

Cost-effectiveness analysis of the helicopter emergency medical services for stroke patients in Austria

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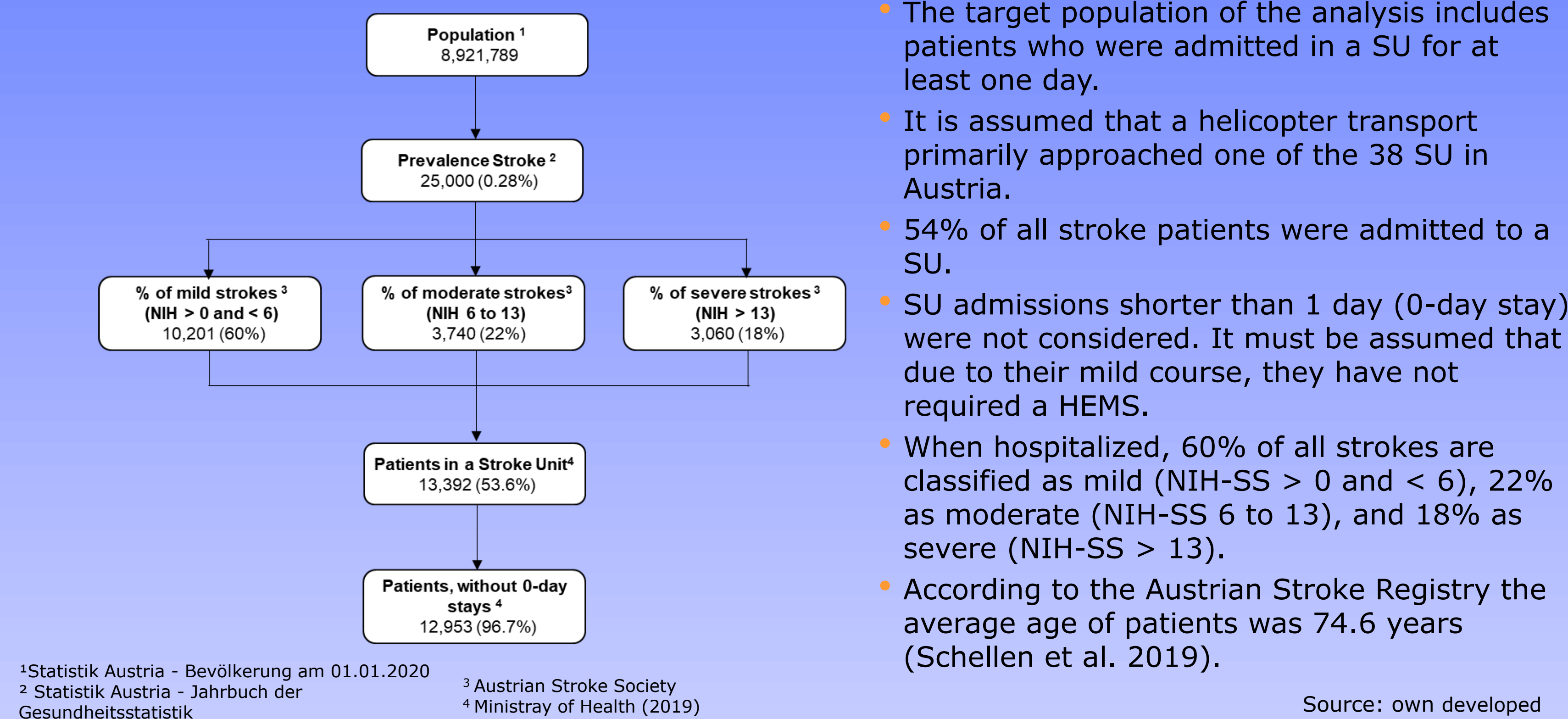
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Objectives

Many patients suffer from acute stroke at a significant distance from dedicated stroke centers. Since onset of advanced stroke care is time critical, the impact of rapid transport provided by helicopter emergency medical services (HEMS) on patient outcome merits further evaluation. Accordingly, the aim of this study was to evaluate the cost-effectiveness of a HEMS compared with ground-based ambulance-transport for patients with acute stroke to a stroke unit (SU).

