Review of Cardiovascular Disease Prevention and Control Programs: International Experience and Challenges in China

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Abstract

Major cardiovascular risk factors in China, such as hyperlipidemia, hypertension, dietary factors, exposure to tobacco, diabetes, obesity and physical inactivity, have contributed to deteriorating trends in cardiovascular disease (CVD) deaths. In past years, a number of CVD prevention programs have been initiated in European and American countries and successfully brought down CVD related death rate by involving various parties such as physicians, patients, government agencies and payers. However, there is rare published literature that systemically reviewed such experience, which would be highly valuable for China and other countries with high CVD burden. In this article, we review the published literature on CVD prevention and control programs and report on interviews of local and foreign experts to provide recommendations for China-specific CVD prevention and control programs. In order to provide practical suggestions, we describe the type of programs as patient, physician, pharmacist, nurse, or payer-focused. Based on this evidence and identified challenges in China, programs focusing on disease management, treatment adherence, physician/health care provider education, financial incentives, and integrated healthcare are recommended for the prevention and control of CVD in China.

Keywords: Cardiovascular diseases; Policy; Prevention; Review; China


Background

China is facing a rapid rise of non-communicable diseases and a shift to chronic disability due to urbanization, rising incomes, and ageing, posing major challenges for the Chinese public health system. Cardiovascular disease (CVD) is the single greatest cause of death in China, with almost 40 percent of deaths attributed to CVD ailments.

CVD risk factors are expected to play a significant role in the growing CVD epidemic and are estimated to contribute to half of coronary heart disease related death. The 2010 Report on Cardiovascular Diseases in China identified several risk factors for cardiovascular disease in China, predominately hypertension, dyslipidemia, poor diet and nutrition, smoking, diabetes, and physical inactivity. Extrapolating from a regional sample, 31.2% of Chinese adults are exposed to at least one of the risk factors, while 10.2% are exposed to more than four risk factors. A risk projection study employed a Markov computer simulation model to predict rates of CVD in China from 2010 to 2030, incorporating risk factors such as blood pressure levels, total cholesterol levels, active smoking, and diabetes. The study found that, if risk factor levels were held constant, projected cardiovascular events would increase by >50% between 2010 and 2030. Applying projected increases in blood pressure, total cholesterol, diabetes, and decreases in active smoking, cardiovascular events increased by an additional 23%.

A number of programs have been conducted in China targeting at primary and secondary prevention of CVD. For example, the Bridging the Gap on CHD Secondary Prevention in China (BRIG) project focuses on improving the quality of
care of coronary heart disease (CHD) patients and close the gap between clinical practice and guidelines. Specifically, the China Cholesterol Education Program (CCEP) investigates baseline characteristics of outpatients with CHD, in order to identify the gap between guidelines and clinical practice in statin interventions.

The efficacy and cost-effectiveness of primary preventive strategies for reducing CVD have been investigated in several population-based studies in China and elsewhere. In May 2012, the Chinese Ministry of Health, in conjunction with 15 departments, signed the “China National Plan for NCD Prevention and Treatment (2012-2015)”. Cardiovascular disease objectives were listed in the plan, including primary prevention, such as improved healthy lifestyle and encouraging exercise. In addition, the Sports department was tasked with the implementation of the National Fitness Program (2011-2015) to carry out mass sports activities. Public policy initiatives, particularly related to lifestyle modification, would be an effective method to control the impending CVD epidemic. While China’s commitment to CVD prevention is laudable, there is still a lack of population-wide, effective interventions.

However, an analysis of the ability to achieve the goals set by the Healthy China 2020 program found that implementing public policy initiatives to reduce CVD risk factors would require significant changes in health systems and public policy. In particular, the limited infrastructure for chronic disease care means China is ill-equipped to deal with the escalating chronic disease epidemic. In addition, increased rural-to-urban migration is projected to be a major driver of the CVD epidemic in China. Initiatives suited to both urban and rural environments would therefore be required. In a nationwide US program (Million Hearts Initiative), prevention through “ABCS” (Aspirin when appropriate, Blood pressure control, Cholesterol management, and Smoking cessation) were rolled out targeting a broad set of stakeholders.

