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Time for a revolution in
stroke care

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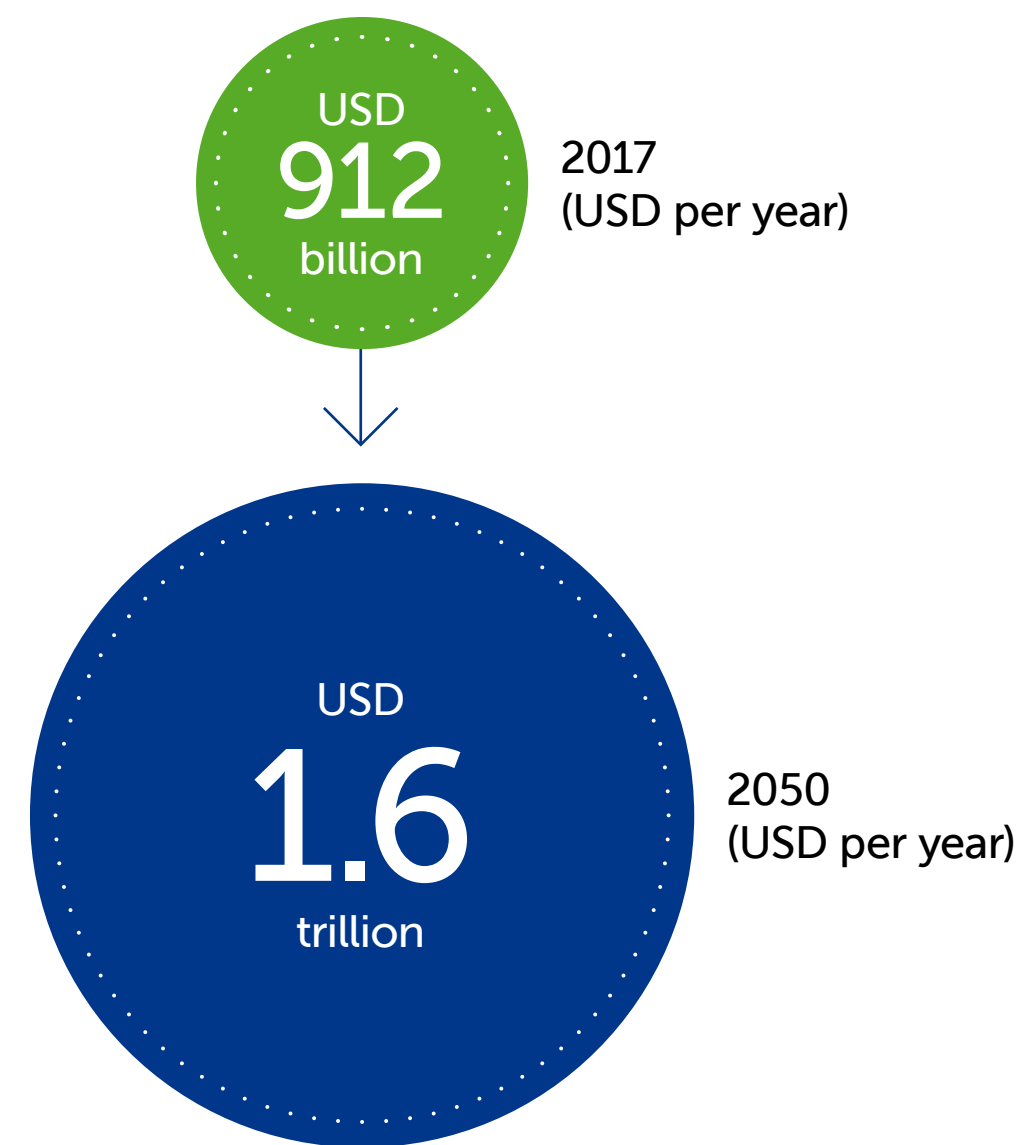
Serious investment to optimize stroke management will bring significant economic benefits and make a real difference in the lives of millions.

Stroke is a leading cause of disability and the second leading cause of death worldwide.

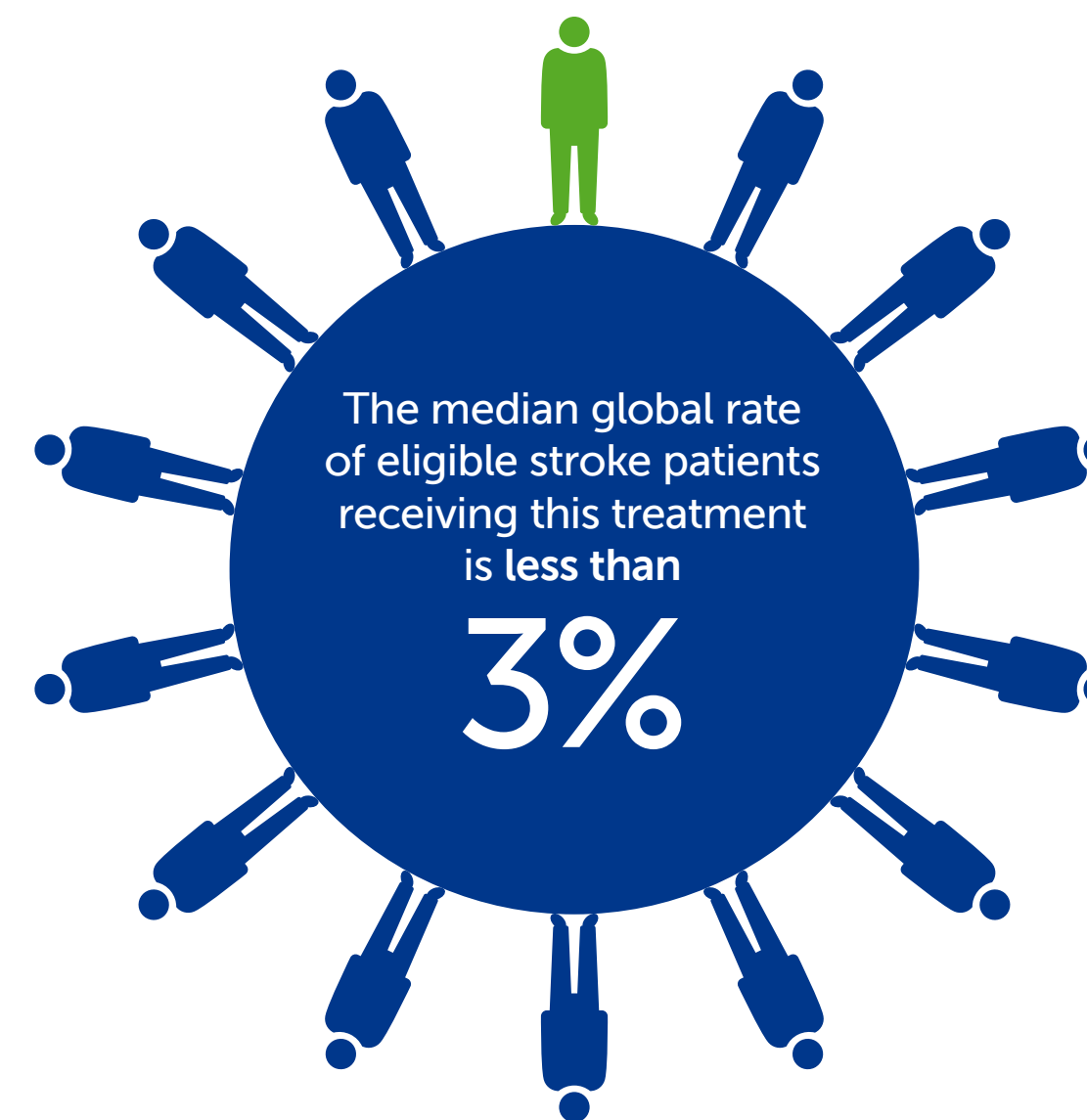


12 million people worldwide have a stroke every year. Half of those affected die, while a similar number face permanent disability.

