

A new paradigm for primary prevention strategy in people with elevated risk of stroke

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Existing methods of primary stroke prevention are not sufficiently effective. Based on the recently developed Stroke Riskometer app, a new 'mass-elevated risk stroke/cardiovascular disease prevention' approach as an addition to the currently adopted absolute risk stroke/cardiovascular disease prevention approach is being advocated. We believe this approach is far more appealing to the individuals concerned and could be as efficient as the conventional population-based approach because it allows identification and engagement in prevention of all individuals who are at an increased (even slightly increased) risk of stroke and cardiovascular disease. The key novelty of this approach is twofold. First, it utilizes modern far-reaching mobile technologies, allowing individuals to calculate their absolute risk of stroke within the next 5 to 10 years and to compare their risk with those of the same age and gender without risk factors. Second, it employs self-management strategies to engage the person concerned in stroke/cardiovascular disease prevention, which is tailored to the person's individual risk profile. Preventative strategies similar to the Stroke Riskometer could be developed for other non-communicable disorders for which reliable predictive models and preventative recommendations exist. This would help reduce the burden of non-communicable disorders worldwide.

Key words: epidemiology, methodology, prevention, risk factors, stroke

The most recent Global Burden of Disease 2010 estimates (1) showed that the global burden of stroke continues to increase, with 16.9 million of people being affected by stroke annually, resulting in over 100 million disability-adjusted life years lost. There is also a worrisome global trend showing an increase in the number of strokes in young and middle-aged adults by 25% between 1990 and 2010 (2). This epidemic of stroke can and should be stopped and reversed (3), as over 90% of strokes are potentially avoidable (4). While management strategies for primary stroke prevention in high cardiovascular disease (CVD)

risk individuals [including stroke and transient ischemic attack (TIA)] are well established (5), they are underutilized (5–7), and existing methods of primary stroke prevention are not sufficiently effective (8,9). The health care system has so far been largely unsuccessful in providing meaningful information to assist people to adhere to recommended lifestyle and medications (5,9,10). Uptake of this information is particularly low in people with moderately increased risk of stroke who would benefit from lifestyle changes (9,11). Inadequate CVD risk factor management (9) is implicated in underutilization of evidence-based primary stroke prevention strategies in those with moderately increased risk of stroke (12).

It is generally accepted that to be effective, primary stroke prevention should include both community-wide and high-risk preventative strategies. While community-wide efforts to reduce the prevalence and improve control of major modifiable risk factors for stroke (e.g. salt intake reduction, smoking cessation, blood pressure control) are the most cost-effective strategies for stroke prevention at a population level (3,13), they often require legislative changes and continuous educational campaigns. Currently used by health professionals, high-risk preventative strategies are aimed at the identification and management of people with high risk of stroke (e.g. people with elevated blood pressure, dyslipidemia, carotid artery stenosis). However, one of the main problems with this high-risk stroke prevention strategy is that it misses out most of the people who later develop a stroke because in reality most strokes are happening in people with only a mild increased risk of CVD (14,15). In addition, people with only a mildly elevated risk of CVD often do not seek medical attention and, therefore, it is difficult to include them in stroke prevention interventions. Currently available CVD risk assessment algorithms (16–18) allow calculation of absolute risk of CVD (including stroke), but they are designed for use by health professionals. Yet, one of the main challenges in effective stroke prevention on an individual level is the lack of awareness about stroke symptoms and risk factors as well as self-managing strategies to reduce their risk of stroke.

The question is how to improve stroke prevention in individuals with an increased CVD risk in the most efficient way? We recently developed an app called Stroke Riskometer (19) that has the potential to significantly improve stroke and CVD prevention on an individual level. Based on the Framingham Heart Study stroke prediction algorithm (17) and enhanced to include seven additional major risk factors important for stroke (diet, physical activity, waist-to-hip ratio, alcohol, psychosocial stress, family history of stroke or heart attack, race/ethnicity), this user-friendly Stroke Riskometer is able to provide an estimate of the individual's absolute risk of stroke within the next 5 and 10 years for anyone from the age of 20 up to 90+ years old. The importance of

