiple levels-interpersonal, organizational, community and public policy. Behavioral change, especially population-wide, can reduce the effects of adverse social and environmental conditions. It is also obvious that while trying to change health behaviors of a population, powerful forces such as social, psychological, and environmental conditioning can become obstacles. Since individuals move through varying “stages of change” when modifying their behavior, selected CVD interventions should be tailored according to the target population’s or individual’s readiness to change. Therefore it is important to involve multiple sectors such as work sites, schools, churches, and clinics etc as channels to diffuse the intervention effects to the target community.

The community based approach in CVD prevention is cost-effective due to use of mass communication methods, ability to diffuse information successfully through use of community networks, and potential for influencing environmental, regulatory and institutional policies. A comprehensive approach targeting multiple risk factors and a systematic design to implement and evaluate the process would help us to demonstrate the effectiveness of community health intervention projects for prevention of non communicable diseases.

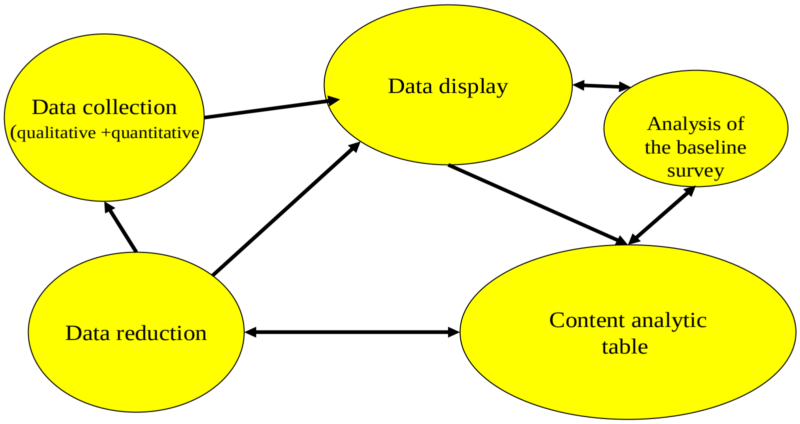
3.1: Health Promotion Interventions in industrial settings

3.11: The underlying principles of health promotion intervention were:

- Multi level influences are important in targeting health related human behaviours. Multiple influences are even more important when multiple health related behaviours are being targeted.
- No single "*model*" fully explains human behaviours. We use a combination of models for developing the conceptual framework and the intervention.
- India thrives with multi-cultural, ethnic, geographical and religious diversity which is further compounded with wide socioeconomic differences which result in wide variations in the health practices and lifestyle behaviours of individuals, families and societies.

An integrated approach combining the *social cognitive learning theory*, the *social network theory*, the *discounting theory, social marketing theory, life- skill training, social skills component and impulsivity in social situations*, was used to develop the thematic concepts of intervention package. The *thematic and scientific content, context* and *presentation* of the material were derived from the *latest research evidence world-wide and qualitative and quantitative data from the target industrial populations.* The factors differentiating the more successful health promotion intervention programs from the modestly successful ones were use of formative research (qualitative research), emphasis on modifying *social norms*, social and physical environment and the use of tools of '*social marketing*'.