The direct and indirect costs are conservatively estimated to be more than double over the next 25 years.



Mechanical thrombectomy has been proven to be both effective at achieving better clinical outcomes and highly cost-effective for patients with acute ischemic stroke. Globally though, **access to mechanical thrombectomy is extremely low.**



Policy recommendations

Effective policy can and does make a significant impact.

- 1 Set targets and quality indicators, assess current gaps and prioritize stroke care in global, national, and regional health plans
- 2 Expand and invest in infrastructures for essential stroke services, including stroke units and intravenous thrombolysis
- 3 Expand and invest in (capital) infrastructures for advanced stroke services: mechanical thrombectomy
- 4 Increase the necessary skills in the health workforce
- 5 Make sure that payment models provide for adequate reimbursement of essential and advanced stroke care
- 6 Build a strategy to actualize the potential savings of essential and advanced acute stroke care

Executive Summary

Stroke: a challenge and an opportunity

To reduce the burden of stroke, we must understand its impact. This impact is massive, not only on the brain, the very organ that defines us, but also on our health, our families, society and the economy.

Stroke is the leading cause of disability and the second leading cause of death worldwide. Every year, an estimated 12 million people worldwide have a stroke³, a half of those affected die, while a similar number face permanent disability.

The resulting financial, physical, and emotional burden on family and community makes stroke one of the most significant healthcare burdens in society. The incidence of stroke is increasing in young and middle-aged people globally, and disproportionately affecting the working population. The direct and indirect costs are conservatively estimated to be more than USD 912 billion annually and are expected to almost double over the next 25 years^{1,4}.

However, there now is a beacon of hope: significant progress has been achieved in acute stroke treatments in recent years, especially for patients with the most severe types of ischemic stroke, or brain infarcts – which comprises the largest proportion of stroke patients. Mechanical thrombectomy, a minimal invasive surgical procedure, has delivered transformational outcomes for patients who received it. While the procedure reduces the likelihood of a future characterized by disability and dependence, access and availability remains limited across the globe.

Mechanical thrombectomy has revolutionized treatment options and offers a key opportunity to reduce the impact of stroke. Large and multicentre clinical trials have shown that mechanical thrombectomy is a highly effective treatment for the most severe and debilitating strokes, preventing – and even reversing – their impact. If treated in time, major strokes now have become ‘curable’, which was unheard of a decade ago. Yet, in 2019, in Europe an average of fewer than 7% of all ischemic stroke patients received such treatment.

Doubling this number to a still very modest 15% would substantially improve the lives of 285,000 Europeans⁵. And that is only in Europe. Investing in acute stroke care is not just a financial commitment; it’s a highly effective investment in the lives of millions

Strengthening stroke care infrastructure: a worthwhile investment

‘Time is brain’ is the mantra in stroke care, because every minute a major ischemic stroke goes untreated, millions of neurons die.

Clearly, speed and availability of specialized care is of utmost importance. Patients need to have access to stroke centres within short timespans. The geographical density of adequate stroke care infrastructure needs to be improved. Faster response times and access to better and more advanced healthcare is possible, but also depends on bold investment choices that will increase treatment capacity, public awareness and prevention.

Improving access to lifesaving and disability-preventing treatments would transform care and provide patients with significantly better health outcomes. While this would require investment to develop multiple basic and specialized stroke treatment centers, it would also help allocate scarce healthcare resources in the most efficient manner by reducing the need for costly downstream services in nursing homes, rehabilitation clinics, and home care.

Mechanical thrombectomy was subject to the WHO-CHOICE analysis, the program in the World Health Organization that helps countries decide priorities based on considerations of impact and cost-effectiveness. The strong evidence base for mechanical thrombectomy is represented by the inclusion of this treatment in Appendix 3 of the WHO Global NCD Action Plan⁶.

Access to stroke care is critical to reach universal health coverage

The current stroke trajectory shows that governments cannot achieve their commitments to Universal Health Coverage (UHC) if access to quality acute stroke care is not included in the package of essential care. Now is the time to revolutionize treatment.

It is vital that we support access to better stroke care through increased awareness and investment. There is ample evidence that acute stroke treatments, including mechanical thrombectomy, provide increased medical and economic effectiveness. Investing in stroke care is a highly effective investment in the lives of millions.

If we can’t reduce the impact of stroke, then achieving the UN Sustainable Development Goal 3 target– reducing premature mortality from noncommunicable diseases by one-third by 2030 – will be impossible.

It is time to make stroke care a global priority.



A revolution in stroke care

The absolute number of people affected by stroke, which includes those who die or remain disabled, has almost doubled in the past 30 years and is continuing to rise.¹

The burden of stroke must not be underestimated. At the frontline, is the brain, the organ that defines us. It influences our ability to talk, walk, our behavior, our personality, our very identity.

When a stroke occurs, the blood supply to the brain is interrupted, causing cells to die – either by a blood clot (ischemic stroke) or a ruptured blood vessel (hemorrhagic stroke). It is vital to act rapidly. If not treated quickly and effectively, patients can die or have profound long-term health implications, such as paralysis, speech impairment, and cognitive difficulties. Survivors also require comprehensive rehabilitation and ongoing medical treatment.

