Chapter 7:
Translating Prevention Of Diabetes Into Real Life Settings
– The MDRF Experience

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Abstract:
With 366 million people, primarily from low middle income countries, estimated to have diabetes in 2011, preventing diabetes and its complications has now become a global health challenge. Models of primary and secondary prevention of diabetes can be used for the prevention of other NCDs as well since chronic diseases share the same risk factors such as physical inactivity, unhealthy eating habits and tobacco consumption. This paper cites some 'real-world' examples of successful programs for prevention of diabetes at Chennai in southern India. If these models could be replicated in other developing countries, it could significantly reduce the burden of not only diabetes, but other NCDs as well.

Introduction:
Diabetes mellitus is growing in epidemic proportions in developing countries like India with a resultant increase in morbidity and mortality (1). According to the recent Indian Council of Medical Research; India Diabetes (ICMR-INDIAB) study there are 62.4 million individuals with diabetes and 77 million with prediabetes in India in 2011 (2) This figure has been validated by the Diabetes Atlas 5 published by the International Diabetes Federation recently which also predicts that the number would increase to over 100 million by year 2030 (3). Moreover the epidemic is slowly moving from urban to rural areas, from the
affluent to the less privileged and from older to younger people (2 - 5). This has massive economic and social implications and makes a compelling case for prevention of diabetes. Effective preventive strategies are thus the need of the hour. This article will present some successful 'real world' preventive strategies for diabetes in Southern India.

Levels of Diabetes Prevention

The natural history of diabetes is characterized by gradual progression from normal glucose tolerance through impaired glucose tolerance (which includes impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT)) to clinical diabetes and then to the stage of complications (Figure 1). Prevention of diabetes can be done at every stage in the natural history of diabetes (6)

**LEVELS OF PREVENTION OF DIABETES**

- **Primordial prevention**
  - Population approach

- **Primary prevention**
  - High risk approach

- **Secondary prevention**
  - Good control of diabetes

- **Tertiary prevention**
  - Treatment of complications

**Figure 1: Levels of Diabetes Prevention**
Primordial Prevention:

This refers to applying preventive strategies even before risk factors start. For example encouraging the adoption of healthy lifestyle at a very young age to prevent childhood obesity. This will help reduce the risk factors and thereby reduce the risk of future disease.

Primary Prevention:

This focuses on the high risk individuals from a population, i.e. people who have a greater chance of getting the disease. Thus, people having prediabetes (IFG and/or IGT) will be the targeted group for any intervention strategy to be implemented for the prevention of diabetes.

Secondary Prevention:

This refers to the prevention of complications in people already diagnosed with disease. For example in an individual with diabetes, good control of blood sugars right from the time of diagnosis will help to prevent the complications of diabetes.

Tertiary prevention:

This refers to further limiting disability and impairment in people who already have developed some early complications of diabetes. For example, a person who shows early signs of kidney damage due to diabetes can prevent more severe complications such as end stage kidney failure by following a proper medical regime. Laser photocoagulation to prevent blindness due to diabetic retinopathy is another example.

All the levels of prevention are important and complementary. Primordial and primary prevention contribute most to the health of the whole population by preventing the onset of the disease, while secondary and tertiary prevention are focused on restoring the health of the individuals with disease.

Evidence for Primary and Secondary Prevention of Diabetes from Research Studies:

Research studies have clearly shown that type 2 diabetes is a result of a complex interaction between genetic and environmental (lifestyle) factors. The presence of a lag period between normal glucose tolerance and the onset
of clinical diabetes (i.e: the period of prediabetes) provides an ideal platform for targeted intervention within large communities. Evidence based intervention programs for the primary prevention of diabetes have been largely successful when high risk groups were targeted. In the past decade, many trials like the Diabetes Prevention Project (DPP) in the USA have shown that lifestyle modification which includes healthy eating, behavior changes and increased physical activity can help to prevent or delay the onset of type 2 diabetes. The Look AHEAD (Action for Health in Diabetes) trial, another US based trial focusing on secondary prevention, examined the effects of intensive lifestyle intervention on changes in weight, fitness, and CVD risk factors during a 4-year study. Researchers at 16 centers across the United States worked with 5,145 people, with half randomly assigned to receive an intensive lifestyle intervention and the other half to a general program of diabetes support and education. Both groups also received routine medical care from their own health care providers. They showed that compared to usual diabetes support and education, lifestyle intervention can produce sustained weight loss and improvements in fitness, glycemic control, and CVD risk factors in overweight and obese people with type 2 diabetes (7, 8). Although, the Look AHEAD study intervention was stopped early because this did not translate into reduction in the primary outcome which was cardiovascular events, it confirmed other important health benefits of the lifestyle intervention, including decreasing sleep apnea, reducing the need for diabetes medications, helping to maintain physical mobility and improving quality of life (9).