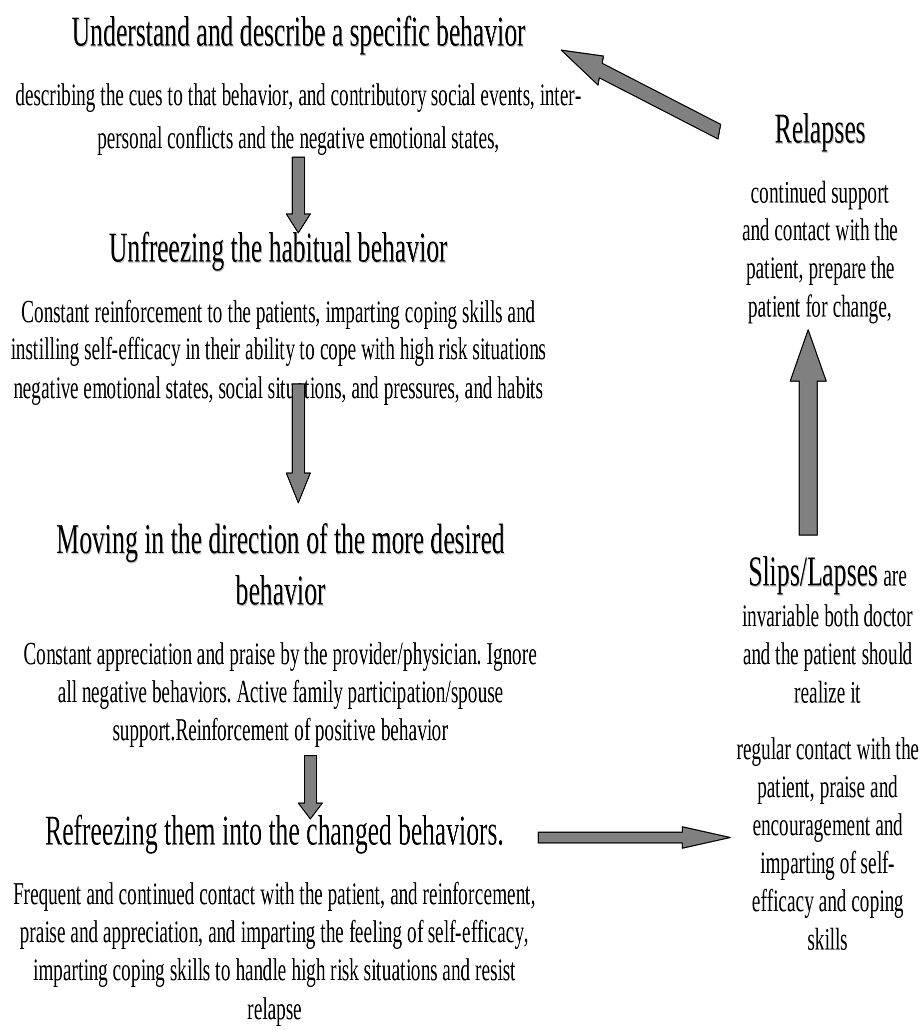
Development of theoretical concepts



The developed theoretical concepts were then communicated to the target population using simple, catchy regional languages through colorful posters, colorful banners, written illustrative booklets/handouts, appointment cards and audiovisual promos on different themes. The intervention materials were highly pictorial as a good proportion of the worksite population are not adept at reading/writing. Changes in the medium were subjected to the inputs received during the formative research. Regular health education classes, film shows, seminars, group discussions and question answer sessions were also conducted. Innovative and culturally suitable approaches to health promotion like contests, cooking lessons, etc were conducted after consulting the management and employee representatives.

Training of supporting staff at the site was important for the success of implementation of intervention strategies effectively at the site. Special training sessions were conducted for them by experts in this field and their work was monitored throughout the programme. Key management functionaries of the site were given responsibility to monitor the onsite activities. Regular feed back from the employees was obtained both qualitatively and quantitatively. These feedbacks were used to modify the intervention package during the course of the study.

