

Cost-effectiveness of NT-proBNP in patients with chronic heart failure with or without type 2 diabetes mellitus in Austria

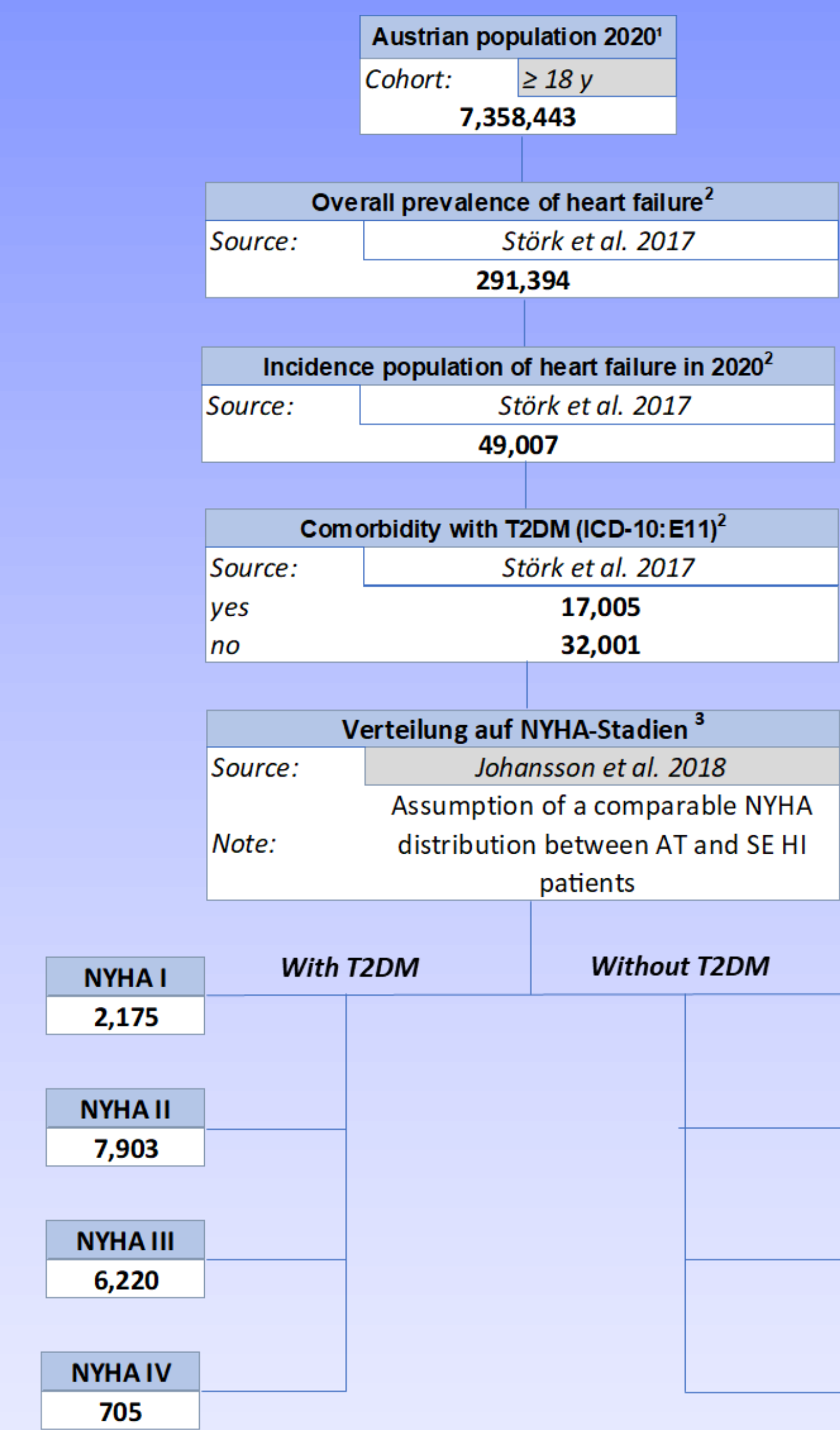
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Objectives