Dyslipidemia has been shown to be significantly associated with CVD particularly as a key risk factor of coronary heart disease. However, studies have also demonstrated that cardiovascular risk factors interact with each other. Dyslipidemia treatment could further lower CVD risk of patients who are treated for their hypertension and diabetes. As risk factors such as hypertension and diabetes have been covered extensively in published literature, this study aims to identify existing prevention and control of CVD initiatives that focused on dyslipidemia management, which could serve as effective templates for initiatives in China.

**CVD Prevention programs**

**Physician-oriented programs**

Although treatment adherence and proper clinical management are the major challenges in CVD control, and physician non-adherence to prevention guidelines adds to these challenges and adversely impacts the quality of care. The worksite initiative Worksite Wellness – A Cholesterol Awareness Program was based on the principles that cholesterol education at the worksite can improve lipid profiles and heart-healthy behaviours. Participants attended classes led by certified diabetes educators, focusing on cholesterol management through diet, exercise and healthcare. The intervention was found to result in a significant reduction in TC and low-density lipoprotein cholesterol (LDL-C), but no significant change in blood pressure or weight.

**CVD Prevention programs**

**Patient-oriented programs**

The major challenges facing prevention of cardiovascular events are improper treatment and poor adherence to treatment. Non-adherence results in more cardiovascular events, decreased length and quality of life, and millions of dollars more in health care costs each year. There is a precedent for patient-oriented programs targeting adherence to hyperlipidemia treatment, which could reduce the burden of disease of CVD on China. An initiative in Australia, Coaching patients On Achieving Cardiovascular Health (COACH), aimed to address challenges to hyperlipidemia treatment, including the reluctance of patients to initiate lipid-lowering therapy, therapy not being titrated to therapeutic levels, and non-compliance or discontinuation of therapy. Patients were recruited during their hospital admission from coronary care units or open heart surgical units and randomized into coaching or no coaching groups. Coaching group patients were guided on working with their physicians to achieve target levels for total cholesterol (TC) and other risk factors. The coach initiated contact with the patient by telephone at 2nd week for the first coaching session, followed by three phone coaching sessions followed at 6-week intervals and the fifth call at 24th week. Analysis of the outcomes found that mean TC levels at 6 months were significantly lower for the coached group, and that being coached had an effect of equal magnitude to being provided with lipid-lowering therapy.

Numerous studies have established the link between providing worksite programs targeting employee health and improved cardiovascular outcomes. The US worksite initiative Worksite Wellness – A Cholesterol Awareness Program was based on the principles that cholesterol education at the worksite can improve lipid profiles and heart-healthy behaviours. Participants attended classes led by certified diabetes educators, focusing on cholesterol management through diet, exercise and healthcare. The intervention was found to result in a significant reduction in TC and low-density lipoprotein cholesterol (LDL-C), but no significant change in blood pressure or weight.

**Physician-oriented programs**

Although treatment adherence and proper clinical management are the major challenges in CVD control, and physician non-adherence to prevention guidelines adds to these challenges and adversely impacts the quality of care. Educational interventions and incentive programs targeted at physicians is another intervention that has the potential to greatly improve the quality of CVD preventive care in China, and lower CVD morbidity and mortality.

The primary reference for the use of physician incentives is the Quality and Outcomes Framework (QOF) program, established by the UK National Health Service (NHS) to provide financial incentives to general practitioners (GPs) to achieve better health outcomes and higher patient satisfaction. In this program, each general practice was scored on over 100 performance indicators according to the measured quality of care it delivered. The framework was annually revised and the latest framework consists of 5 domains: Clinical; Public Health; Public Health - Additional Services; Patient Experience; Quality and Productivity. This is an alternative approach to the common, fee-per-patient approach, which incentivises unnecessary tests and servicing. Studies have found that QOF led to improvements in quality for all indicators in the incentivized schemes and noted an improvement in both process and outcome measures in diabetes care in the UK. However, there are challenges inherent in the QOF program design, including the complexity of the design, the risk of neglecting important areas not covered in the scheme, and the risk of gaming and misinterpretation.