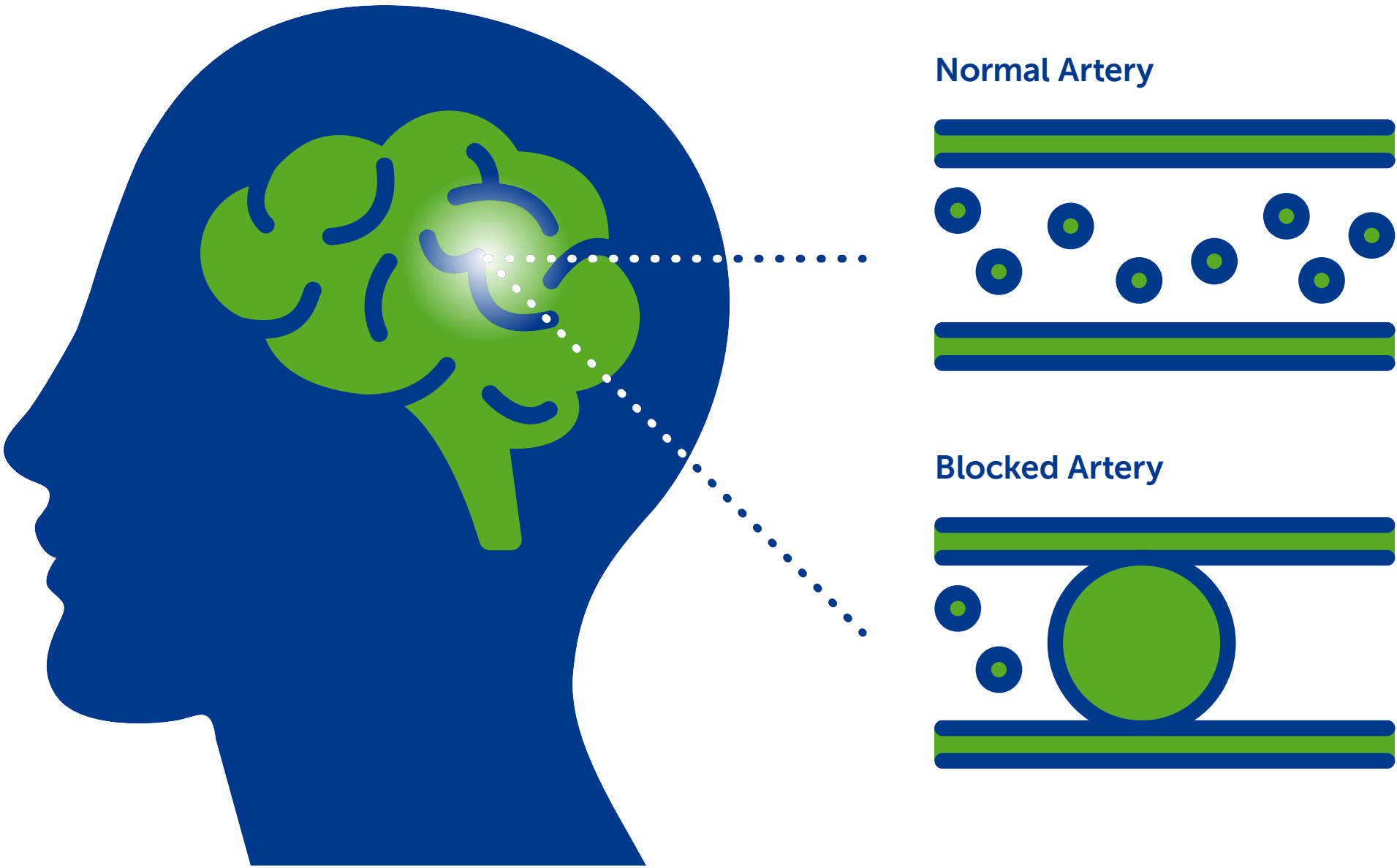
Acute stroke treatment in the form of intravenous clot-busting medication has been available for almost three decades. And although this treatment is effective, it is only applicable in the initial hours after onset of an ischemic stroke. This time restriction is hard to overcome and results in an overwhelming majority of patients to miss out on this life- and disability-saving treatment and resulted in the need to create effective care pathways.

Key clinical trials in 2015 demonstrated that mechanical thrombectomy, a new endovascular therapy, was highly effective in treating major ischemic strokes, also beyond the initial hours after onset. The catheter-based treatment, where a device is positioned inside the occluded vessel and the clot is pulled out, was found to be able to reverse or significantly reduce the impact of a stroke. Although the time window of treatment effectiveness has expanded with this procedure option, it remains crucial to get patients to treatment as fast as possible and minimize the damage. And to achieve this a regional stroke infrastructure needs to be implemented.

Yet, despite the impactful treatment effect, high-quality stroke infrastructure to support broad access to thrombectomy is still underdeveloped in many places. Thrombectomy is only performed on a minority of eligible patients across the globe.

Policymakers have an important opportunity to speed the dissemination of both essential and advanced stroke care infrastructures across the globe.

Figure 1: Ischemic Stroke



Mechanical thrombectomy:
A minimally invasive surgical technique for removing a blood clot from the brain artery that causes the stroke, or brain infarct. A small incision is made in the groin, and then thin tubes (catheters) are threaded through the blood vessels to remove the clot.

The health-economic case of implementing comprehensive stroke care

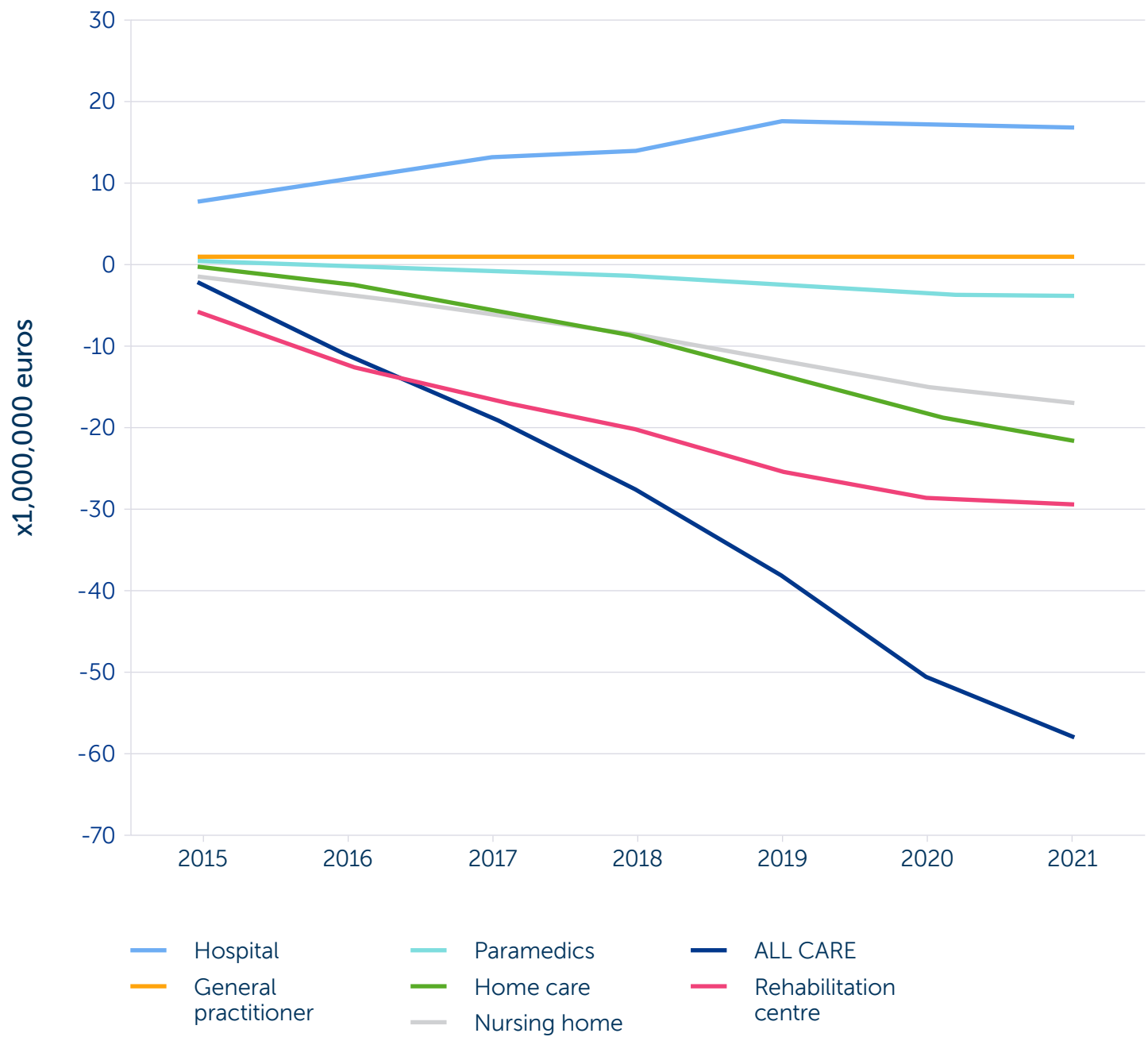
Mechanical thrombectomy has been proven to be both effective at achieving better clinical outcomes and highly cost-effective for patients with acute ischemic stroke. Based on 19 scientific articles on cost-effectiveness from a payer perspective, mechanical thrombectomy was cost-effective in all cases, and in 11 articles it was even dominant (i.e. negative incremental cost-effectiveness ratio: the unweighted average cost-effectiveness was minus €1,213 and this means this treatment may result in both lowering costs and provides better results compared to the current standard of care.*

While many of these studies were conducted in high income countries, the RESILIENT trial in Brazil (see case studies) has also firmly established the cost-effectiveness of thrombectomies within the public healthcare system of middle income countries⁷.