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adding those seven risk factors for better stroke prediction has been demonstrated in the recent INTERSTROKE study (4). Importantly, the Stroke Riskometer user can find out not only their absolute risk of stroke development but also a baseline risk to compare their risk against, thus allowing them to know their risk of stroke compared with someone of their age and gender who has no risk factors. The former represents a new paradigm for high-risk stroke prevention strategy, which is distinctly different from the traditional threshold-based approach in which people are categorized into low, moderate, and high-risk groups (20). However, the threshold-based high-risk approach is for use by health professionals and is less appealing to the individuals concerned because it does not tell them at what particular risk of CVD/stroke they are compared with people of the same age and gender but without any additional risk factors. For example, a woman of 35 years old who has a family history of stroke (her father had a stroke at the age of 64), eats less than six servings of fruits and/or vegetables a day, has experienced significant mental or emotional stress (permanent or several periods) over the last year, has a systolic blood pressure reading of 128 mmHg, and has an absolute risk of stroke within the next 5 years of 0.15%. Although her absolute risk is relatively low, her relative risk of stroke is roughly 1.7 times greater than someone of her age and gender who has no contributing risk factors (0.09%), and this is likely to be perceived by the woman as the significant stimulus to reduce her risk of having a stroke. However, if we base our estimates on one of the threshold-based CVD risk charts (21), the woman's risk falls into a mild CVD risk category, which seems to be far less of a motivation for her to reduce her risk of stroke. This represents a new application of the basic underlying idea of

targeting the whole population instead of a high-risk group for primary prevention (so-called 'prevention paradox' concept) first introduced by the epidemiologist Geoffrey Rose in 1981 (14). The key novelty of this approach is twofold. First, it utilizes modern far-reaching technologies [global mobile Internet subscriptions is expected to reach 4.5 billion by the end of 2018, with the mobile phone remaining the most frequently used access device (<http://www.ericsson.com/ericsson-mobility-report> accessed date 17 March 2014)], allowing huge number of individuals across the globe to calculate their absolute risk of stroke within the next 5 to 10 years *and to compare their risk* with those of the same age and gender without risk factors. Second, it employs *self-management* strategies to engage the person concerned in stroke/CVD prevention, which is tailored to the person's individual risk profile. However, whether this smartphone-based high-risk strategy on a population level is effective in changing people's behavior and improving stroke prevention remains to be proven, and we are planning an international clinical trial to test this hypothesis. Current feedback from over 5300 Stroke Riskometer app users is encouraging, and the app is being validated against the Framingham stroke prediction algorithm.

There are also other important features of the Stroke Riskometer to improve stroke prevention. For example, people can change details they enter in the Stroke Riskometer to visually observe the effect of changes in their risk of having a stroke. The Stroke Riskometer can also be used to estimate a risk of recurrent stroke by people who have already experienced a stroke or TIA and to calculate their risk of having a heart attack within the next 5 and 10 years. It can also be used for monitoring progress of stroke and heart attack prevention. The app (version 1) is available as a free



Fig. 1 Some snapshots of the Stroke Riskometer App screens from some smartphones and iPad.

download for iPhone, iPad [<https://itunes.apple.com/nz/app/stroke-riskometer/id725335272?mt=8> (access date 17 March 2014)], Android tablets, and other smartphone users [<https://play.google.com/store/search?q=stroke%20riskometer&hl=en> (access date 17 March 2014)] (Fig. 1). The World Stroke Organization has endorsed the free version of the Stroke Riskometer [<http://www.world-stroke.org/education/stroke-riskometer> (access date 17 March 2014)]. In addition, a premium version of the Stroke Riskometer app (Stroke Riskometer Pro) contains audio-visual educational information about stroke and stroke prevention and provides recommendations from experts on how to manage risk factors based on a person's stroke risk profile to reduce the risk of having a stroke or heart attack. The self-management of stroke and CVD risk factors is also a new and appealing approach in preventative medicine (22,23). All the education information and recommendations are based on internationally recognized primary stroke prevention guidelines (5). Tailoring the recommendations to a particular person and presenting them in a self-management format is likely to improve the uptake of this educational information. It is expected that the self-management, individual risk profile-oriented recommendations together with the educational and stroke risk self-assessment tool will empower a user to take control of and improve their stroke prevention. The increased utilization of modern mobile technologies such as smartphones provides a unique opportunity to introduce new prevention strategies to those at elevated risk of stroke or CVD (there are currently 1 billion smartphone users in the world and this number is projected to increase to 1.4 billion by the end of 2013). Although this is a new 'mass-elevated risk stroke/CVD prevention' approach to stroke/CVD prevention at an individual level, it is important to note that the Stroke Riskometer is not designed to be a replacement for seeking professional medical advice, but rather an educational self-management tool that allows users to identify if they fall into a risk category and take preventive measures to protect against future strokes. Therefore, the Stroke Riskometer app should be considered as an addition to the currently adopted absolute stroke/CVD prevention approach. It should also be noted that estimates based on the Stroke Riskometer app may not be generalizable to a global audience, and further research should be carried out to validate and improve accuracy of the stroke prediction algorithm for different populations in different countries.