Heart failure (HF) is a clinical syndrome with a global burden. In Austria, 291,400 people affected a HF, of which 49,007 are newly detected. The symptoms of HF are non-specific and sometimes difficult to distinguish from those of other diseases. NT-proBNP serves as a useful biomarker for exclusion diagnosis and for risk stratification of HF, not only in patients with acute symptoms but also in outpatients with an ambiguous clinical presentation. The aim of the analysis is to evaluate the cost-effectiveness of screening patients with or without type 2 diabetes-mellitus (T2DM) with NT-proBNP to detect HF compared to no-screening, i.e. diagnosis based on clinical signs from the perspective of the Austrian health-care system.

Figure 1: Incidence and prevalence of heart failure with and without T2DM



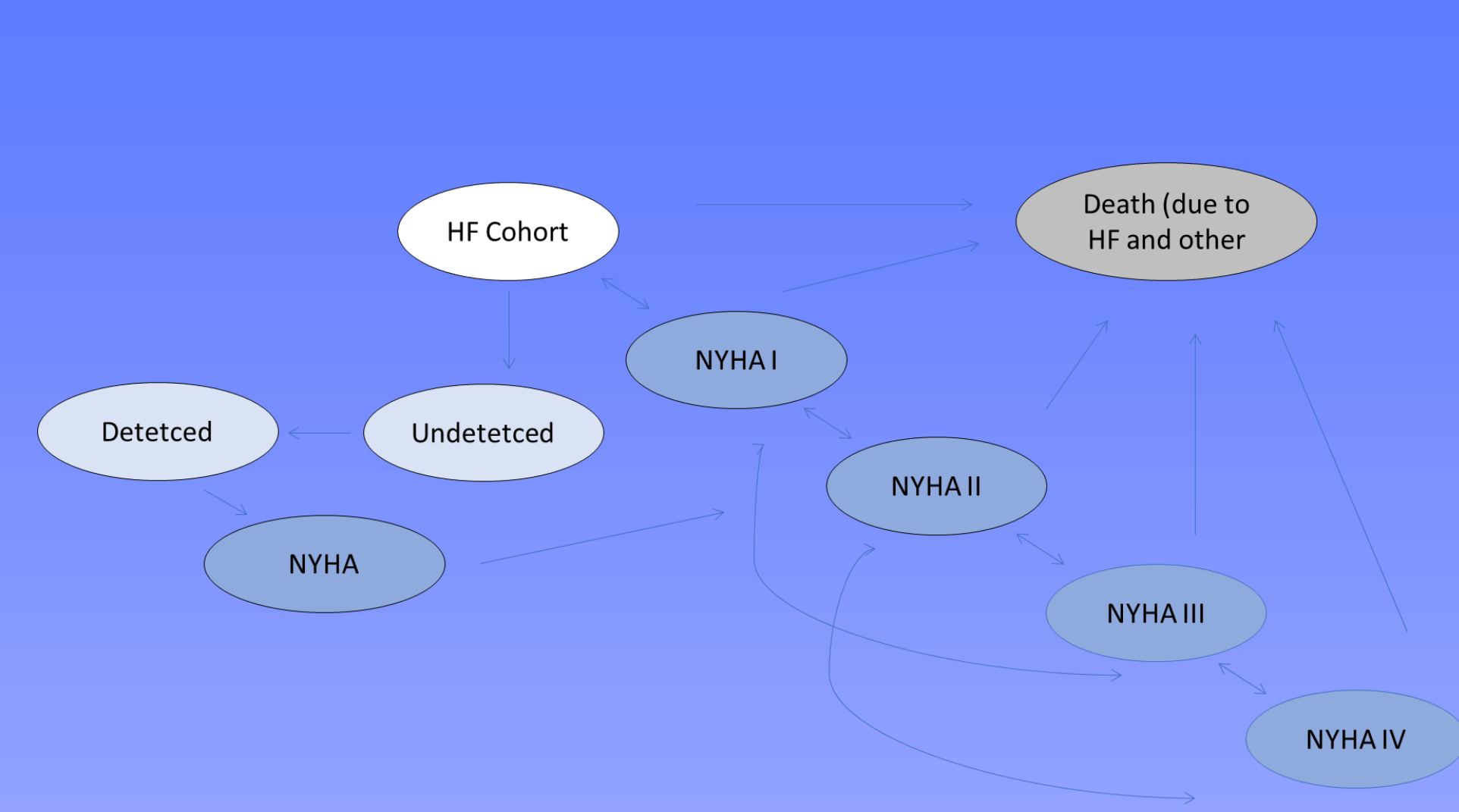
- According to data from Statistik Austria, 7,358,443 adults are expected in Austria by mid-2020.¹
- The number of patients with HF in Austria is estimated to be between 250,000 and 300,000.
- To assess the prevalence and incidence of HF in Austria, German and Swedish registry studies were used, which map both the outpatient and inpatient care areas of HF.^{2,3}
- ICD-10 codes I50.0, I50.00, I50.01, I50.1, I50.11, I50.12, I50.13, I50.14, I50.19, I50.9, I11.0, I13.0 and I13.2 were defined as HF diagnoses.
- The breakdown of the HF population by NYHA stage was taken from the prospective Swedish registry study by Johansson et al. (2018).³
- The patient group considered in the analysis includes patients with newly emerging HF, with or without T2DM. Störk et al. (2017) documented an incidence rate of 666 out of 100,000 inhabitants (0.67%) suffers a HF. For Austria, this results in 49,007 known cases. Of these, 34.7% or 17,006 also suffer from a T2DM.
- In addition to the known cases, there is a percentage of undiagnosed cases; 19% according to von Giessen et al. (2016); thus, the total HF cohort accounted for n= 58,388 patients.

