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## Review Article

# Prevention and follow-up in thromboembolic ischemic stroke: Do we need to think out of the box?



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### ABSTRACT

Stroke is one of the most debilitating thrombotic diseases, and world-wide it is estimated that by 2030, 23 million people will be affected. Except for the impact on the individual families, the world economy is also affected adversely. Although the medical treatment and knowledge of stroke are both increasing and well-researched, we still do not see a decrease in stroke prevalence. Currently various diagnostic tests are employed to determine the specific type of ischemic stroke as classified by the TOAST criteria. However, these tests are done after the stroke has occurred and therefore only contribute to the unquestionably crucial aspect of treating that particular stroke patient, but it does not improve prevention of future events. Prevention strategies regarding first-time stroke need urgent attention given the alarming present and future incidence of stroke. Therefore, here we discuss the importance of stroke prevention and suggest a more inclusive, perhaps “new” comprehensive approach for pre-stroke screening. Ultrastructural tests, particularly scanning electron microscopy, provide an innovative and novel advance in preventative and individualized patient-centered precision medicine. This precise technique when used in combination with well-established methods, as well as viscoelastic methods like thromboelastography (TEG), as a screening tool to prevent stroke can ultimately alleviate the financial and economical burden of stroke and also improve quality of life. Although we appreciate the fact that this suggestion might be difficult to accept by clinicians, a bold new approach is needed to address this pandemic we call stroke.

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## 1. Introduction

Stroke, one of the most debilitating conditions, mainly results from ischemia due to occlusion or stenosis of the blood vessel (approximately 87% of stroke cases) while a few cases are attributed to hemorrhage where a blood vessel ruptures or leaks [1,2]. Annually 17 million people

worldwide are affected by stroke and in 2010 alone there were 33 million stroke survivors with many cases associated with disability [3]. About 800,000 of these cases occur in the USA [4], with primary stroke being the major contributor (around 600,000 cases) [5]. In the United States alone every 40 s someone suffers a stroke, while, on average, a person dies of a stroke every 4 min [4]. Furthermore, it is envisaged that by 2030 an additional 3.4 million people will suffer a stroke compared to 2012 [6]. A global estimate for 2030 is 23 million people suffering a primary stroke with almost 7.8 million deaths as result of stroke [7, 8].

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A subsequent increase in stroke survivors (an estimated 15.2 million individuals), ascribed to the increase in the aging population, accompanied by increased strain on health- and social-care structures, is thus inevitable [6]. Although there are so many stroke survivors, survival is a double-edged sword, as it is also considered to be the foremost cause of chronic disability [5]. Almost a third of stroke survivors are permanently disabled and one fifth requires institutional care after 3 months [9]. Almost half of stroke cases in the elderly result in cognitive deficits while a third affect the independence of these individuals to perform daily activities [10]. Post-stroke quality of life is therefore (mostly) synonymous with functional impairment.

500 people per 100,000 are currently living with post-stroke consequences [11] and it is suggested that by 2030, stroke-related disability will rank as the fourth leading cause of disability-adjusted life years, relating to the years lost due to illness [12]. It not only alters the lives of those who suffered the stroke, and who most likely are disabled by it, but also it influences the lives of the victim's family and loved ones as well as caregivers [13].

The financial implications are currently believed to have the following global impact:

- Stroke consumes roughly 2–4% of total global health-care expenditure [11].
- Estimations for 2030 suggest that direct medical stroke-related expenses will be triple the current value and is estimated to be \$184.13 billion.
- Annual cost as a result of lost productivity, will most probably increase with 68%, to approximately \$56.54 billion [6].
- The total annual cost in billion € 2010 of stroke in Europe is about 64.1 [14].
- In the USA it is the section of the working population with the most

employment experience (age 45–64 years) that are expected to be hit the hardest with increased stroke incidence of 5.1% by 2030 [6].

In the current paper we discuss the importance of stroke prevention and suggest a more inclusive, perhaps “new” comprehensive approach for pre-stroke screening. Fig. 1 supplies the summary of this paper.

From the above-mentioned, the indirect cost of stroke, particularly premature mortality along with lost productivity, is therefore much greater than the sum of all direct costs of stroke [15]. Unfortunately these staggering numbers only reflect the economical burden of stroke, while the costs borne by patients and their family, as well as the cost of comorbidity is not even cited [16]. Since primary stroke represents almost 80% of all stroke events, the main focus should therefore be on more effective prevention strategies to bridle the future escalation in stroke incidence and resulting disability [10,17].