Increasing the number of patients receiving a mechanical thrombectomy will moderately increase the pressure on hospital care budgets in the short term. However, this may lead to substantial financial savings in other parts of the healthcare sector, especially rehabilitation, home care and nursing home care. This has been validated by a rare and recent budgetary impact analysis from the Netherlands leading to an estimate of almost sixty million of annual savings on these care pathways after three years⁸.

* Based on an internal scoping review by prof. dr. H. van de Baviere (Philips). This review can be accessed by request.

Figure 2: Budget impact in the Netherlands of endovascular treatment as add-on to usual care (2015-2021). Conclusion: thrombectomy costs are by far outweighed by downstream healthcare savings.⁸



As the introduction or increase of mechanical thrombectomy leads to overall budget savings, this will create room for facing other financial challenges or additional medical expenditures where needed most.

A significant opportunity exists to unlock considerable healthcare savings through dedicated fiscal policies and active purchasing, designed to increase quality and reduce costs.

On top of this, societies will benefit from savings because of an increase in the labor productivity of patients who can return earlier to their former occupations and activities. Since care intensity per patient declines, upgrading stroke services also implies a reduction of the carbon footprint.

There is a clear case to invest in highly needed stroke infrastructure capabilities.



Policy recommendations

Serious investment to optimize stroke care will bring significant economic benefits and make a real difference in the lives of millions. It will substantially contribute to the accomplishment of UN Sustainable Development Goal 3.4 that seeks for a one-third reduction in premature mortality from NCD's. It will also have a huge impact to reduce disability because of stroke. Policymakers need to draft and strictly execute more ambitious plans to strengthen stroke care in their jurisdictions.

Health systems can strengthen stroke care along four pillars:

- better prevention;
- creating more stroke units with access to basic treatment: intravenous thrombolysis;
- expanding access to thrombectomies; and
- a coordinated approach.

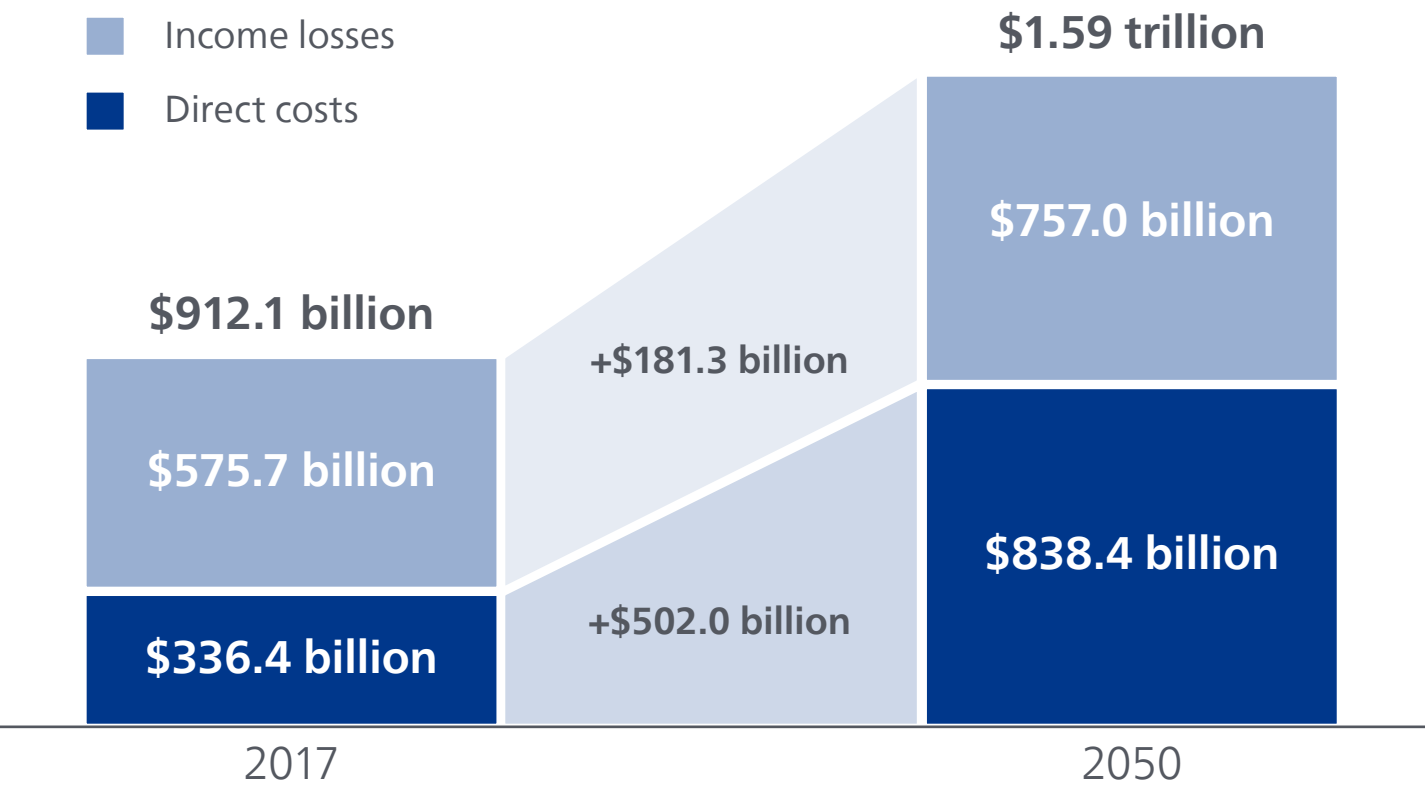
Better prevention

Prevention is one of the most effective and cost-efficient ways to reduce the stroke burden. The World Health Organization believes a fundamental strengthening of prevention (of high blood pressure and other determinants) and better monitoring strategies is paramount to reduce the global burden of stroke⁶.

The benefits of effective prevention will take time but are significant because they will also decrease the burden of other NCDs. To be fully effective, it is also important to focus on populations from more vulnerable backgrounds.

At the same time, it is vital to ensure that acute stroke care and post-stroke care services are strengthened and more easily accessible.

Figure 3: Global economic costs of stroke, US\$¹



Universal access to essential stroke care: more stroke units providing intravenous thrombolysis

Essential stroke care is founded on the ability to provide a 24/7 service with trained staff, enough ICU beds, coordinated care, and access to intravenous thrombolysis. Resource constraints remain a barrier in many health systems, and ensuring stroke sufferers have access to dedicated stroke centers, including intravenous thrombolysis, is a vital first step in low- and lower-middle-income countries. There are also large opportunities to further improve and expand access to essential stroke care in middle- and higher-income regions. Making use of the possibilities of digitalization and connected care, such as teleradiology, AI in diagnostics, and connecting information flows, can be a big help and provide more seamless essential stroke care for patients.