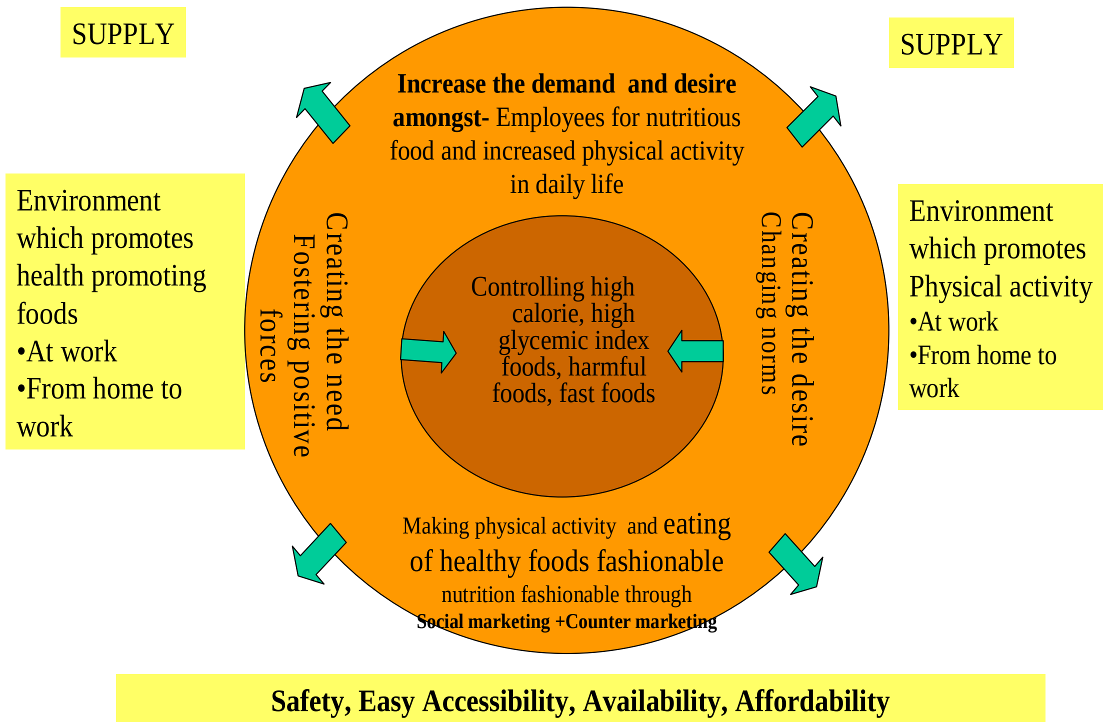
Training personnel at site in behavioral techniques



3.12: Process Measures

After key indicator variables have been identified during the baseline mixed methods assessment, content and context-specific process measures were developed.

Action at Ground Level



3.13: Population wide approach

3.14: Health Education: Health education of industrial workers and their families formed a major component of the CVD surveillance programme. The health education component largely focused on changing unhealthy behaviors and inculcating healthy behaviors related to cardiovascular health based on existing scientific evidences in the target community. Thematic concepts were developed pertaining to physical activity, blood pressure, intake of fruits and vegetables, diabetes, body mass index and heart healthy life using cognitive theory and health belief model. The developed theoretical concepts were communicated to the target population using simple, catchy regional languages through colorful posters, colorful banners, small handouts, appointment cards and audiovisual promos on different themes. Regular health education classes, film shows, seminars, group discussions and question answer sessions were conducted independently in each site.

3.15: Policy level changes

There were some major health policy changes in all participating industries. They were;

(i) Smoke free policy at work place: Tobacco use was banned in six out of the ten industries

(b) Healthier options were also served along with normal menu in three industry canteens

(c) Measures to improve physical activity (Stopping the company bus outside the main gate, restriction of lift use in first and second floor, walking paths inside the company and residential area etc.

3.16: High Risk Approach

All high risk individuals (individuals with hypertension, diabetes, smokers, known CHD or stroke cases etc) were referred to a health care facility for further risk stratification and treatment. Individual and group counseling sessions on diet, tobacco use and physical activity also conducted for those who are with established risk factors.

4.0: Evaluation of interventions

We carried out an intermediate evaluation of our intervention strategy after one year of intervention. As compared to the baseline survey, at the end of one year, self reported overall physical activity levels and fruits and vegetable consumption increased by 17.1% and 36.3% respectively among the study subjects. Almost one third (31.3%) of the study population reported conscious effort to decrease fat consumption since the baseline survey. However, no significant difference in prevalence of tobacco consumption was observed from the baseline survey results.