Most of the above studies are from randomised controlled trials (RCTs). Translating the results of RCTs to the 'real-world' is beset with numerous challenges, more so, in lower and middle income (LMIC) countries like India. A recent report on challenges in real life diabetes translation research listed barriers such as patient retention, lack of availability of a multidisciplinary team, lack of awareness (for ex. prediabetes may not be considered a high risk condition or obesity may not be considered a disorder) (10). The report recognized that community participation and grass root level work are important factors for successful implementation of real life translation research projects.

There is very little published data on such community based efforts in prevention of diabetes and virtually none from developing countries. We present below four examples, based on own experience at the Madras Diabetes Research Foundation, Chennai in the implementation of community based translational research in preventing diabetes in southern India.
(1) The Asiad Colony Success Story: The Chennai Urban Population Study (CUPS) was an epidemiological study carried out in two urban residential colonies, one representing a middle income group (Asiad Colony in Tirumangalam) and the other representing the low income group (Bharathi Nagar slum in T.Nagar) in Chennai city, in southern India (11). All individuals aged 20 years and above residing in these two colonies were invited to participate in the study. The study showed a significantly higher prevalence of diabetes in the middle income group (12.4%) as compared to the lower income group (6.5%) (12). Results of the study were discussed with the residents of both colonies. However as the prevalence of diabetes was low in the low income group, only standard lifestyle advice was given to this group. In the middle income group, the need for prevention of diabetes was stressed in the form of various health promotional activities. These included various awareness lectures and distribution of educational material on healthy food options and the need for increasing physical activity. After these awareness campaigns, the residents of Asiad Colony (middle income colony) realized the value of physical activity and built a beautiful park adjacent to their colony, by raising funds through their own efforts. After the park was constructed, not just the Asiad colony residents but even people from the nearby neighbourhoods, increased their physical activity. Thus, this project was a great success with regard to community participation and acceptance of a diabetes prevention program. It significantly increased the awareness about diabetes and also led to an increase in physical activity as the percentage of residents who exercised increased from 14.2% at baseline to 58.7% (in a span of 5-6 years) representing a 300% increase in physical activity (13). The big question was: Did this intervention help reduce or at least slow down the rapidly escalating diabetes rates? A follow up study was done after 10 years to assess the new diabetes prevalence rates in the same two colonies (Figure 2).
Figure 2: Changes in prevalence rates of diabetes in middle and lower income groups in Chennai (2001 – 2010)

As can be seen in Figure 2, during this period, in the lower income group, the prevalence of diabetes had increased from 6.5 to 15.3% (135% increase) whereas in Asiad Colony (middle income group), it had increased from 12.4 to 15.4% (24% increase) (Figure 2) (14). This phenomenon is referred to, as 'prevention of excess gain'. (15) This shows that by a moderate investment of time and effort, the rapid rise in the prevalence of diabetes can be arrested. CUPS is one of the first studies from India to have evaluated the effect of a simple, practical, and feasible lifestyle intervention in a real life setting for the prevention of diabetes using community empowerment in a developing country. The local government subsequently undertook the construction or renovation of nearly 200 parks in the city. (16) This study has been cited as a potential model for prevention of diabetes through community action in developing countries in the WHO publication 'Preventing chronic disease – a vital investment' (17).
2) Prevention Awareness Counseling Evaluation (PACE): The Chennai Urban Rural Epidemiology Study (CURES) was a large epidemiological study on diabetes and its complications, initiated in the year 2001-2002 (18) that showed that only 22.2% of the whole population and 41% of the known diabetic subjects were aware that diabetes could be prevented. Moreover only 19% of whole population and 40.6% of the known diabetic subjects knew that diabetes could cause complications (19). In order to improve the awareness about diabetes, a large scale community based diabetes awareness and prevention program was taken up in Chennai called the PACE (Prevention Awareness Counseling Evaluation) diabetes project (20). Under the PACE project, the following activities were undertaken:

a) **Free public awareness campaign:** Large scale public awareness program on diabetes were held in many places like residential sites, workplaces [banks, factories], places of worship [mosques, temples, churches], public places [shopping complexes, exhibitions, and parks educational institutions [schools, colleges] through lectures and interactive programs.