Expand access to advanced stroke care: mechanical thrombectomies

The expansion of advanced stroke care with mechanical thrombectomy as a broadly available acute stroke treatment response significantly lowers the chances of stroke leading to disability, especially among patients suffering from severe stroke.

Unfortunately, access to this effective and cost-saving treatment is still underdeveloped in many parts of the world. For major and most severely debilitating ischemic strokes, mechanical thrombectomy is performed on only a minority of eligible patients. Expanding its access requires investments in high-quality stroke infrastructures and coordinated action to develop stroke education programs to train neurointerventionalists and other professionals. Such investments will induce downstream savings in other parts of the health sector, most notably rehabilitation and nursing homes, and to society more broadly.

Facilities for intravenous thrombolysis and thrombectomies are both WHO recommended interventions for better cardiovascular care, and expansions are urgently needed⁶.

A collaborative policy agenda for better stroke care

What?	Who?
1 Set targets and quality indicators, assess current gaps and prioritize stroke care in global, national, and regional health plans	International organizations, Ministries of Health and other authorities, professional societies
2 Expand and invest in infrastructures for essential stroke services, including stroke units and intravenous thrombolysis - 90% or more of all patients with ischemic stroke should be treated in a stroke unit	Ministries of Health and other authorities, planning and reimbursement agencies, payers, secondary care facilities
3 Expand and invest in (capital) infrastructures for advanced stroke services: mechanical thrombectomy - Stroke units with capacity to do mechanical thrombectomy, should be accessible for every patient within 45 minutes driving radius	Ministries of Health and other authorities, planning and reimbursement agencies, payers, tertiary care facilities
4 Increase the necessary skills in the health workforce	Universities and vocational schools, professional societies
5 Make sure that payment models provide for adequate reimbursement of essential and advanced stroke care	Ministries of Health and other authorities, payment and reimbursement agencies, payers
6 Build a strategy to actualize the potential savings of essential and advanced acute stroke care	Ministries of Health and other authorities, payment and reimbursement agencies, payers





A coordinated approach

Stroke needs to be prioritized in the different policy arenas and relative to other policy goals. Ambitious national stroke plans that focus on building care pathways to bridge gaps in access to quality stroke care by building the necessary infrastructures, worker skills and supporting institutions, are a natural first step. Global understanding among policymakers about the actual burden of stroke is a precondition for any bold steps in national stroke plans. Greater awareness of positive health economic impacts, high cost-effectiveness of better endovascular stroke care, downstream savings, and the importance of widespread access to modern stroke care infrastructure should steer the content of such policy plans.

Ministries of Health, affiliated agencies, and payers should build payment structures and models that accommodate the necessary investments in the acute stroke care pathways. At the same time, they should design policies that build the compliance to capitalize on downstream savings, thus increasing health system resilience and freeing up resources for other needed priorities.

National targets, including quality indicators as set by WSO in *Lancet Neurology*¹, could help policymakers monitor progress and improve stroke patients' outcomes.

This can then inform and further mobilize stakeholders, policymakers, and decision-makers and pave the way for the creation of local champions.

What is there to gain?

Policymakers now have a powerful chance to make measurable progress in creating better healthcare for millions worldwide. Policy changes could reduce direct costs with substantial potential savings, thus freeing up essential resources for other needed priorities for our struggling healthcare systems.

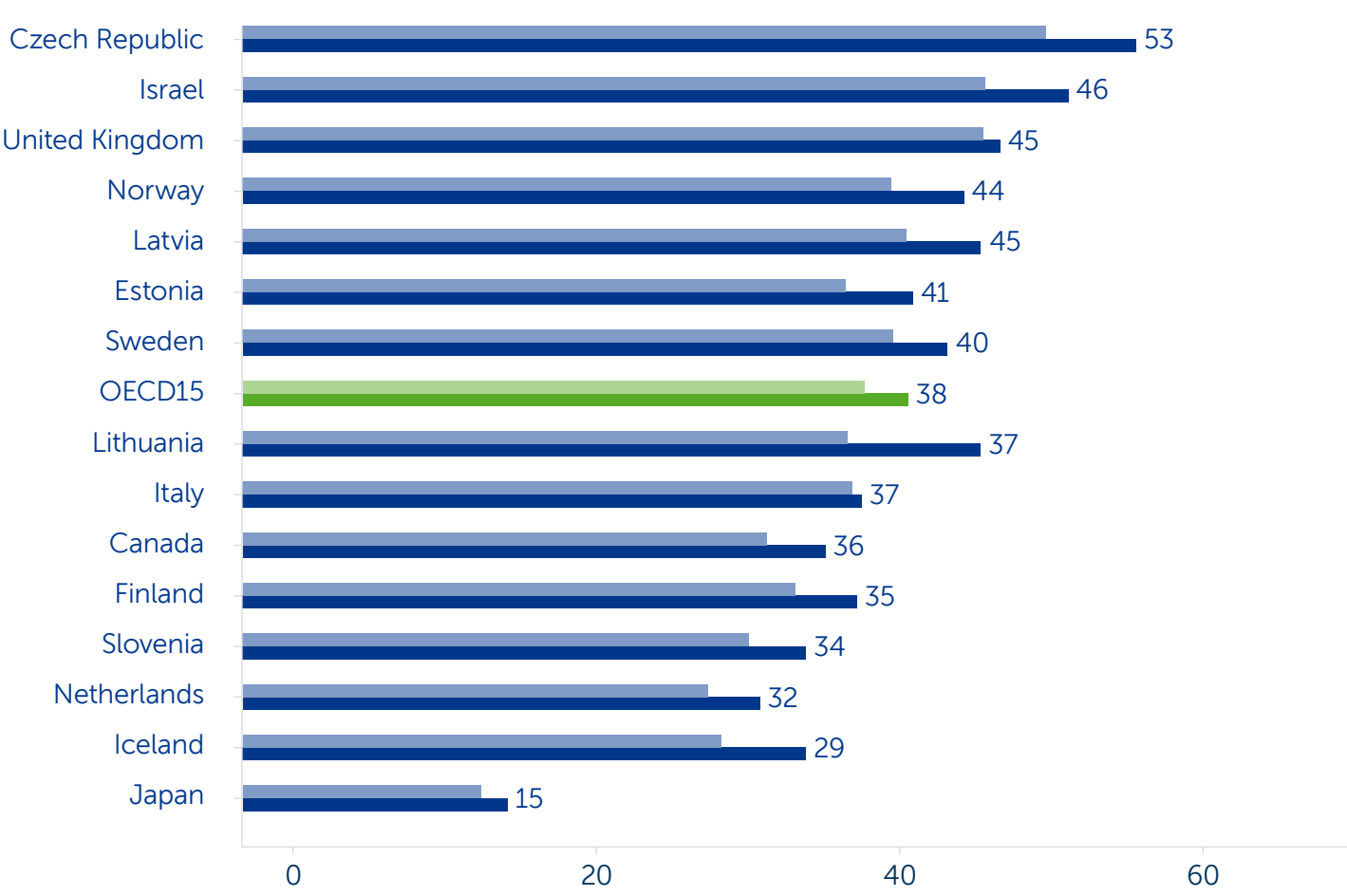
Case studies

Organisation for Economic Co-operation and Development (OECD) member states face a high burden of disease because of stroke and bear high costs (figure 4). Between 2013 and 2021 mortality of stroke and readmissions reduced slowly, suggesting progress on both prevention and treatment has been limited.