References

- 1 Feigin VL, Forouzanfar MH, Krishnamurthi R *et al*. Global and regional burden of stroke during 1990–2010: findings from the Global Burden of Disease Study 2010. *Lancet* 2014; **383**:245–54.
- 2 Feigin VL, Forouzanfar MH, Krishnamurthi R *et al*. Global and regional burden of stroke in 1990–2010: findings from the Global Burden of Disease Study 2010. *Lancet* 2013; **382**:1–12.
- 3 Strong K, Mathers C, Bonita R. Preventing stroke: saving lives around the world. *Lancet Neurol* 2007; **6**:182–7.
- 4 O'Donnell MJ, Xavier D, Liu L *et al*. Risk factors for ischaemic and intracerebral haemorrhagic stroke in 22 countries (the INTERSTROKE study): a case-control study. *Lancet* 2010; **376**:112–23.
- 5 Goldstein LB, Bushnell CD, Adams RJ *et al*. Guidelines for the primary prevention of stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. [Erratum appears in *Stroke*. 2011 Feb;42(2):e26]. *Stroke* 2011; **42**:517–84.
- 6 Mehta S, Wells S, Riddell T *et al*. Under-utilisation of preventive medication in patients with cardiovascular disease is greatest in younger age groups (PREDICT-CVD 15). *J Prim Health Care* 2011; **3**:93–101.
- 7 Simons LA, Simons J, McManus P, Dudley J. Discontinuation rates for use of statins are high. *BMJ* 2000; **321**:1084.
- 8 Ebrahim S, Taylor F, Ward K, Beswick A, Burke M, Davey Smith G. Multiple risk factor interventions for primary prevention of coronary heart disease. *Cochrane Database Syst Rev* 2011 (19 April); CD001561.
- 9 Cox JL, Carr B, Vallis TM, Szpilfogel C, O'Neill BJA. Novel Approach to Cardiovascular Health by Optimizing Risk Management (ANCHOR): a primary prevention initiative examining the impact of health risk factor assessment and management on cardiac wellness. *Can J Cardiol* 2011; **27**:809–17.
- 10 Selak V, Elley CR, Crengle S *et al*. IMPROving Adherence using Combination Therapy (IMPACT): design and protocol of a randomised controlled trial in primary care. *Contemp Clin Trials* 2011; **32**:909–15.
- 11 Jackson R, Lawes CMM, Bennett DA, Milne RJ, Rodgers A. Treatment with drugs to lower blood pressure and blood cholesterol based on an individual's absolute cardiovascular risk. *Lancet* 2005; **365**:434–41.
- 12 Powers BJ, Danus S, Grubber JM, Olsen MK, Oddone EZ, Bosworth HB. The effectiveness of personalized coronary heart disease and stroke risk communication. *Am Heart J* 2011; **161**:673–80.
- 13 Feigin VL, Krishnamurthi R. Stroke prevention in the developing world. *Stroke* 2011; **42**:3655–8.
- 14 Rose G. Strategy of prevention: lessons from cardiovascular disease. *Br Med J (Clin Res Ed)* 1981; **282**:1847–51.
- 15 Reid DD, Hamilton PJ, McCartney P, Rose G, Jarrett RJ, Keen H. Smoking and other risk factors for coronary heart-disease in British civil servants. *Lancet* 1976; **2**:979–84.
- 16 WHO. Prevention of cardiovascular disease: pocket guidelines for assessment and management of cardiovascular risk. Geneva, 2007.
- 17 D'Agostino RB, Wolf PA, Belanger AJ, Kannel WB. Stroke risk profile: adjustment for antihypertensive medication. The Framingham Study. *Stroke* 1994; **25**:40–3.
- 18 Riddell T, Wells S, Jackson R *et al*. Performance of Framingham cardiovascular risk scores by ethnic groups in New Zealand: PREDICT CVD-10. *N Z Med J* 2010; **123**:50–61.
- 19 Feigin VL. Stroke Riskometer App. 2013. Available at <http://www.nisan.aut.ac.nz/stroke-riskometer> (accessed 14 May 2014).
- 20 National Vascular Prevention Alliance. Guidelines for the Management of Absolute Cardiovascular Disease Risk. Canberra, National Health and Medical Research Council of Australia, 2012.
- 21 New Zealand Guidelines Group. New Zealand Cardiovascular Guidelines Handbook: A Summary Resource for Primary Care Practitioners, 2nd edn. Ministry of Health, Wellington, 2009.
- 22 Goris J, Komaric N, Guandalini A, Francis D, Hawes E. Effectiveness of multicultural health workers in chronic disease prevention and self-management in culturally and linguistically diverse populations: a systematic literature review. *Aus J Prim Health* 2013; **19**:14–37.
- 23 Kulzer B, Hermanns N, Gorges D, Schwarz P, Haak T. Prevention of diabetes self-management program (PREDIAS): effects on weight, metabolic risk factors, and behavioral outcomes. *Diabetes Care* 2009; **32**:1143–6.