Figure 1: Derivation of the enclosed target population



Methods

A Markov-model was developed based on the modified Ranking Scale (mRS) states 90 days after stroke to simulate consequences over a 10-year time-horizon. Consequences include recurrent stroke, deteriorated mRS, death due to recurrent stroke or other reasons. Health benefits were measured in quality-adjusted life-years (QALYs) and life-years (LYs). Probabilities were derived from the literature mainly the stroke registry. According to data derived from the OEAMTC Air Rescue, 4.9% of all SU admissions are carried out by HEMS. The target value for an appropriate use of HEMS was assumed to be 20%. The assumption was because 18% of all patients admitted to a SU suffer a severe stroke (NIH-SS<13). Direct-costs (2020 €) were derived from published sources from the payer's perspective. QALYs, LYs and costs were discounted (3% p.a.). Monte-Carlo-simulation accounted for uncertainty.

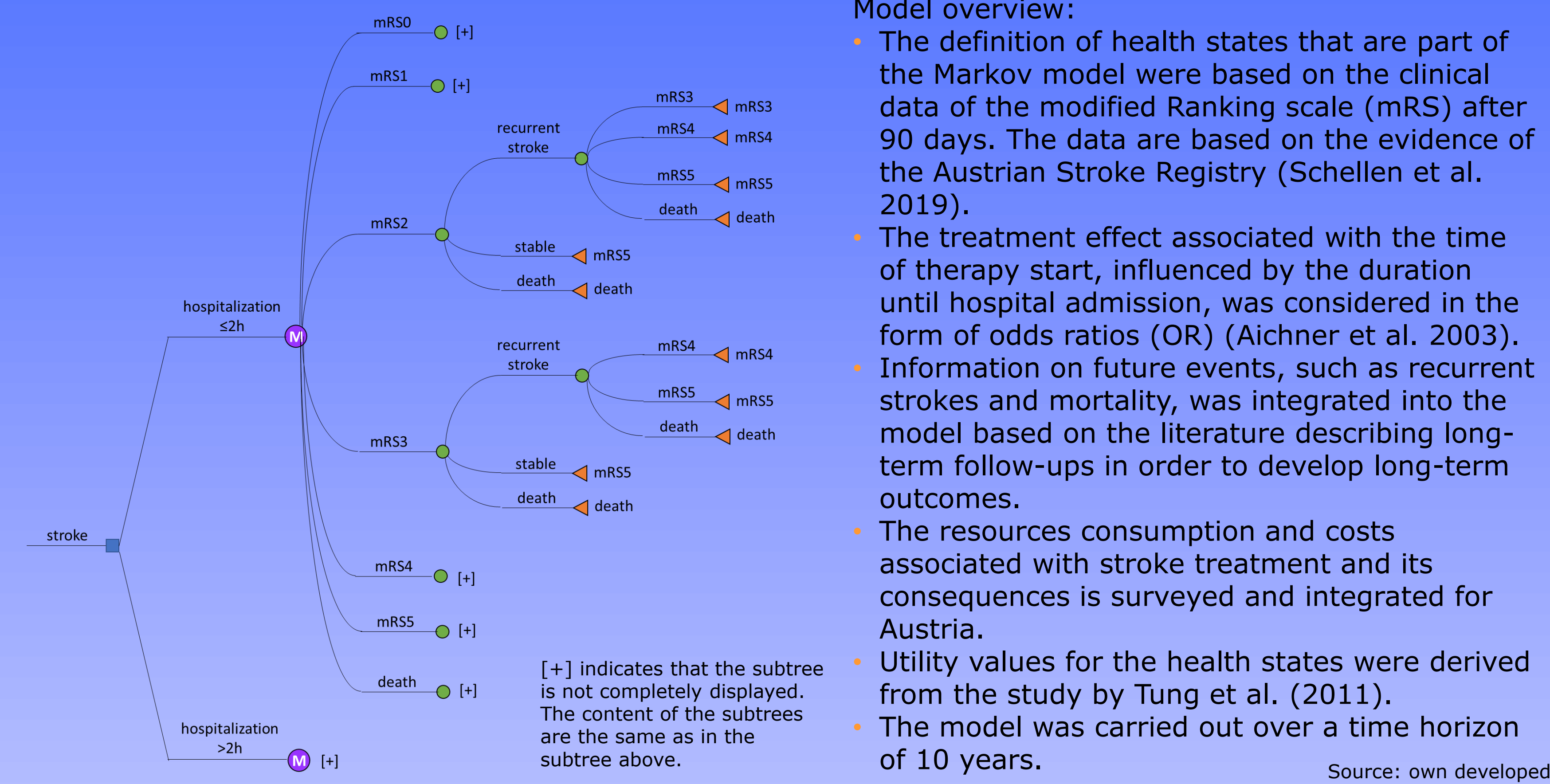
Comparators (therapeutic alternatives)

