Cost-effectiveness Analyses of Acute Ischemic Stroke Care Pathways: A Model for Different Scenarios and Countries

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EE541

Introduction

Acute ischemic stroke (AIS) occurs when a blood clot blocks an artery, leading to a sudden loss of blood flow to a specific part of the brain [1].

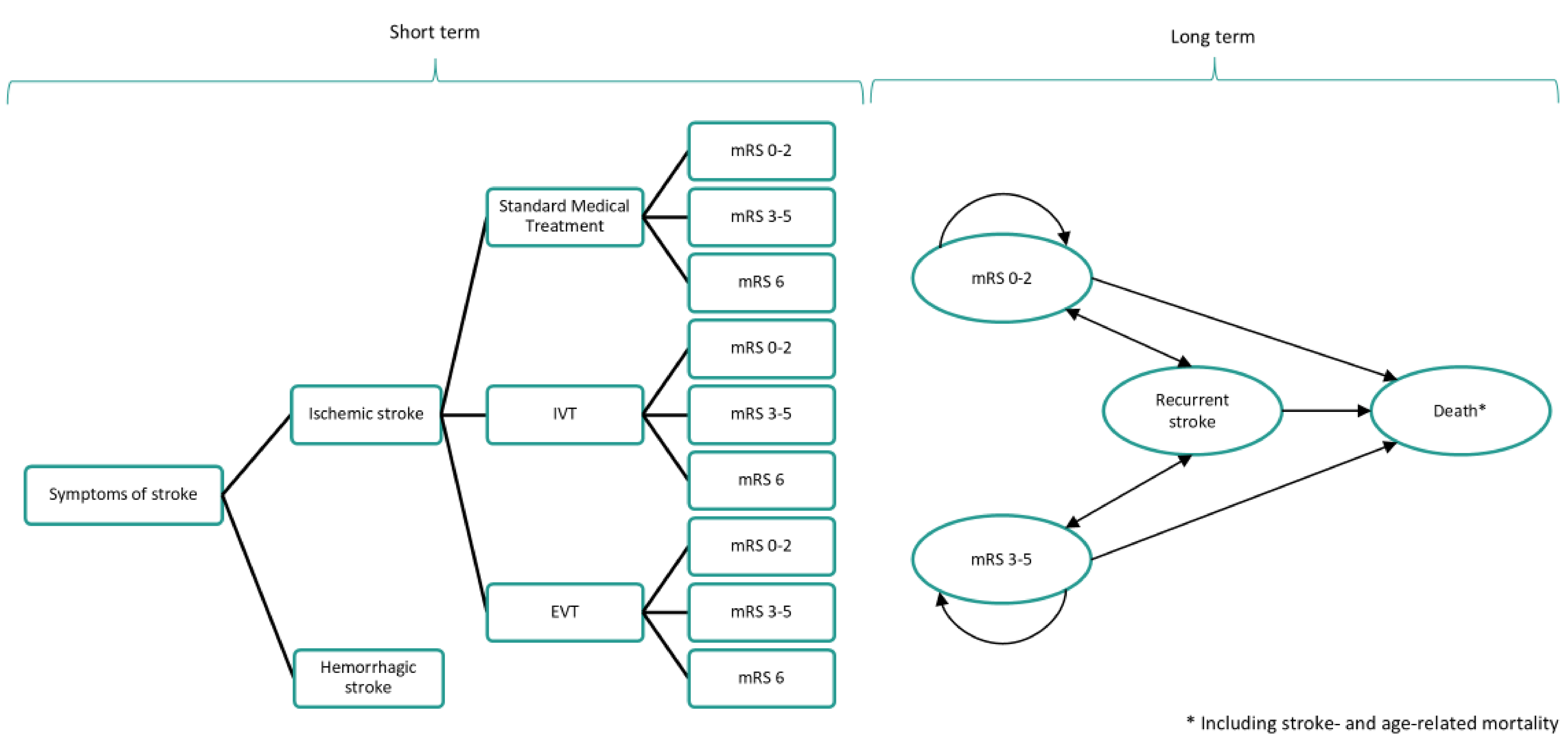
AIS is a leading cause of disability and mortality worldwide, resulting in a significant burden on healthcare, families, society and the economy.

To meaningfully reduce the burden of stroke, the status of the current care and the impact of opportunities to improve patient outcomes and economic outcomes need to be assessed. The Stroke Action Plan for Europe has set targets along the care pathway to improve outcomes [2].

Aim

This study aims to perform a scenario analysis on the cost-effectiveness of the AIS care pathway across different countries, with a view to estimating the impact of country-specific improvements on acute and long-term costs and patient outcomes in AIS.