Another conclusion from figure 4 is that substantial variety exists between countries. This further underlines the scope for improvement.

Patients died and readmitted within one year of discharge after ischemic stroke (2013 and 2021).⁹

Figure 4: Ischaemic stroke



Age and sex standardised rate per 100 patients

We present four encouraging case studies on how better policies can make an impact towards better stroke care. First, in the Netherlands hospitals experimented early with mechanical thrombectomies and presented robust evidence with strong uptake as a result, Second, in Romania, the government steered a substantial increase in primary stroke care. Third, Japan pioneered an early national registry and legal framework for better stroke care. Finally, Brazil also successfully managed enduring progress with a combination of accommodating policies and country specific scientific evidence of better stroke care.

Opportunities for expanding mechanical thrombectomy

The revolution that mechanical thrombectomy has offered for severe stroke patients has not yet led to widespread implementation of high-quality stroke care. This is sobering reality, in spite of the major clinical effects and strong recommendations and international guidelines based on solid evidence from various clinical trials across the world.

Improving stroke care should be considered a solid societal investment in the lives of millions, rather than a financial commitment. For high- and higher-middle-income countries with well-established stroke care networks, the low number needed to treat* and the economic benefits of mechanical thrombectomy make improving its rate of use a vital tool in the fight to lower deaths and disability from non-communicable diseases (NCD).

A commitment to centralizing stroke care in public policy is also proven to boost health outcomes for stroke sufferers in lower-middle and low-income countries. Elevating the base level of stroke care will be crucial to ensuring healthy lives and promoting well-being for all at all ages as part of UN SDG 3 and its aim to reduce mortality and disability from NCDs by 2050.



The Action Plan for Stroke in Europe 2018-2030 states that by 2030, 90% 95% of eligible European patients should have access to intravenous thrombolysis and mechanical thrombectomy. Although considerable efforts have been made, a recent study showed significant differences between countries regarding access to appropriate acute stroke treatment⁵. Gaining an understanding of the trends of mechanical thrombectomy over time might provide insight into the accessibility and the implementation of new treatments in daily clinical practice.

Table 1: Estimated stroke care requirements in Romania per Action Plan Europe

Metric	2017	Ambition according to Action plan Europe
No. of stroke units	10	49
No. of comprehensive stroke centers (mechanical thrombectomy capable)	5	18
No. of IV treatments per year	237	(target rate 18%): 14064
No. of mechanical thrombectomy per year	<20	(target rate 5%): 3947

* The Number Needed to Treat (NNT) represents the number of patients that need to be treated for one patient to benefit from an intervention.



The Netherlands

The Netherlands has been at the forefront of implementing a streamlined acute stroke care pathway emphasizing rapid assessment and treatment. Currently, there are 85 stroke centers, including 20 thrombectomy centers for a population of 18 million inhabitants¹⁰, leading to five stroke centers per million inhabitants and 1.2 centers per million inhabitants that can provide thrombectomies.

The MR CLEAN (Multicenter Clinical Trial of Endovascular Treatment of Acute Ischemic Stroke in the Netherlands) was the first study in the world, published in 2015, to show the high effectiveness of mechanical thrombectomy in a randomized controlled trial. The study showed that successful recanalization in acute stroke can result in a four-fold increase in the likelihood of independence¹¹. Before the start of this study in 2010, research had already suggested that thrombectomies could be beneficial. However, the procedure was not reimbursed in the Netherlands until 2013, when reimbursement to centers was made conditional on participation in the MR CLEAN trial.

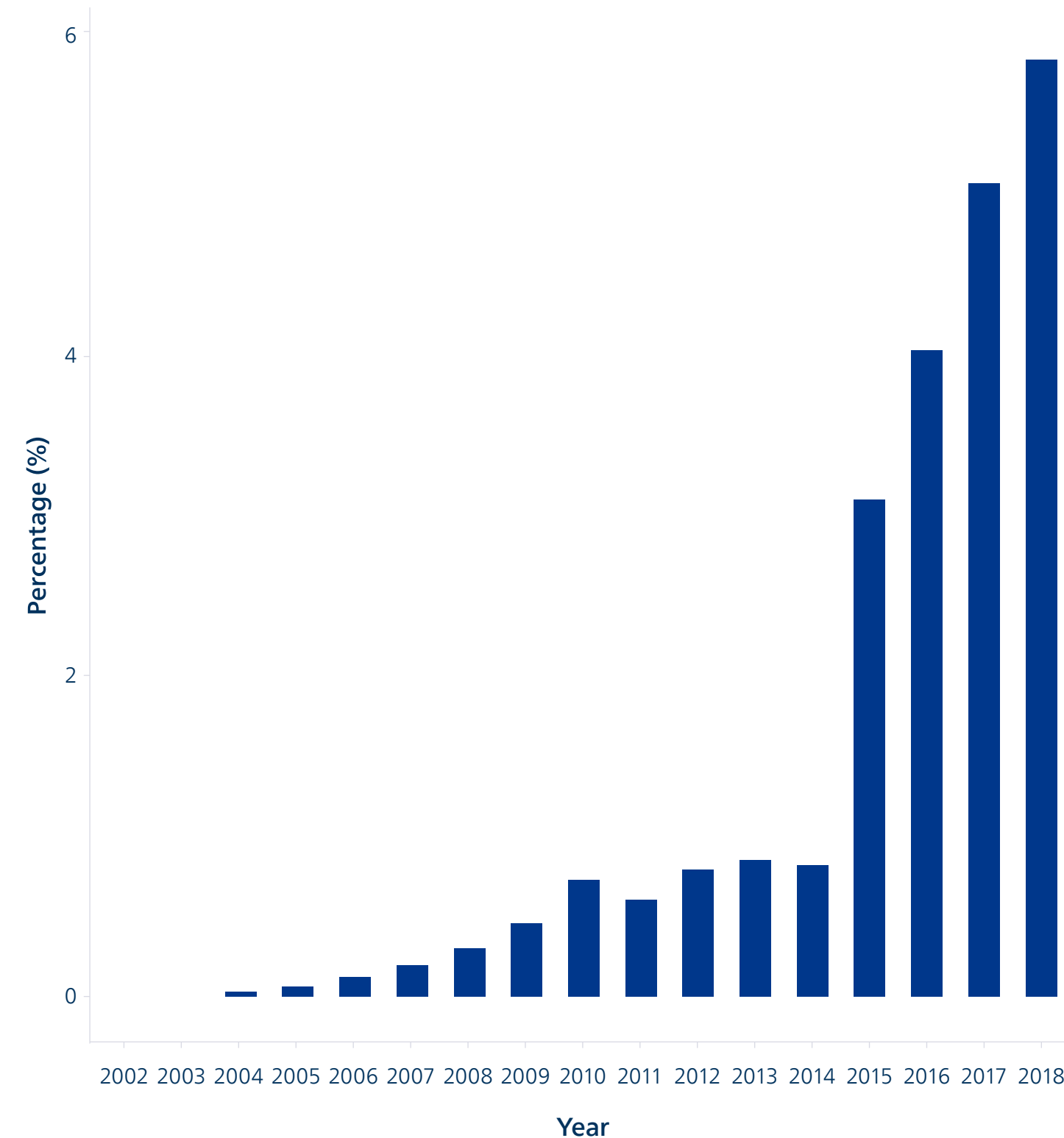
MR CLEAN – impact of mechanical thrombectomy