- SCENARIO (1)
- Increased share of HEMS (20%)
- Current situation of HEMS (4.9%)
- SCENARIO (2)
- Patient delivered with HEMS
- Patient delivered with ground-based ambulance-transport

Clinical Data

Clinical data include mRS stage distribution after 90 days, as well as improvement as a result of faster hospital admission. The stage distribution of the current analysis was based on the evaluation of the Austrian Stroke Registry data (Schellen et al. 2019). Furthermore, mortality and the incidence of recurrent strokes were integrated. The improvement due to faster admission in neurological impairment was determined using odds ratios (OR), which represent the improvement of mRS (Aichner et al. 2003).

Figure 2: Model Design



Resource use and costs

The cost of analysis from the payer's perspective includes direct costs of first and recurrent stroke, transportation costs, monitoring costs and rehabilitation costs. Furthermore, cost components outside the healthcare system was considered, such as costs for nursing homes and the care allowance.

- Stroke costs include stroke unit costs as well as the cost of thrombolysis with rt-PA as well as the intervention costs of mechanical thrombectomy. Resource use and costs were extracted from the Austrian DRG-system.
- Rehabilitation costs, nursing home costs and the care allowance were derived from the literature.

Results

A >20% proportion of stroke patients who were transported by HEMS to a SU is associated with savings over a 10-year time-horizon (3,500.- € to 10,191.- € per patient). Savings are due to a better neurological status (mRS after 90 days), because of the faster onset of stroke interventions. Patients also achieved a higher life expectancy (0.7 to 1.39 LYs) and quality of life (0.23 to 0.86 QALYs).

The following illustrations are intended to present the results of the two comparisons in detail:

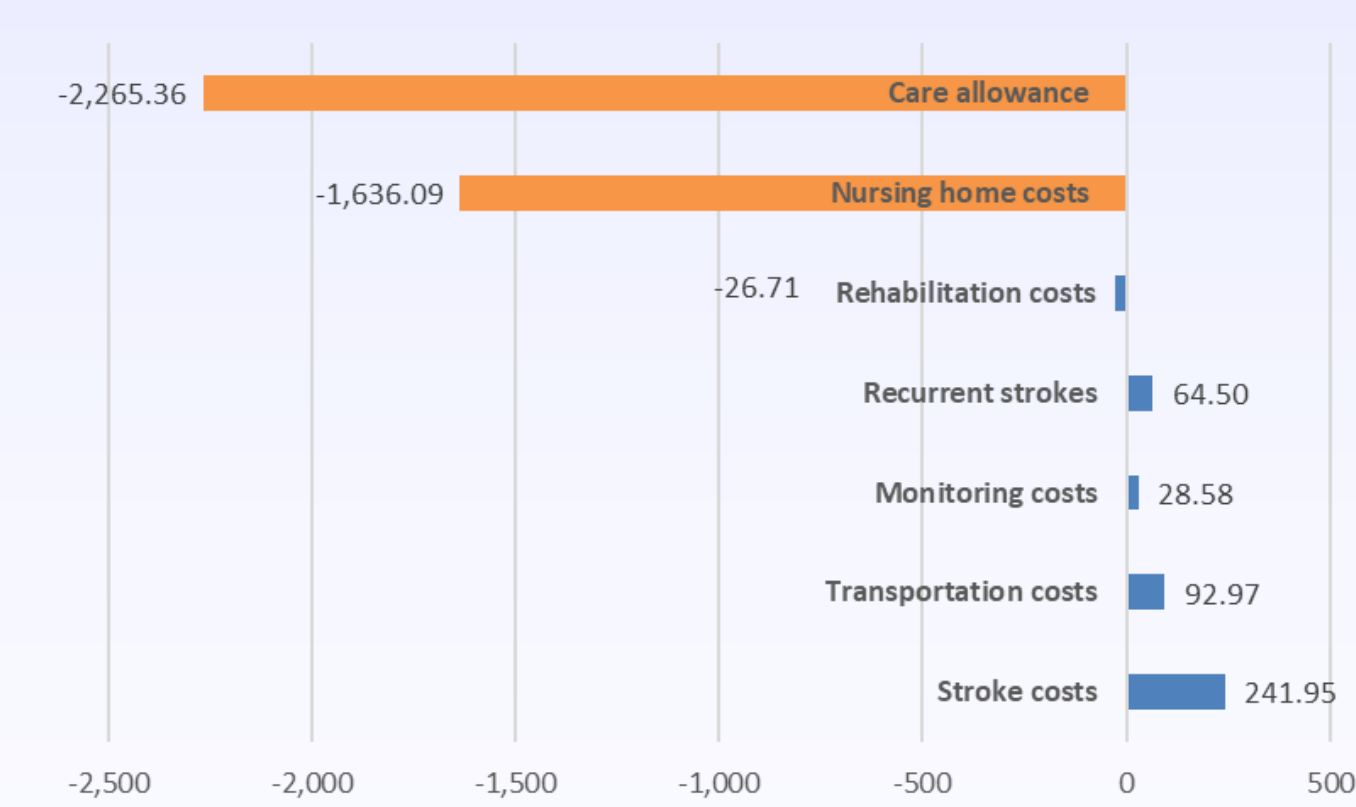
(1) Increased share of deliveries by HEMS (20%) vs. current situation (4.9%)

Table 1: Base case results of scenario (1)

Strategy	HEMS increased share	HEMS Current situation
Total costs per patient	92,710.24 €	96,210.41 €
Difference		-3,500.17 €
QALYs	2.346	2.144
Difference		0.202
ICER/QALY		DOMINANT
LYs	5.166	6.608
Difference		0.558
ICER/LY		DOMINANT