Figure 1. Schematic view of the Decision tree and Markov model



EVT; endovascular treatment, IVT; intravenous treatment, mRS; modified Rankin Scale

Methods

The current AIS care pathway was modeled using a combination of a decision tree and a Markov model (figure 1). The scenarios mentioned below were used as the new care pathways, to compare with the current AIS care pathway per country.

Scenarios based on targets [2,3]:

1. Decrease onset-to-needle (OTN) time to <120 min
2. Decrease onset-to-puncture time (OTP) to <200 min
3. Increase number of Stroke Units (SUs) to 3 SUs per 1 million inhabitants
4. Increase intravenous treatment (IVT) rate to 15%
5. Increase endovascular treatment (EVT) rate to 5%

Countries included here: France, Germany, Italy, Spain, Sweden, The Netherlands, UK.

For the countries that had already met the targets mentioned above, alternative scenarios were modelled, including a twofold increase in EVT treatment rates and a 50% reduction in in-hospital time to treatment.

For the above-mentioned scenarios, the impact on clinical outcome, costs and QALYs were calculated. Data sources included real-world data from national healthcare databases and published literature. Univariate deterministic sensitivity analysis (DSA) and probabilistic sensitivity analysis (PSA) were performed to assess the model robustness and parameter uncertainty.

Table 1. Baseline data of current stroke care compared to targets set [2,3].

	Scenario 1 Decrease onset-to-needle time	Scenario 2 Decrease onset-to-puncture time	Scenario 3 Increase stroke units	Scenario 4 Increase IVT rate	Scenario 5 Increase EVT rate
Target	<120 min	<200 min	3 stroke units per 1 million inhabitants	15%	5%
Germany	96	160	3.7	16.4	6.5
Spain	57	166	1.3	7.5	3.6
France	153	244	2.2	9.2	5.3
Netherlands	85	180	5	20.6	4.6
UK	100	378	3.1	11.7	0.5
Italy	160	225	3	7.4	1.7
Sweden	84	127	7.4	15	2.2

EVT; endovascular treatment, IVT; intravenous treatment. Green; target met. Red; target not met.

Results

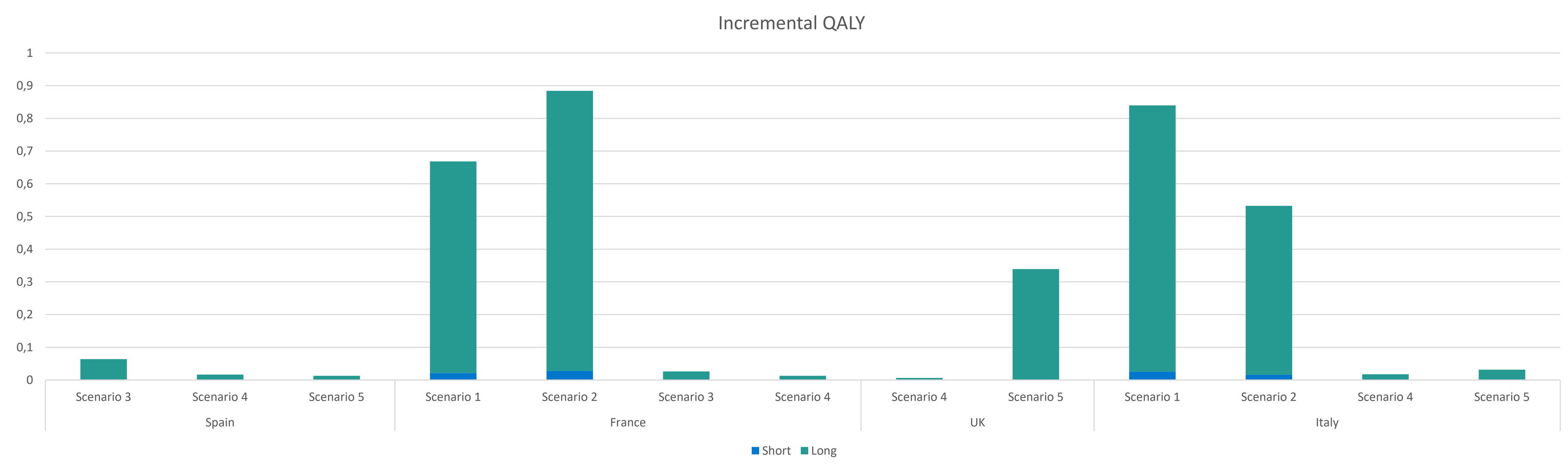
Our analysis showed variability of the impact of different scenarios across different countries. Figures 2-3 report results for countries that did not meet the targets. The results from alternative scenarios for the countries that already met the target are described below. Examples of other outputs calculated by the model, like DSA and modified Rankin Scale shift are shown in figure 4 and 5, respectively.

