Put Disease Prevention First

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Worldwide, non-communicable diseases are the dominant cause of death, with atherosclerotic cardiovascular disease (CVD) a major contributor\(^1\). These deaths are spread across high- to low-income countries, with about one in three of all CVD deaths occurring in under 70 year-olds, amounting to an estimated six million cases annually\(^1\). Analyses in many countries have shown that both an improvement in risk factors and advances in medical therapies have contributed to the fall in age-standardised mortality from coronary heart disease (CHD)\(^2\). Importantly, leading a healthy lifestyle has broader implications for the prevention and management of other non-communicable diseases including cancer, diabetes and chronic respiratory diseases.

Following decades of major advances in the treatment of acute CHD events it is being appreciated increasingly that evidence-based long-term management of CHD is critical to achieve optimal reductions in mortality and morbidity. Each year, approximately 50 percent of major coronary events occur in those with a hospital discharge diagnosis of CHD\(^3\). Half of these recurrent events are fatal\(^3\). A significant number of such CHD events will occur within the first year after hospitalization for non-fatal acute coronary syndromes\(^4\).

Older trials of comprehensive cardiac rehabilitation inclusive of exercise, other aspects of a healthy lifestyle and adherence to pharmacological therapies can improve the course of CHD and reduce all-cause and cardiovascular mortality by up to 25%\(^5\). However concerns have emerged as to whether the benefits of cardiac rehabilitation continue to apply in an era where acute reperfusion therapy (e.g. fibrinolysis/primary percutaneous coronary intervention) and a suite of preventive pharmacotherapies (aspirin and other antiplatelet agents, HMGCoA reductase inhibitors, angiotension-converting enzyme inhibitors or angiotensin receptor blockers and beta-blockers) are very widely available. Indeed much of the highest level trial evidence for cardiac rehabilitation\(^6\) in survivors of acute myocardial infarction (with or without heart failure), those
with stable angina or treated with coronary revascularization is dated, with the patient group that undergo coronary artery bypass graft (CABG) surgery having been somewhat understudied\textsuperscript{7}. Countering this view is a recent large US study of Medicare patients with mixed CHD diagnoses that corroborated improved survival associated with cardiac rehabilitation\textsuperscript{8}.

This issue of \textit{Circulation} includes an important community-cohort study\textsuperscript{9} of the association between attendance at cardiac rehabilitation and all-cause mortality in patients surviving the first six months after CABG surgery.

In this sizable, mostly white, post-CABG cohort from Olmsted County, participation in cardiac rehabilitation was associated with a 46\% relative risk reduction in 10-year all-cause mortality (p<0.001), in absolute terms from 35.7\% to 23.0\% (NNT=8). There was no evidence of a differential effect of cardiac rehabilitation on mortality with respect to age (\geq65 vs <65 years), gender, presence of diabetes or a history of myocardial infarction. Participation rates were much higher than reported in US national and other data\textsuperscript{10}, but it is reasonable to suggest the findings re-affirm the very long-term survival benefit of cardiac rehabilitation after CABG in the era of modern medical therapy. Among important caveats are the facts that most patients in the present study resided within 10 miles of the site of the rehabilitation program and that participation depended on insurance status and other markers of vulnerable patient subgroups, such as smoking.

One key difficulty with cohort studies is the potential for referral and healthy cohort bias, which may lead to an overestimation of the true association between cardiac rehabilitation and beneficial outcomes. However the data was analyzed using multiple propensity score methods, and the authors were appropriately conservative in discussion of this aspect. There is also the matter of whether findings from a single county in Minnesota can be generalized more widely.
Globally, rates of participation in cardiac rehabilitation vary widely but regress to a mean of approximately 30% in those eligible, with those post-CABG consistently among the higher user groups\textsuperscript{9,10}. Poignantly, patient groups that could benefit most from these programs such as older adults, women, remote residents and marginalized groups, are least likely to participate\textsuperscript{11}.

**What might be approaches to overcoming this gap between evidence and practice?**

Increased access, equity and participation in cardiac rehabilitation are influenced by patient, health professional and system level factors\textsuperscript{12}. Among approaches focusing on system level factors are alternative models to traditional centre-based cardiac rehabilitation, incorporation of novel technology such as telehealth, automatic referral of all eligible patients, mapping of available programs using Geographical Information Systems (GIS), and novel approaches to funding.