Similar to the baseline survey, another independent sub sample of the population in the selected seven industries was re-examined again using a structured questionnaire almost four years after the baseline survey. Age group and sex stratified random sampling technique were used to identify individuals in each centre. In total, 6172 individuals participated in the survey (response rate of 93.5%) and biochemical examinations were performed in 5091 (response rate of 77.1%) individuals.

Cross sectional data from the independent surveys showed significant reduction in CVD risk factor levels. In our analysis the cross sectional survey results were complemented by use of follow up data in the same individuals who gave response to the baseline survey. There were significant decline in mean body weight, waist circumference, blood pressure, serum cholesterol, and plasma glucose levels. The mean systolic blood pressure decreased by 6.1 mm of Hg, and diastolic blood pressure by 5.9 mm of Hg. The mean levels of total cholesterol and triglycerides were decreased by 13.4 mg/dl and 9.6 mg/dl respectively. There was a 6.4 mg/dl mean increase in HDL cholesterol level. This would have saved a significant number of individuals in the target community from life threatening cardiovascular events. Overall, in middle-aged populations, a 10 mmHg lower systolic blood pressure (SBP) is associated with a roughly 30 to 40 percent lower stroke risk and 20 to 25 percent lower ischemic heart disease (IHD) risk, a 1 mmol/l lower cholesterol level is associated with about a 15 to 20 percent lower stroke risk and 20 to 25 percent lower IHD risk, and a 2 kg/m2 lower BMI is associated with an 8 to 12 percent lower stroke and IHD risk and an approximately 20 to 30 percent lower diabetes risk.

There could be several reasons for the changes that we observed. These include true changes due to the interventions, changes detected by chance alone, secular changes in risk factors in the general community, and regression dilution bias. However, it is more likely that these changes are true changes because the behavioral changes and the biochemical changes are in the same direction. It is unlikely due to the secular trends as the project duration was relatively short. The difference in outcome measures due to regression dilution effect is minimum and considering the size of the effect it is insignificant.

India being the second largest population in the world, small reduction in the population risk factor profiles will result in a larger reduction of morbidity and mortality due to CVD, thereby saving millions from disability and expenditure on curative measures. Even the human capital in the organized sector itself is huge, almost 400 million workforce in the country, to make an overall national impact. India's vast population size, social, economic and cultural diversities, underscores the importance of developing culturally relevant and context-specific health education strategy tailored to the needs of the population. Additionally, spreading surveillance programms like this in other sectors of the society will provide information on what the important risk factors are, how they should be avoided, and what needs to be disseminated through mass media, health campaigns, and public information systems.

5.0 Sustainability

The programme is now handed over to the existing health care system in these industries. The health promotion programmes are currently being carrying out with help of the health care staff available at the site under the supervision of the chief medical officer. The twinned medical college and the principal investigator at the selected medical college are providing the technical help for development of intervention materials, and its dissemination. They are also helping the industry medical officer in the management of CVD risk factors. All high risk group individuals are being followed up by a specialist in the medical college. Although, the approach is same the intensity of activities are different at different sites. The major set back is lack of availability of funds allotted for organizing similar activities.

6.0: Financial analysis

7.0: Message to corporate employers

These workplace interventions for chronic disease prevention and control are often successful means of improving the health of employees by focusing on risk factors that inhibit productivity and also incur the health and economic burdens. These interventions can lead to large gains; both in the short and long term, for employees and employers by not only improving productivity, reduced levels of absenteeism & employer cost saving, but also create a healthy & positive workplace environment. The changes brought by similar programmes can only last if they become part of the culture of the industry. Results are short-term if changes in behaviour are not embedded in the culture of the company and the community. Therefore, employers must coordinate these efforts inside and outside the workplace. It is important to consider health of employees into the mission, business objective and policies of the organization.

Fighting chronic disease is a difficult task but a step forward to initiative similar programmes in worksites will bring huge rewards; a healthy, productive and energetic workforce. The resources required to initiate such programs are relatively affordable and may be to the tune of 50% of your existing corporate social fund per annum.