In Germany, doubling the EVT treatment rate resulted in a QALY gain of 0.07 and lifetime cost savings of €709.34 per patient, totaling €187M saved for all AIS patients. Additionally, halving door-to-puncture time to treatment led to a QALY gain of 0.99 and lifetime savings of €4106.60 per patient, resulting in total savings of €1B.

In the Netherlands, doubling the EVT treatment rate resulted in a QALY gain of 0.06 and lifetime incremental costs of €302.18 per patient. Additionally, halving door-to-puncture time to treatment led to a QALY gain of 1.62 and lifetime savings of €6655.36 per patient, resulting in total savings of €129M.

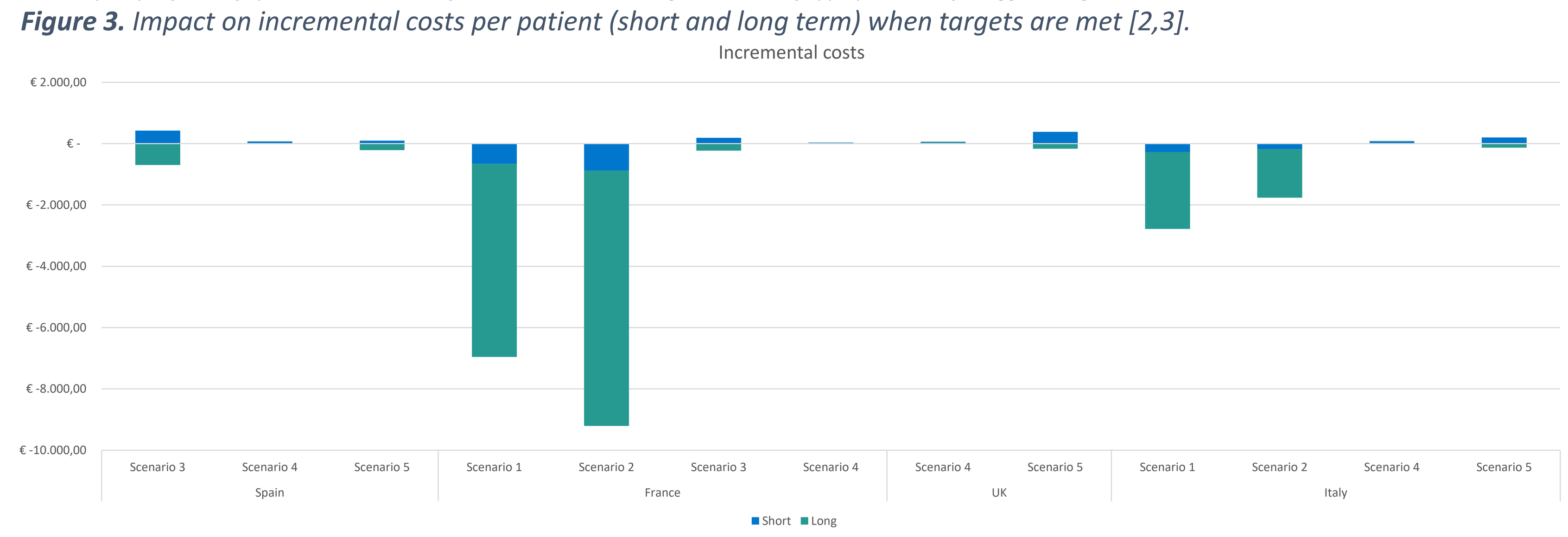
In Sweden, doubling the EVT treatment rate resulted in a QALY gain of 0.02 and lifetime cost savings of €170.20 per patient, totaling €2.4M saved for all AIS patients. Additionally, halving door-to-puncture time to treatment led to a QALY gain of 0.59 and lifetime savings of €7987.86 per patient, resulting in total savings of €114M.

Figure 2. Impact on incremental QALY per patient (short and long term) when targets are met [2,3].



QALY; quality adjusted life years. Note; scenario 2 for UK was not calculated given the lack of appropriate data for bigger changes

Figure 3. Impact on incremental costs per patient (short and long term) when targets are met [2,3].



Note; scenario 2 for UK was not calculated given the lack of appropriate data for bigger changes

Figure 4. Univariate deterministic sensitivity analyses for doubling the EVT rate in Germany