b) As education has always been an important tool in promoting health, one hundred and sixty four - “PACE Education Counters” were opened in many places in Chennai. Free diabetes educational materials like brochures, booklets, flash cards and posters in both English and Tamil (local language) were distributed to the public. The material was also made available at bookshops, shopping complexes, food chain stores, and family physician clinics.

c) **Mass Media** has always been a successful tool in promoting health to a larger audience. A documentary film prepared on diabetes was telecast in the local television and radio. The messages on diabetes and its prevention were also conveyed using various other media like newspaper, cinema theaters, and mobile phones [SMS (short message service)].

d) **Empowerment of General Practioners** (GPs) – A training program was conducted for GPs who were trained on diabetes management and prevention strategies. The aim of the training was to improve the overall diabetes health care management practice and also increase awareness about prevention. A total of 232 GPs were trained. There was a 20% increase in their awareness scores with regards to diabetes prevention and management, after the program. (21)
The PACE project conducted in the year 2007 showed that 81% of people surveyed had heard of a condition called 'diabetes' compared to 75.5% in 2001-2002 during the CURES survey. Almost 74% of the city residents were also aware that the prevalence of diabetes was increasing as compared to 60.2% reported earlier during CURES. Significantly more people knew that diabetes could be prevented by a combination of diet and exercise. Respondents reporting that obesity, family history of diabetes, hypertension and mental stress could contribute towards diabetes also increased significantly after PACE (p<0.001). More people were also able to correctly identify the main organs affected by diabetes. (22) Through the PACE program, a total of 774 camps were conducted all over Chennai. Overall, 76,645 individuals were screened for diabetes of which 13,340 (17%) were individuals with known diabetes, 2,825 (4%) were newly diagnosed cases of diabetes and 5,738 (7.5%) individuals were found to have pre diabetes. Through the PACE project, over two million people in Chennai were educated about diabetes and its complications, over 76,000 individuals were screened with blood glucose testing for diabetes and 232 general practitioners were trained in diabetes prevention, management and treatment. (20 - 22)

PACE can thus be taken as a model for the conduct of additional, carefully planned and evaluated programs related to diabetes and other non-communicable diseases in developing countries and for the implementation of policies necessary to support such efforts such as India’s National Program for Prevention and Control of Diabetes, Cardiovascular disease and Stroke. (23, 24)

3) Diabetes Community Lifestyle Improvement Program (D-CLIP): Social science research has repeatedly shown that knowledge is only a component of behaviour change. Hence, as a follow up of the large scale PACE program, our next effort focussed on lifestyle modification through behaviour change and empowering the communities involved.

Even though Diabetes Prevention Program (DPP) was hugely successful, very few studies have tried to replicate this model in their respective settings outside the United States. The Diabetes Community Lifestyle Improvement Program (D-CLIP) was taken up by us, as an effort to take diabetes prevention to the community in a 'real-world' setting. D-CLIP uses a stepwise model of diabetes prevention with lifestyle as a continuous approach and metformin added when needed. In the D-CLIP study, individuals with prediabetes were randomized into two arms - an
intervention and a control arm. The intervention consisted of aggressive lifestyle modification through 16 once weekly classes regarding diet and exercise followed by 8 maintenance classes. The classes consisted of the DPP lesson plans that were culturally modified. The control arm received standard care. A unique feature of D-CLIP is its effort to involve members from the community (called 'Dia-ambassadors') in the program along with 'peer support groups' or 'buddy systems' which makes this a sustainable program driven by the community for the community (25). This study which closes out in mid 2013 is already showing promising initial results such as improved metabolic, nutritional and biochemical parameters in the intervention group participants.

Diabetes prevention trials to-date have included only individuals with IGT or individuals with both IGT and IFG. None have addressed the wider, at-risk population with either IGT or IFG alone and especially those with FPG between 100-110 mg/dl. By recruiting people with IGT, IFG, or both, interventions like DCLIP advance the ability to generalize diabetes prevention to a much wider population of people.