As mentioned previously, a driving factor of CVD in China is the significant dyslipidemia treatment gap between the treatment recommended by Chinese prevention guidelines and actual clinical treatment by physicians. The China Clinical Control of Dyslipidemia - Goal Attainment Initiative (CCCD) was established in 2008 to address these issues, by enhancing Chinese physicians’ management of lipid-lowering treatment in clinical settings. As part of this initiative, Xie and authors found that better medical insurance cover, care in a province-level hospital rather than county-level hospital, treatment by a non-cardiologist and use of a statin were statistically significantly associated with better compliance to...
lifestyle interventions with a focus on nutrition, physical activity, and medication adherence [30, 31].

**Pharmacist-oriented programs**

Systematic reviews of randomised studies suggest significant reductions in cardiovascular risk through pharmacist intervention at patient level and healthcare professional level [32]. Building on this evidence base, the NHS in Scotland implemented the 12-month pharmacist-led Statin Outreach Service (SOS) program [33]. Pharmacists who had received additional training were able to identify patients with CVD who were not prescribed a statin at optimal dose or did not have cholesterol at target, and then provide individualised recommendations for changes. Patients in practices allocated to SOS were found to be significantly more likely to have cholesterol at target due to improved statin prescribing, and statistically significant improvements were seen in all secondary outcomes. Community Pharmacy Assistance in Total Cardiovascular Health (CPATCH) is another pharmacy-lead program targeting improved statin adherence in Canada. In this program, community pharmacies from across the country were randomized to deliver either an adherence intervention to their patients, or usual care [34]. Intervention pharmacies were trained to employ a practical adherence strategy targeted at new users of statin medications. Outcomes to be assessed include mean statin adherence and persistence among new users. Results from this trial are pending.

**Nurse-oriented programs**

Practice nurses show greater adherence to CV prevention guidelines compared to general practitioners [35, 36], and that nurse-coordinated prevention programs can be highly effective [37, 38]. In a matched, cluster randomised, controlled trial as part of the EUROACTION project, hospitals and general practices were randomized to a nurse-led intervention program or usual care for patients [39]. The program focused on lifestyle change, along with risk factor control and therapies. Participated couples had to attend at least 8 sessions, one every week, which included assessment, group workshop. Patients were provided with personal record card for lifestyle and risk factor targets and support packs for their family members. A greater proportion of patients achieved TC and LDL-C targets in the intervention group, and improvements in prescriptions of cardio-protective therapies (ACE inhibitors and statins) were also observed. The intervention was associated with significant improvement in lifestyle, diet, blood pressure, and physical activity. The EUROACTION PLUS trial found that an intensive intervention substantially increased smoking abstinence, and reduced overall cardiovascular risk compared to usual care [40].

A randomized, controlled trial, Nurse Telephone Management of Cholesterol in Diabetes (NATCHOS), tested the effectiveness of a nurse-run, telephone-based intervention to improve lipid control in patients with diabetes in a low-income patient population, and found a significant increase in proportion of patients achieving the LDL-C goal in the intervention group [41].

This telephone outreach program was considered an adjunct to usual care in which the nurses independently checked labs and initiated and titrated lipid-lowering medications over the telephone with a 2-week follow-up call to assess for medication side effects and a 6-week follow up call to recheck lipids after medication changes. Average cost to the healthcare system and hospital admissions were also significantly lower in the intervention group. The Specialist Nurse-Led Intervention to Treat and Control Hypertension and Hyperlipidemia in Diabetes (SPLINT) program was conducted to treat and control hypertension and hyperlipidemia in diabetes through specialist nurse-led care [42]. In this program, diabetic patients received invitation to attend specialist nurse-led clinics and offered with targets of treatment for hypertension and hyperlipidemia. After that, attendance was every 4–6 weeks until targets were achieved. Individuals with raised blood pressure and/or total cholesterol were randomized into intervention and usual care. Nurses in the intervention provided lifestyle advice and titration of drug therapies according to guidelines. The intervention was found to be associated with a significant improvement in patients achieving targets for hypertension and hyperlipidemia, and a significant reduction in all-cause mortality.