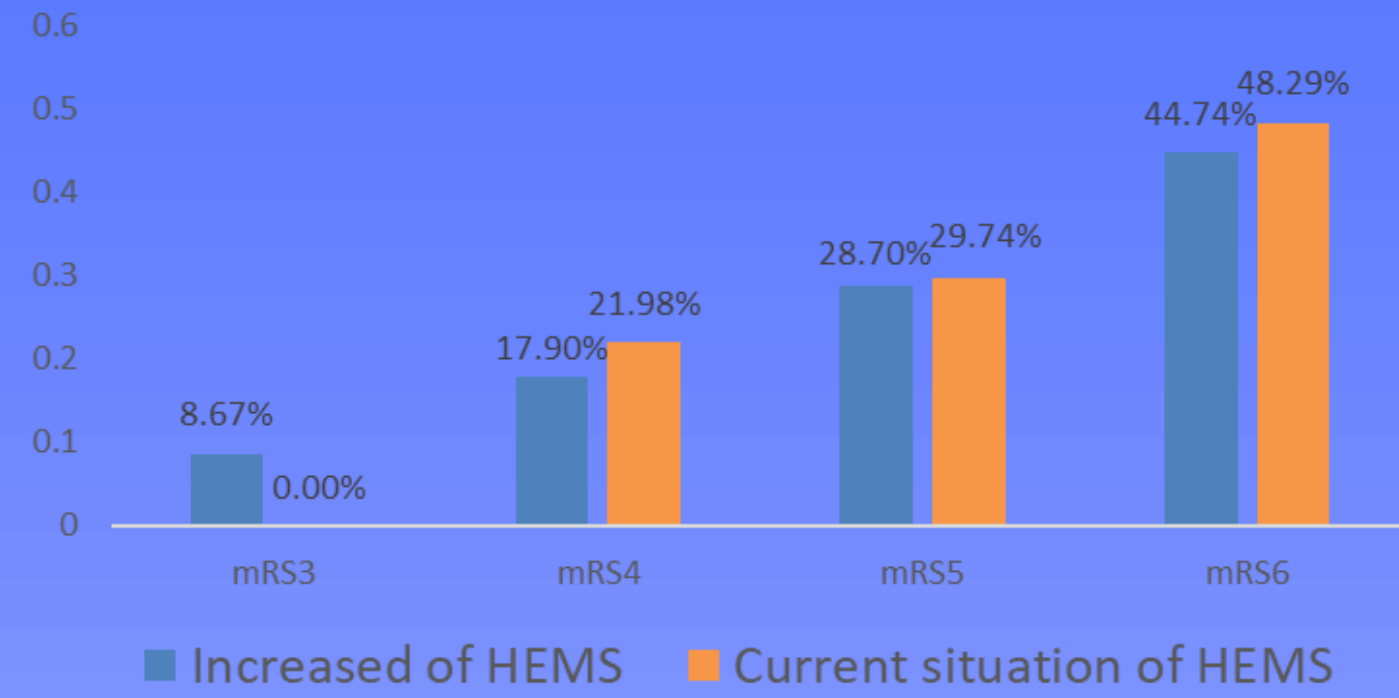
Source: own calculations

Figure 3: Additional costs and savings of scenario (1)



The average total cost per patient, with an increased share of HEMS, is 92,710 € over 10 years, compared to per patient costs in the current situation of 96,210 €. An increased percentage of HEMS dominates the current situation. Looking at the individual cost components, the average costs of stroke treatment are higher with an increased proportion of HEMS, but are compensated by savings in rehabilitation, nursing home and care allowance costs (Fig. 3).

Figure 4: mRS distribution in year 10 of scenario (1)



Source: own calculations

(2) Patient delivered with HEMS vs. patient delivered with ambulance-transport

The cost advantage increases significantly to -10,191 € when a HEMS is compared with a ground-based ambulance-transport. The comparison showed again a dominant result.

Table 2: Base case results of scenario (2)

Strategy	HEMS	No HEMS
Total costs per patient	86.808.73 €	96.999.66 €
Difference		-10,190.93 €
QALYs	2.882	2.118
Difference		0.764
ICER/QALY		DOMINANT
LYs	5.773	4.608
Difference		1.164
ICER/LY		DOMINANT

Figure 5: Additional costs and savings of scenario (2)