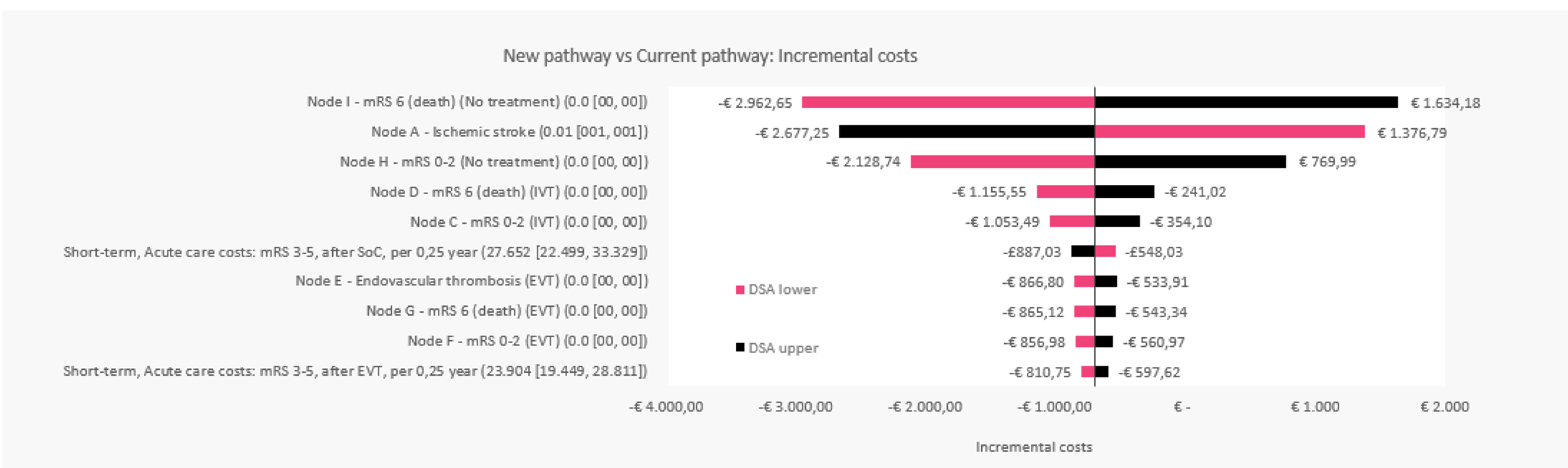
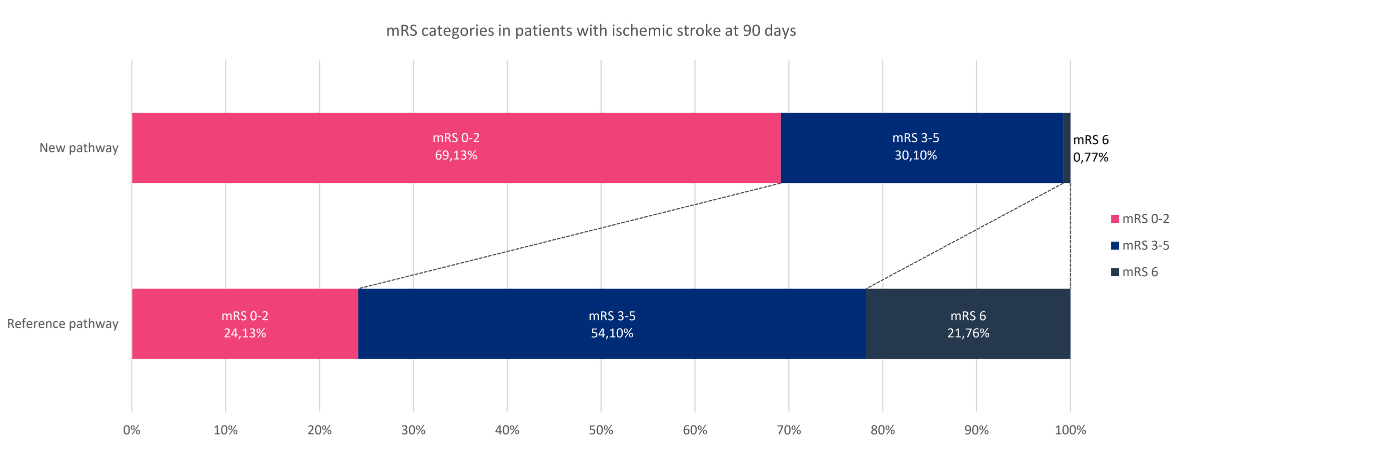


Figure 5. Shift in modified Rankin Scale at 90 days for halving the door-to-puncture time in the Netherlands



mRS; modified Rankin Scale, mRS 0-2; good functional outcome (independent), mRS 3-5; bad functional outcome (dependent), mRS 6; death

Conclusion

The most cost-effective strategies to improve the AIS care pathway differ by country due to the varying level of the current AIS care and costs.

Our model provides a valuable adaptable tool for policy- and decision makers to evaluate and optimize AIS care pathways across diverse settings, potentially leading to significant economic and health benefits.

The model can be applied to a country, yet also provider level, across the entire care pathway (from prevention to home care). Our study highlights the importance of country-specific strategies to improve the health economic outcomes of the AIS care pathways.

References

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Full reference list upon request

Important references used for model

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