¹Statistik Austria - Bevölkerung am 01.01.2020 nach Alter und Bundesland
- Access on 04.12.2020
² Störk et al. 2017
³ Johansson et al. 2018
⁴ van Gieseen et al. (2016)

Methods

A time-discrete Markov model was developed to simulate the effect/improvement (lifetime costs, quality-adjusted life-years/QALYs and life-years/LYs) due to a NT-proBNP screening in the undetected subgroup of the total HF patients. All patients with HF (un-/detected) run into the model according to a distribution of NYHA-classes. The model considers disease-progression by transition of NYHA-classes. Undetected patients may remain undetected or be detected with the help of NT-proBNP or symptoms. Patients with known HF exhibit a slower disease-progression than undiagnosed patients. The probability of dying is influenced by the respective NYHA-class. Direct costs (2020€) were derived from published sources. QALYs, LYs and costs were discounted (3% p.a.).

Figure 2: Model Design



Source: own developed

Resource use and costs

The cost of analysis from a healthcare perspective includes NT-proBNP screening costs, monitoring costs, NYHA costs, and drug costs.

- NT-proBNP cost and monitoring costs reflected current reimbursement tariffs
- HF SoC medication costs corresponds reimbursement prices
- NYHA costs: costs due to HF according to NYHA classes were derived from a publication by Biermann et al. (2012). The work measured the illness-related resource consumption of outpatient services, hospitalizations including rehabilitation stays. The costs were determined for Germany for the year 2009. For the present analysis, costs were inflated to 2020 and purchasing-power-parities adjusted.

Sensitivity

The sensitivity of NT-proBNP was derived from a real-world study by Boonman-de Winter (2015), which documented values for the NYHA classes. The sensitivity for NYHA I is 25%, NYHA II 87.9%, NYHA III 89.7% and NYHA IV 100%. The model assumes a 20% HF risk.