## 2. Current approach: diagnostic testing and preventative strategies

Currently various diagnostic tests are employed to determine the specific type of ischemic stroke as classified by the TOAST criteria [18–22]. These tests are, however, after the stroke and only contribute to the unquestionably crucial aspect of treating that particular stroke patient, but it does not improve prevention of future events. Prevention strategies regarding first-time stroke need urgent attention given the alarming present and future incidence of stroke. Fig. 2 shows a comparison of current diagnostic and preventative measures.

With regard to prevention strategies, two core approaches are currently followed namely the ‘mass’ approach and then the ‘high risk’ approach. The first focuses on decreasing the risk factor exposure of a population while the latter concentrate on identification of specific

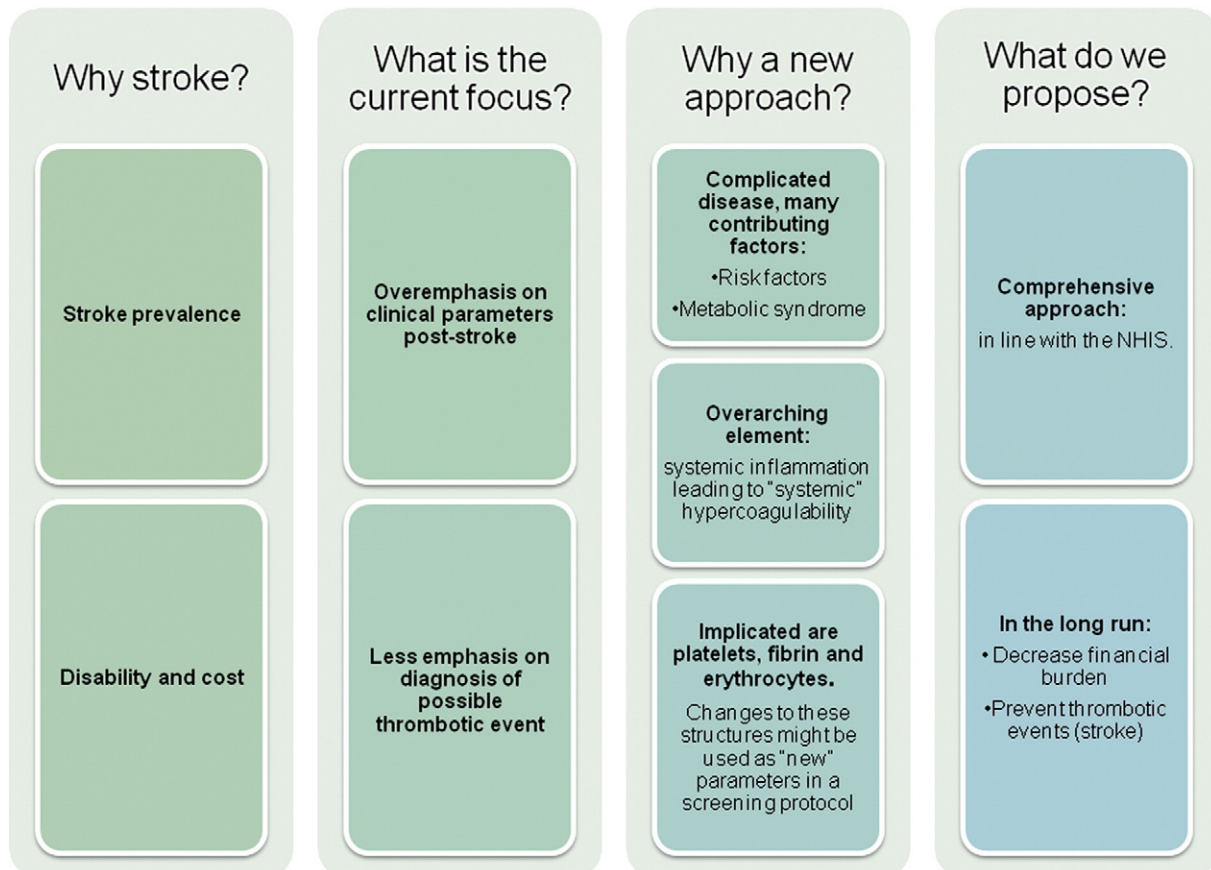


Fig. 1. Synopsis of the prevention of stroke and a new comprehensive approach for pre-stroke screening.

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