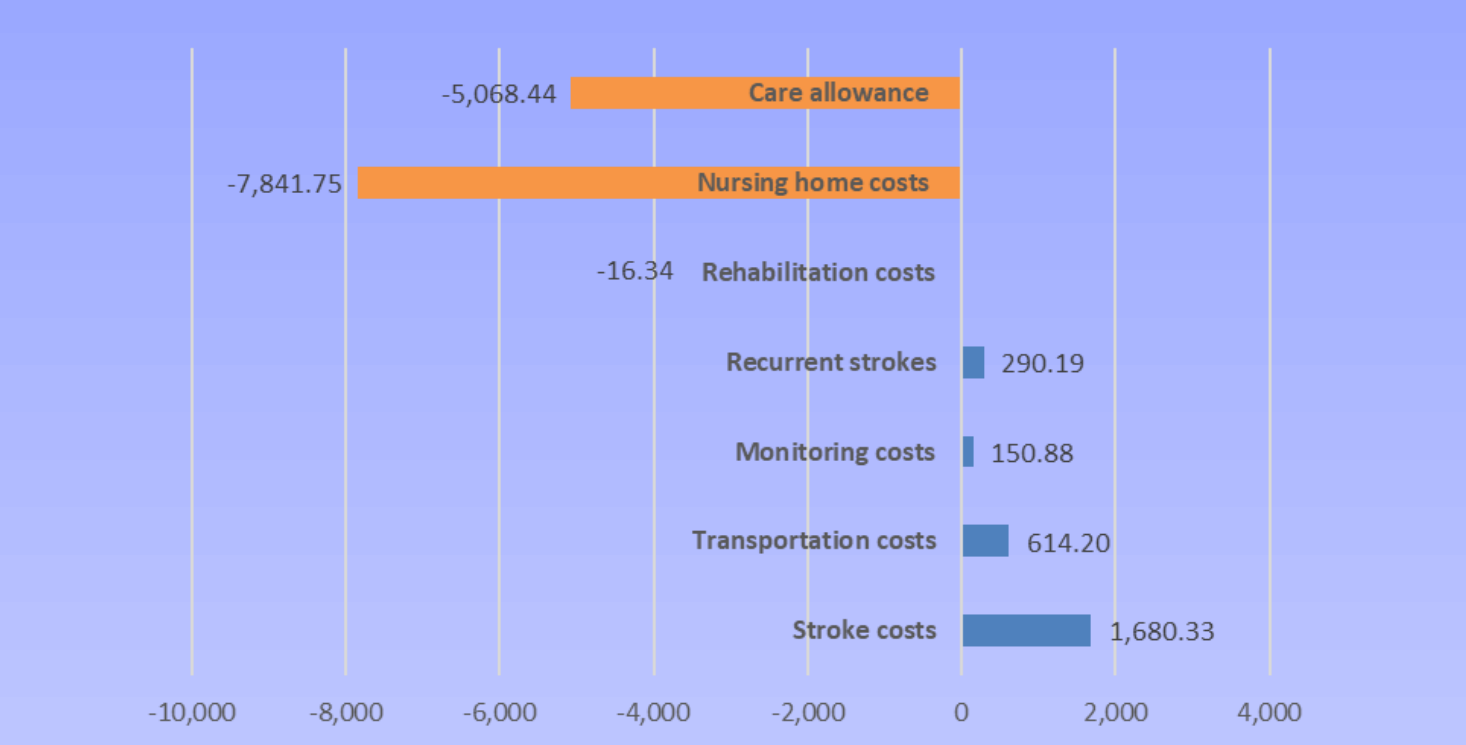
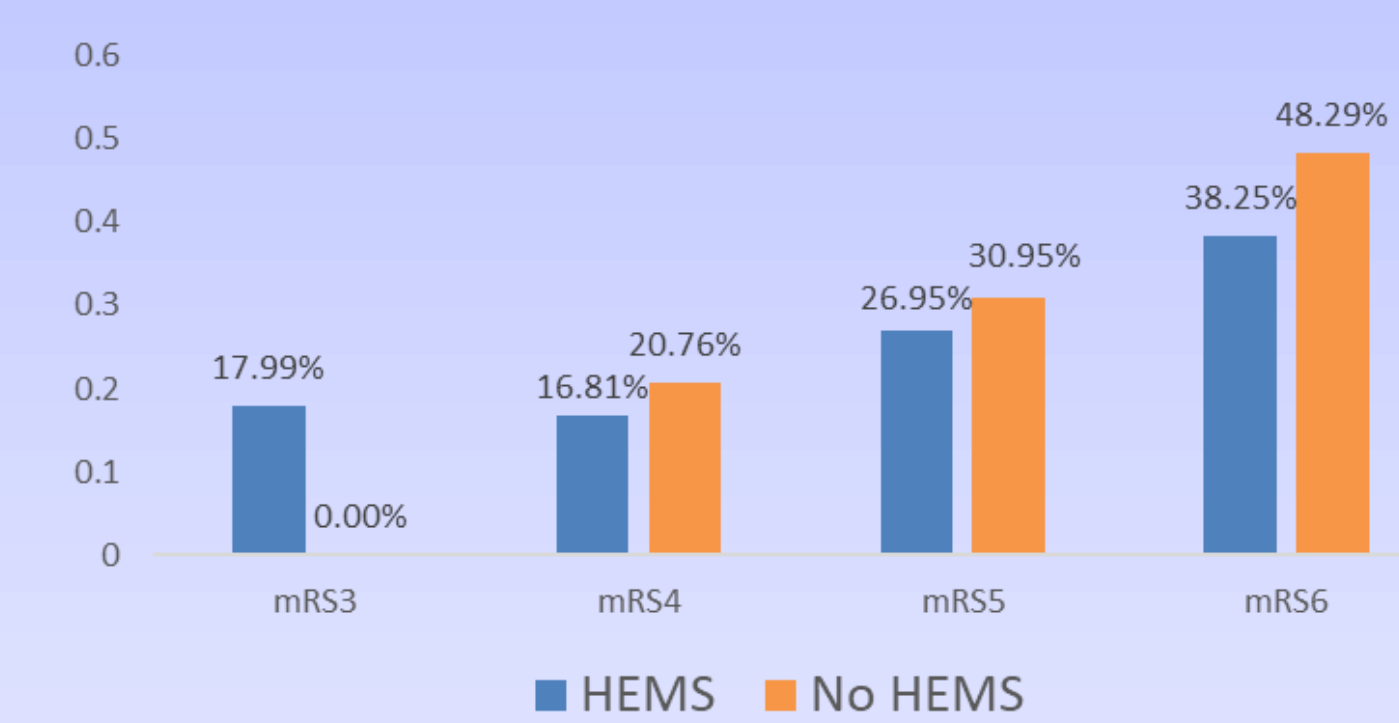