Alternatives to traditional cardiac rehabilitation, often termed secondary prevention programs, have evolved and are now incorporated into major international guidelines for ongoing management of patients with CHD. For example, the current American Heart Association and American College of Cardiology Foundation Guidelines for secondary prevention in patients with atherosclerotic cardiac or other vascular disease recommendation states “a home-based cardiac rehabilitation program can be substituted for a supervised, center-based program for low risk patients”\textsuperscript{6}. These secondary prevention programs encompass various settings (e.g. family medical practice, specialized clinics, in the home) and diverse platforms for delivery (e.g. written manual, telephone/electronic support). These have been associated with reduced all-cause mortality (15\% lower; \(P<0.001\)) and also a decrease in subsequent acute myocardial infarction (17\% lower; \(p<0.002\))\textsuperscript{13}. Providing flexible, patient-centered and medium to long-term prevention programs is important to target the large numbers of people with CHD.
who are currently underserved by existing hospital-based cardiac rehabilitation programs. Notably, a systematic review comparing home with center-based cardiac rehabilitation reported higher participation rates in the home-based programs\textsuperscript{14}. Also, telehealth is an evolving method for delivering cardiac secondary prevention programs in the home through the telephone, email, the Internet or videoconferencing, singularly or in any combination\textsuperscript{15}. A meta-analysis of telehealth interventions found a non-significant trend toward lower all-cause mortality than center-based programs, underpinned by significant improvements in risk factor profiles in the intervention groups compared with controls.

A study from Ontario, Canada, involving 2635 CHD patients showed that the combination of automatic and face-to-face referral resulted in the highest rates of participation in cardiac rehabilitation, followed by automatic referral alone, and face-to-face referral alone, when compared with referral at the physician’s discretion\textsuperscript{16}. Wider adoption of system level strategies such as systematized referral and telehealth could increase access to programs and improve health outcomes for the majority with CHD, including underserved patient groups.

A new approach provides another avenue for the design and location of prevention programs servicing the needs of rural and remote communities, whilst commensurate with available local resources\textsuperscript{17}. Innovative modelling using GIS technology enabled derivation of an index which quantitated access by road to a principal referral hospital, and subsequently to cardiac rehabilitation among other services, relative to the geographic dispersion of Australia’s population. Although over 90 percent of Australian residents have reasonable access to hospital-based cardiac rehabilitation, i.e. within one hour drive time, it is elsewhere reported that participation rates in cardiac rehabilitation are similar (i.e. suboptimal) to those in the US. The authors recommended that population locations with limited access to cardiac services could
benefit from nationally coordinated, virtual, or electronically supported cardiac care systems including the development of innovative strategies to improve access to both acute care and cardiac rehabilitation.

The economic evidence for cardiac rehabilitation and secondary prevention programs is less well developed in comparison to the efficacy for favourable risk factor modification and improved survival. Earlier economic analyses indicated the cost-effectiveness of comprehensive cardiac rehabilitation and secondary prevention programs. However previous calls for additional evidence in this regard continue to apply. Cost comparisons between comprehensive center-based cardiac rehabilitation and alternative early post-discharge secondary prevention programs (e.g. home-based program) are nascent with a small UK study suggesting no appreciable cost savings between the two interventions, possibly due to the high cost of home visits. Importantly, savings in unplanned cardiac readmissions and improved quality of life associated with participation in cardiac rehabilitation/secondary prevention in a heterogeneous patient population with CHD, shown in a meta-analysis by Clark et al signals where the best evidence for cost-effectiveness may lie in future economic analyses. Other analyses have shown that cardiac rehabilitation can be considered to be as equally cost-effective as most of the technologies and drug therapies that are used to manage patients with CHD.

Although they might make sound economic sense, at present in many settings funding for cardiac rehabilitation and associated programs is constantly under review, capped or in some cases being reduced. Particularly, funding for innovative secondary prevention programs is usually opportunistic. In this environment, new financial models probably need to be identified. In a commentary on funding of chronic disease management aimed at reducing preventable hospitalizations, the concept of “social benefit bonds” was identified. A group of investors...
might advance funds with the focus on service providers to achieve specific outcomes of social worth. In theory, such a financial instrument could then yield a market rate of return to investors subject to measured public sector savings from documented and independently verified health outcomes, such as fewer preventable hospitalisations in CHD patients.

Combined, cardiac rehabilitation and secondary prevention programs have the potential to increase access and equity and allow higher participation rates that can improve the health outcomes of the majority of people living with CHD and more generally, atherosclerotic CVD. The benefits for participants in cardiac rehabilitation and secondary prevention occur within 12 months and extend out to at least 10 years\textsuperscript{5,7,13}. The findings can be considered to apply equally for patients following an acute coronary syndrome (with or without heart failure) and recipients of coronary revascularization procedures, and across all age groups\textsuperscript{6,18}.

If the optimal benefits of cardiac rehabilitation and secondary prevention are to be realized by the majority of patients living with CHD then there is more to be done. The need to refocus on prevention programs early after a diagnosis of CHD and extending over the longer-term is major public health priority. The current service provision of prevention programs falls well short of delivering proven effective therapies to all in need. With coronary intervention integral to the management of CHD, cardiac surgeons and interventional cardiologists can have a profound and ongoing influence by encouraging referral of their patients to rehabilitation and ongoing prevention programs. This is underscored by the fact that a physician’s (or in this case, a proceduralist’s) direct endorsement to their patients of the importance of cardiac rehabilitation and other secondary prevention programs is known to strongly influence attendance\textsuperscript{9}.

**Conflict of Interest Disclosures:** None.
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