4) The Chunampet Rural Diabetes Prevention Project (CRDPP): Majority of India’s population (72%) lives in rural areas, yet most of the diabetes health care facilities are concentrated in the urban areas. Some of the challenges to delivering health care to rural areas include lack of awareness about diseases due to ignorance and illiteracy, lack of trained doctors and paramedical staff, limited access to clinics or public health centers due to problems with transport or infrastructure and poverty. Screening for diabetes is more challenging in rural areas resulting in a larger burden of undiagnosed diabetes, (24) which can consequently lead to higher rates of diabetes related complications due to delayed diagnosis and/or improper treatment. Hence, there is an urgent need for practical, feasible and sustainable prevention and screening programs for diabetes and its complications in the rural community. With this objective, a rural diabetes model called 'The Chunampet Rural Diabetes Prevention Project' or CRDPP was developed with the aim of not only providing holistic diabetes care, but also to take up diabetes prevention through the use of telemedicine. (26)
This project was started in March 2007 by empowering local people. The project was funded by the World Diabetes Foundation, Denmark, and undertaken in a cluster of 42 villages in and around Chunampet in Chithamur block of Kancheepuram district of Tamil Nadu in southern India. The project offers preventive and health care services in diabetes at the aforementioned levels of diabetes prevention:

**Use of Telemedicine in Health care:**

One of the major problems faced by the rural population is the lack of facilities for specialized screening and treatment of diabetes related complications which means that the patients have to travel long distances to the nearest city for this purpose. Use of a mobile unit with a satellite provided by the Indian Space Research Organization (ISRO), appropriate equipment and trained technicians has helped to bridge this gap and ensure increased accessibility to the health services in rural areas. The van is equipped with a digital retinal camera, electrocardiography (ECG), doppler and biothesiometry and is used to screen for the complications of diabetes. Village health workers (VHW) and research assistants (RA) are used to encourage and motivate all individuals with diabetes to undergo screening for complications. Retinal images are sent via satellite transmission to Chennai. Ophthalmologists at the tertiary care diabetes centre at Chennai review the photographs and provide consultations at an appointed time. Employing the VHW’s ensures long term sustainability of the program as this allowed individuals with basic-high school qualification, after undergoing rigorous training in basic health research techniques, to gain employment in their own village. (26 - 27)
Basic infrastructure in mobile van:

- Facilities for screening for diabetes complications (Retinal camera, Snellen visual acuity chart, Doppler, Biothesiometry and ECG)
- V-Sat dish for telemedicine facility
- Video conferencing equipment
- Computers and Laser printers

Personnel

- Trained eye technician
- Trained clinical technician
- Information Technology (IT) assistant
- Dietitian

Figure 3: Telemedicine Van used in CRDPP

With the help of the telemedicine van 27,014 individuals (86.5% of the adult population) were screened in and around the 42 villages of Chunampet. There were 1,138 individuals (4.9%) with diabetes and 3410 with prediabetes (14.6%). The mean glycated haemoglobin levels among the diabetic subjects in the whole community decreased from 9.3±2.6% to 8.5±2.4% within a year. Less than 5% of patients needed referral for further management to the tertiary diabetes hospital in Chennai. (27) Thus, the CRDPP can be used as a model for diabetes prevention and health care delivery in developing countries like India especially in rural areas. (28)
Various modalities were used to spread diabetes awareness in these villages such as the use of the family and self help groups, traditional village performing arts such as dance drama, theme based skits, peer group support and one to one sessions. There were demonstrations on making healthy low cost recipes utilizing locally sourced food materials, awareness programs through puppet shows, skits on diabetes, and diet exhibitions. Villagers were also told about the importance of kitchen gardens. The awareness of diabetes in the rural community thus increased manifold and simultaneous screening helped to detect diabetes early and thereby reduce the burden of diabetic complications in the community.

Conclusions:
Effective implementation of translational research for the prevention of diabetes particularly in low and middle income countries is a challenge but can be achieved through community empowerment. However, prevention needs a multisectoral approach involving the Government, corporates, urban planners and the public. For all this to happen, the Government has to take on a more active role in prevention of disease as well as involving major stakeholders while making policy decisions. Prevention of diabetes is definitely a preferable option to the burden of a life long and increasingly expensive treatment of the disease and its complications. The Chunampet model (CRDPP) shows how this can be done even in a low resource, rural setting in India.

There is an obvious need to design strategies which are both culturally and socio economically appropriate for addressing lifestyle issues on a large scale. Approaches directed at people with pre-diabetes are likely to be the most cost effective as up to 60% of cases of incident diabetes are attributable to IGT and/or IFG (29). There is also enough data suggesting that more than 50% reduction in progression to type 2 diabetes from IGT can be achieved with lifestyle changes (30-35). However, the provision of infrastructure and planning the logistics to support and sustain such an intervention on a large scale remains a challenge in any health care setting. Herein lays the role of 'diabetes ambassadors' or the community health workers or volunteers who can aid in the long term sustainability of such programs. The time for action is NOW.
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