Figure 6: mRS distribution in year 10 of scenario (2)



Source: own calculations

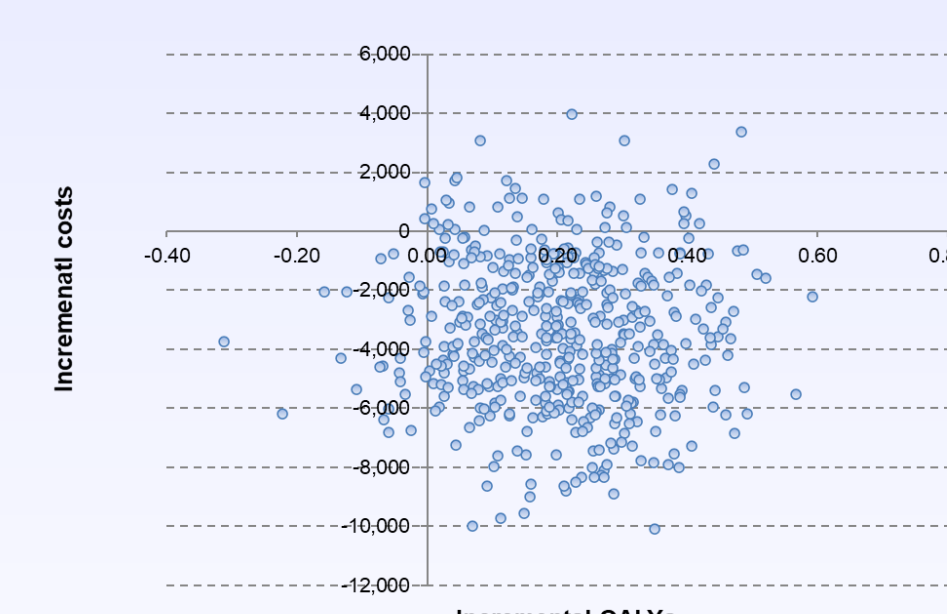
- Patients delivered by HEMS into a SU also achieved a better outcome.
- In year 10, more patients were in better health stages according mRS than in the comparator group; e.g. 18% in mRS3 with HEMS vs. 0% without HEMS.
- HEMS generated additional 0.764 QALYs or 9.2 months in perfect health.
- HEMS also improved life expectancy by 1.164 LYs or 14 months (undiscounted by 16.7 months).