4x increase
in likelihood of
independence

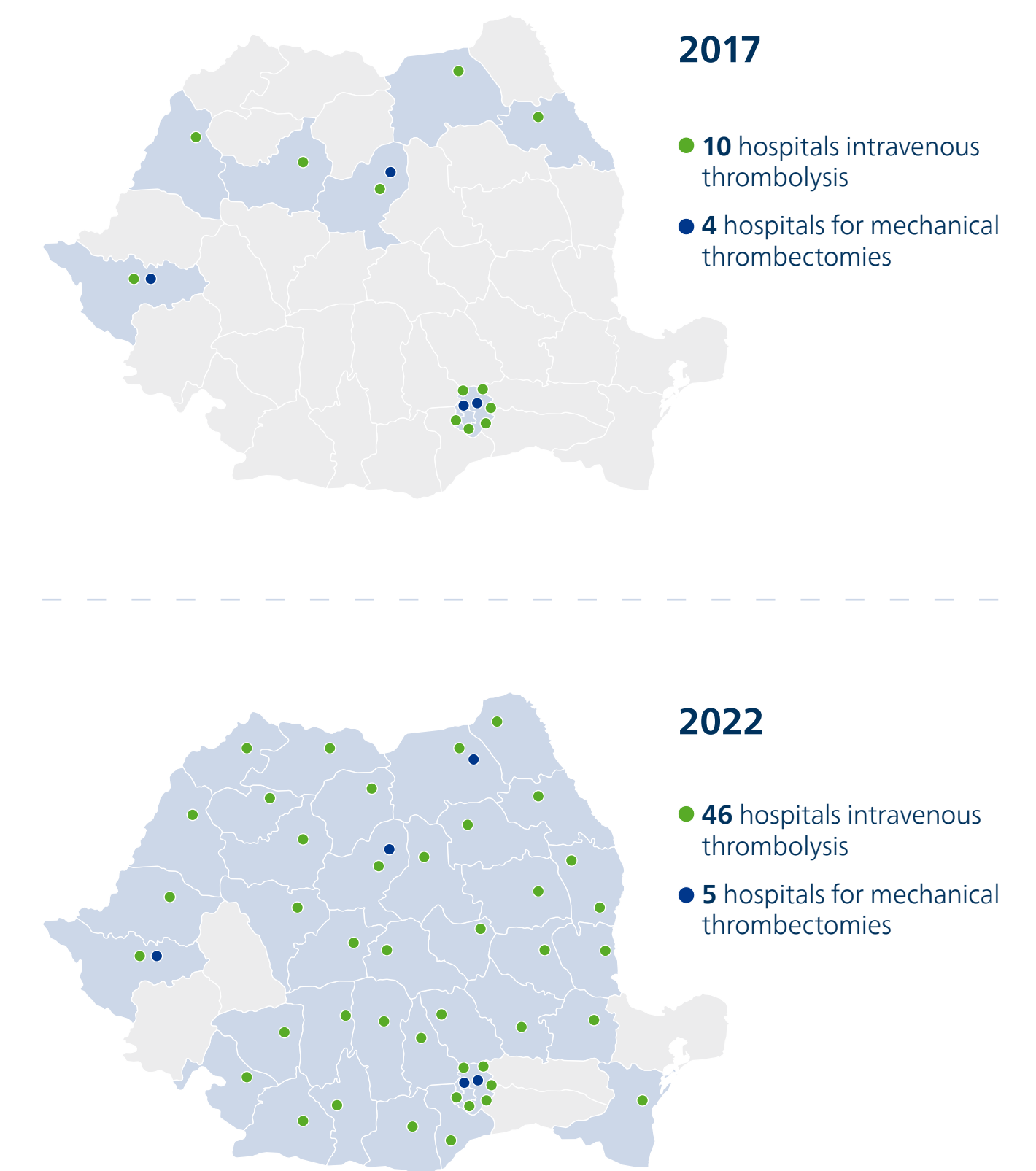
Multiple Dutch studies⁶ have focused on minimizing treatment delays, establishing comprehensive stroke centers equipped with the necessary technology and expertise, and creating a network of hospitals capable of performing mechanical thrombectomy.

Figure 5: Proportion of Acute Ischemic Stroke Patients Receiving mechanical thrombectomy¹⁰



Romania

Over the past seven years, Romania has dramatically improved the availability of basic acute essential stroke care through the development of country-wide intravenous therapy. With this solid base, an actionable and significant improvement in mechanical thrombectomy stroke care is now also feasible in the next five years.



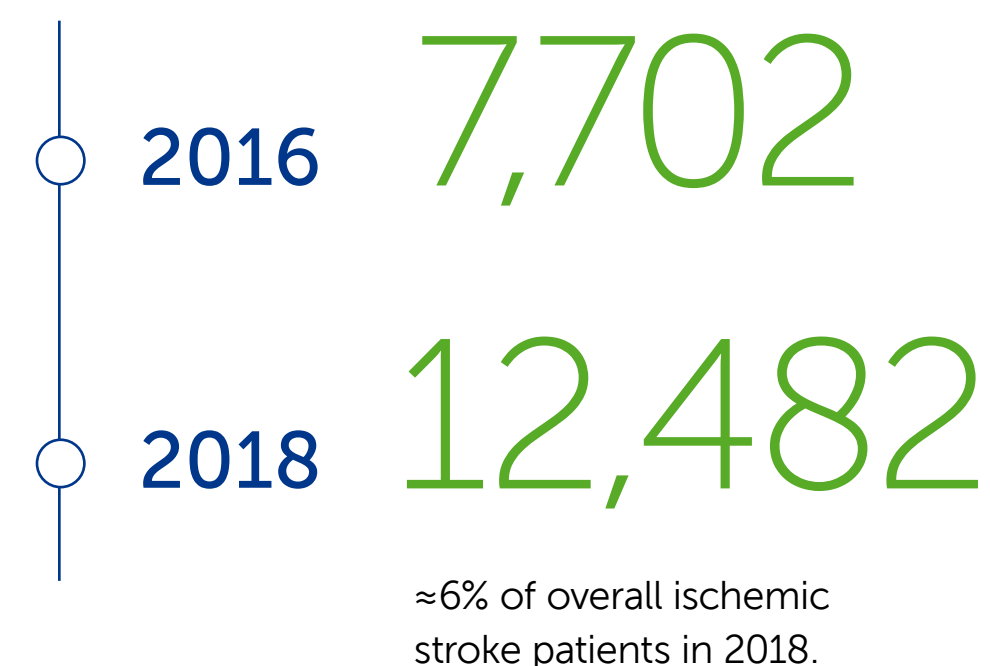


Japan

Stroke is the fourth leading cause of death and requires the most demand for nursing care in Japan¹². Since the annual medical cost of stroke is estimated at \$11.1bn and the cost of nursing care at \$12.3bn, the effect of stroke on the society and economy of Japan is extremely high.