**Payer-oriented programs**

Germany implemented a nationwide pay-for-performance scheme for multiple risk factors (including diabetes and coronary heart disease) within its social health insurance structure, by offering financial incentives for sickness funds to implement disease management programs, and health care providers to implement integrated care projects for chronically ill patients [43]. The scheme offers numerous benefits, such as the ability dynamically readjust financial incentives for identified deficiencies in the healthcare system, incentives to develop a more refined risk-adjustment system, and increased choices of care for patients. Pay-for-performance can be applied to physicians as well. The fee schedule for GPs in Australia was based on payment for each consultation provided, which provided incentives for a high turnover of patients and shorter consultations, leading to higher costs due to inappropriate prescribing and referral, and poor quality of care [44]. The Practice Incentive Program (PIP), a pay-for-performance scheme introduced in 1999, superimposed on the existing fee-for-service system, included capitation payments and pay-for performance to encourage higher quality of care in diabetes and other conditions [45]. The PIP was found to significantly increase the probability of an HbA1c test being ordered by the GP, indicating a positive impact on the quality of care in diabetes.

**Other programs**

The National Cholesterol Education Program (NCEP) in the US provides guidelines clinical updates recommendations for detection, evaluation and treatment of high blood cholesterol, conducts workshops for physicians and the general public, organizes research and disease prevention programs at workplaces, and advises schools on curriculum changes [46]. Surveys like the NCEP Cholesterol Awareness Survey and National Health and Nutrition Examination Survey (NHANES) are used to assess hyperlipidemia, CHD mortality, cholesterol checks, and average cholesterol levels of the population, in order to identify underserved populations, health status trends and identify risk factors. The NCEP has been successful, with widespread adoption of NCEP guidelines resulting in more people getting their blood cholesterol checked, a trend towards pharmacological intervention at lower cholesterol levels, a reduction in average blood cholesterol levels, a decline intake of saturated fats/cholesterol, and a reduction in CHD mortality [47]. Furthermore, the NCEP guidelines may be successfully adapted to different demographics, with a study in Thailand associating NCEP-based dietary modification with significantly lowered TC and LDL-C levels [48].

The North Karelia Project is a comprehensive community health intervention program for CVD control initiated in North Karelia in Eastern Finland and introduced to a few developing countries [49]. This program aims to reduce CVD mortality and...
incidence through reduction of smoking, serum cholesterol and elevated blood pressures by integrating community organizations and community involvement. Dietary changes aimed at reducing serum cholesterol levels are among the main objectives. The effects of the program showed the net reduction of estimated coronary heart disease (CHD) risk by 17% for men and 12% for women with significant decreases in total mortality rates during the program. Besides that, the program costs were relatively low. Another community-wide program that was conducted in a low-income rural community in Franklin County, Marine and lasted 40 years assessed health outcomes associated with an integrated, comprehensive cardiovascular risk reduction program targeting at risk factors such as hypertension, cholesterol and smoking as well as diet and physical activity. Reductions in hospitalization and mortality rates attributed to better control of these risk factors were observed in this program.

Challenges and opportunities to CVD prevention activities in China

We have identified several successful prevention strategies used throughout the world. However, whether these projects are effective, affordable and scalable to the Chinese environment remains unknown. Through in-depth interviews with local and international experts’ familiar with the healthcare landscape in China, we were able to identify specific challenges to the implementation of CVD prevention programs in China.

One of the challenges is the burden of financing for the programs. In countries with developed infrastructures and universal health care, identifying patients with cardiovascular symptoms is relatively straightforward, as there is an established system and financing for patient screening and treatment. However, in developing countries such as China, there are few screening programs to identify patients with cardiovascular risks, and the continuous costs of treatment that follow a diagnosis may pose a significant financial barrier, with uncertainty over ability of the patient to cover the full cost or co-payment. A further barrier to patients seeking treatment is the role of traditional Chinese medicines, which may deter or delay patients from accessing effective treatments.

In addition, it is currently illegal for pharmaceutical manufacturers to liaise directly with hospitals or patients. This severely limits the effectiveness of pay-for-performance and similar incentive schemes, and also makes it difficult to organize public initiatives without the need to coordinate with intermediaries. Working with charity organizations, medical associations or the government represent ways to circumvent this restriction to implement these types of strategies.