Sensitivity Analysis

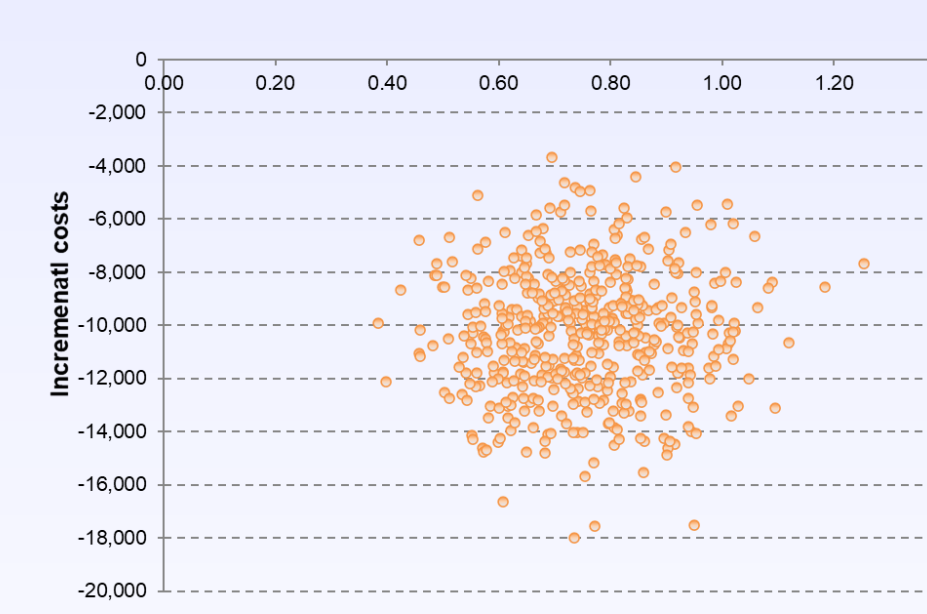
Probabilistic and deterministic sensitivity analysis were carried out to examine the robustness of the model.

Figure 7: Scatterplots of the probabilistic sensitivity analysis (PSA)

Scatterplot, increased HEMS vs. current situation



Scatterplot, HEMS vs. no HEMS



Source: own calculations

Conclusion

In the entire cohort of stroke patients in 2020 (n=12,953), savings of 45.3 million € could be achieved. 1 € spend in HEMS results in savings of 15.9 € in the health-care and social system.

References

Schellen C, Posekany A, Ferrari J, Krebs S, Lang W, Brainin M, Staykov D, Sykora M; Austrian Stroke Unit Registry Collaborators. Temporal trends in intracerebral hemorrhage: Evidence from the Austrian Stroke Unit Registry. PLoS One. 2019 Nov 20;14(11):e0225378.
Additional literature with the authors