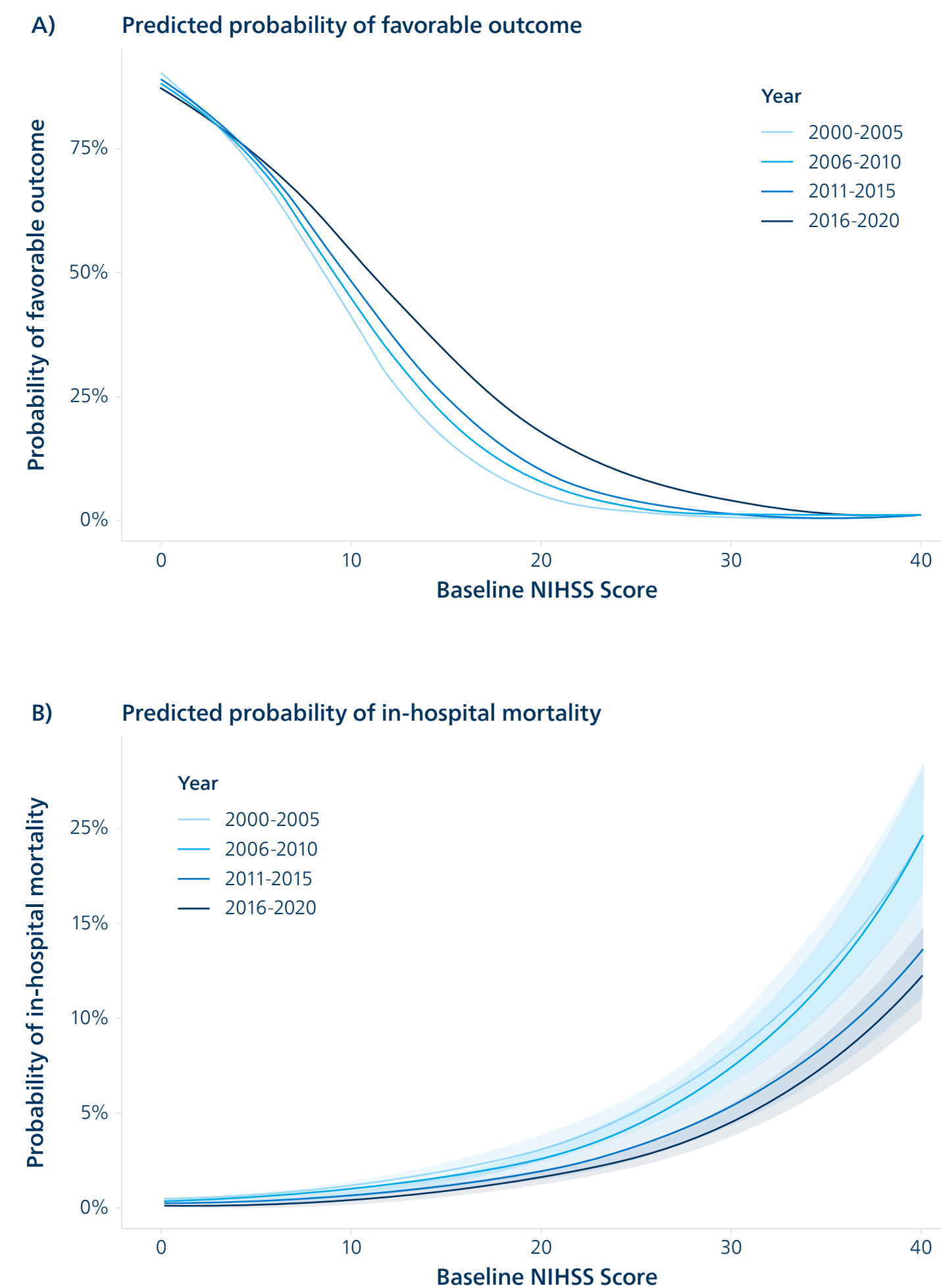
The first legislative measures targeting stroke and cardiovascular disease in Japan were established in December 2018¹³. The Japanese National Plan for Promotion of Measures Against Cerebrovascular and Cardiovascular Diseases was formulated in October 2020. The Japan Stroke Data Bank (JSDB), a Japanese stroke registry that had already started in 1999, has been collecting clinical data from many Japanese hospitals¹⁴.

Figure 6: Number of patients receiving mechanical thrombectomy in Japan¹⁵



The use of intravenous thrombolysis and mechanical thrombectomy increased in Japan between 2000 and 2020, especially for patients with National Institutes of Health Stroke Scale score ≥ 10 ¹⁶. With growing use of thrombectomy in Japan the probabilities for favorable outcome and mortalities have changed accordingly.

Figure 7: Associations between baseline NIHSS score and outcomes in 5-year cohorts¹³



Brazil

Brazil provides an impressive example of success in addressing the heavy burden of NCDs and has made significant progress in stroke care. In 1996, stroke was the number one cause of death in the country. While the country's first stroke unit opened that year, it wasn't until 2008 that the Ministry of Health created a national stroke program based on the experience of 35 stroke centers performing intravenous thrombolysis.

The National Law for Stroke was published in 2012. As of 2023, more than 300 public and private hospitals are prepared for acute stroke care, with 100 licensed and supported by the Ministry of Health.

Mechanical thrombectomy has recently been approved as a stroke treatment in Brazil's public health care system following the successful results of the RESILIENT trial, the first trial performed in a middle-income country and sponsored by the Ministry of Health, which proved the efficiency and cost-effectiveness of this treatment.⁷





Conclusion

Breaking down barriers

The burden of stroke is massive and continues to rise worldwide. It is the second leading cause of mortality and a key cause of long-term disability worldwide. This places a significant and growing burden on healthcare and the economy.

While effective treatments are available, access to care is limited to just a fraction of stroke patients. Technologies such as mechanical thrombectomy are not just another tool but a beacon of hope, offering the potential to improve the lives of millions of people who experience the impact of stroke every year. Policymakers and other stakeholders should recognize the potential these treatments have to strengthen their health systems and increase access. Improving access to mechanical thrombectomy and developing the 24/7 infrastructure networks needed to support this treatment will require concrete actions, but the potential for positive change is within our grasp.

Investing in stroke care and research is not just a financial commitment, but also a highly effective investment. The current human and economic cost of stroke is enormous today, and without targeted efforts, it will only escalate. The efficacy of intravenous thrombolysis and especially mechanical thrombectomy surpasses that of treatments for comparable NCDs by a wide margin. Investing in these treatments will yield long-term savings on the direct costs for nursing and rehabilitation, and help to alleviate the strain on healthcare budgets regardless of a country's income level. Investing in stroke care will increase quality of life and reduce costs.

Governments, payers, providers, professional societies, and patient groups all have a crucial role to play in combatting this disease. Their collaborative efforts can bring meaningful change. This entails not only increasing the capacity of stroke units as the first level of care, but also significantly boosting the proportion of patients receiving effective advanced treatment, thereby preventing lifelong disability and ensuring functional independence after a stroke. It means educating health workers, individuals, communities, and the entire care pathway, about the importance of swift action in the event of a stroke. By taking these steps, governments can empower their citizens and take responsibility for improving the health of their nations.

The time to act on tackling the burden of stroke is now.

The World Stroke Organization and Philips are committed to working with all stakeholders to strengthen the stroke care system, so that it better serves patients across their entire care experience.

Together we must, and we can, break down the physical, clinical and operational barriers to care to reduce the global burden of stroke.

For more information, read the Philips Position Paper¹⁷ on Shaping the future of stroke care or visit the World Stroke Organization¹⁸.

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