The continuing focus on treating acute conditions within a fee-for-service system is the most significant challenge to implementation of prevention initiatives, as fee-for-service results in a disincentive for healthcare providers to prevent patients from getting sick. A more outcomes-based approach would theoretically correct this, but interviewed experts noted that China does not emphasize the quality of outcomes, and policies attempting to emphasize prevention and primary care are poorly-implemented. The lack of effective implementation of an electronic medical record (EMR) system also makes scientific evaluation of outcomes difficult. As the healthcare infrastructure in China grows, and the focus shifts to outcomes-based scientific approaches, the environment will become more conducive to comprehensive CVD prevention and control programs.

Another major challenge in the Chinese context is the lack of awareness of chronic diseases, CVD risks, and the benefits of a healthy lifestyle. Limited education initiatives targeting CVD major risk factors have been done in China. There has been no analysis on the reach and effect of those programs such as government supported education initiatives to increase physical activity and improve diet. Effective implementation would require support from the government, medical associations and pharmaceutical companies.

Furthermore, a large proportion of doctors and health personnel in China are not well prepared to respond to people’s needs due to a lack of time, proper education, training and awareness, and this often leads to a treatment gap. Activities to encourage physicians and HCPs to follow treatment guidelines, enhance their training and expand their role in patient DMPs are recommended to address these issues, and the China Clinical Control of Dyslipidemia (CCCD) initiative provides a possible template.

Disease management programs (DMPs) are an effective method to improve the health of persons with CVD and to reduce health care service use and costs associated with avoidable complications. To ensure the efficacy of DMPs, patients must be effectively identified and enrolled, after which physicians and other healthcare providers within these programs can educate patients on CVD management. The patient-oriented COACH initiative from Australia, and the nurse-led programs EUROACTION, NATCHOS and SPLINT are examples of highly successful DMPs addressing CV risk factors. Expansions of such programs in China would be effective in controlling CVD risk factors.

Although statins have indisputably proven to reduce fatal and nonfatal events in patients with cardiovascular disease, poor adherence to treatment remains a concern, due to irregular or interrupted intake and high frequency of discontinuation or lack of persistence. In the Chinese context, it is recommended that pharmaceutical companies and hospitals work on providing pharmacist/nurse-based or technology-based adherence programs, similar to the CPATCH program in Canada. International experts noted the effectiveness of such programs, while a local expert emphasized the need to tailor adherence programs to the cultural context, including collecting detailed background information on the patients, and educating nurses on delivering the right messages to the patients. The BRIG and CCEP programs demonstrate the potential of improved adherence on improving CVD outcomes.

Integrated healthcare programs are needed to address lack of coordinated healthcare in China. Programs for health professionals and public would increase their awareness about CVD/hyperlipidemia, and provide them with the information and skills to manage the disease. The National Cholesterol Education Program, European Heart Health Strategy (EuroHeart), and China Initiative for Diabetes Excellence (CIDE) initiatives could offer wealth of experience and learning for implementing integrated healthcare programs in China. Financial incentive programs can be used as a tool both to improve the performance of providers and to improve quality and actual health outcomes. An international expert on financial incentive programs cautioned that pay-for-performance schemes would represent a difficult proposition in China, due to the legal issues surrounding the engagements of manufacturers with hospitals and patients, and the threat of gaming outcomes due to inefficient data collection. They highlighted a significant general problem with pay-for-performance schemes, whereby
financial incentives alone cannot be expected to modify physician behaviour, but would need to be accompanied by a behavioural intervention targeted at their professional profile.

Conclusion
In summary, the burden of CVD disease in China is growing, and prevention of key risk factors would significantly improve health outcomes and reduce the financial impact. DMPs and initiatives focusing on treatment adherence represent the most effective methods of preventing and controlling CVD risk factors in China, supplemented by ongoing awareness and educational efforts. Key challenges, including budget constraints and a transition away from a fee-for-service system, would need to be proactively implemented to ensure the success of such initiatives.

Declarations of Interest
Both Wei Yu and Ruizhi Shi are the employees of Pfizer China. The other authors report no other relationships that could be construed as a conflict of interest.

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