Results

In the per-patient analysis (at age 60 over lifetime), the ICER/QALY of NT-proBNP vs. no-screening was 5,160€ for HF patients; 5,236€ for the subgroup with T2DM and 5,004€ without T2DM. Considering the total cohort (n=58,388) with the corresponding age structure over lifetime, ICERs improve for the total HF patients (4,265€) and considerably for the subgroup with T2DM (n=20,267) to 1,878€.

From the point of view of the entire HF cohort (n=58,388), an NT-proBNP screening is able to save 34.43 million € in NYHA costs over lifetime. The additional cost of NT-proBNP screening amounts to 73,890 €.

Table 4: Base case results per HF patient (with and without T2DM)

Strategy	Screening with NT proBNP	No Screening
Total costs (€) per patient	29,214.79	27,415.11
Difference (€)	1,799.68	
QALYs	4.504	4.155
Difference	0.349	
ICER/QALY (€)	5,159.63	
LYs	7.825	7.438
Difference	0.387	
ICER/LY (€)	4,653.44	

Source: own calculations

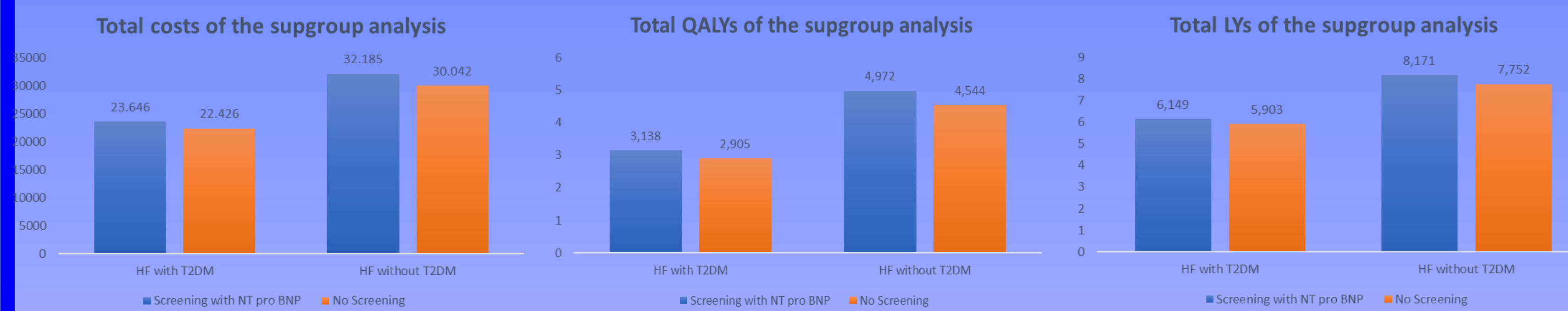
Model overview:

- The following comparison alternatives are analyzed:
 - NT-proBNP (incl. a physical examination)
 - no screening (physical examination)
- The economic analysis is carried out over a lifetime horizon.
- The patient group under consideration suffers a HF (detected or unknown).
- The analysis also considers two subgroups:
 - Heart failure with T2DM
 - Heart failure without T2DM
- The advantage of detected HF is presented based on the following indicators:
 - a slower disease progression (lower transition probabilities to the higher NYHA classes)
 - Administration of drug therapy
 - a lower mortality rate
- The model is performed for the following patients, as well as cohorts:
 - an average patient with HF from age 60 over lifetime
 - an average patient with HF and T2DM from age 60 over lifetime
 - an average patient with HF without T2DM from age 60 over lifetime
 - the cohort with HF (n=58,388)
 - the cohort with HF and T2DM (n=20,267)
 - the cohort with HF without T2DM (n=38,121)

In the subgroup of patients with HF and T2DM, an ICUR of 5,235.52 € per average patient was determined for the NT-proBNP screening strategy vs. no screening. For the entire cohort (n=20,267), cost-effectiveness improves to an ICUR of 1,877.50 €.

For the subgroup of HF patients without T2DM, an ICUR of 5,003.86 € was determined per average patient. Considering the entire cohort (n=38,121) results in an ICUR of 5,044.82 €.

Figure 3: Base case results per HF patient with and without T2DM

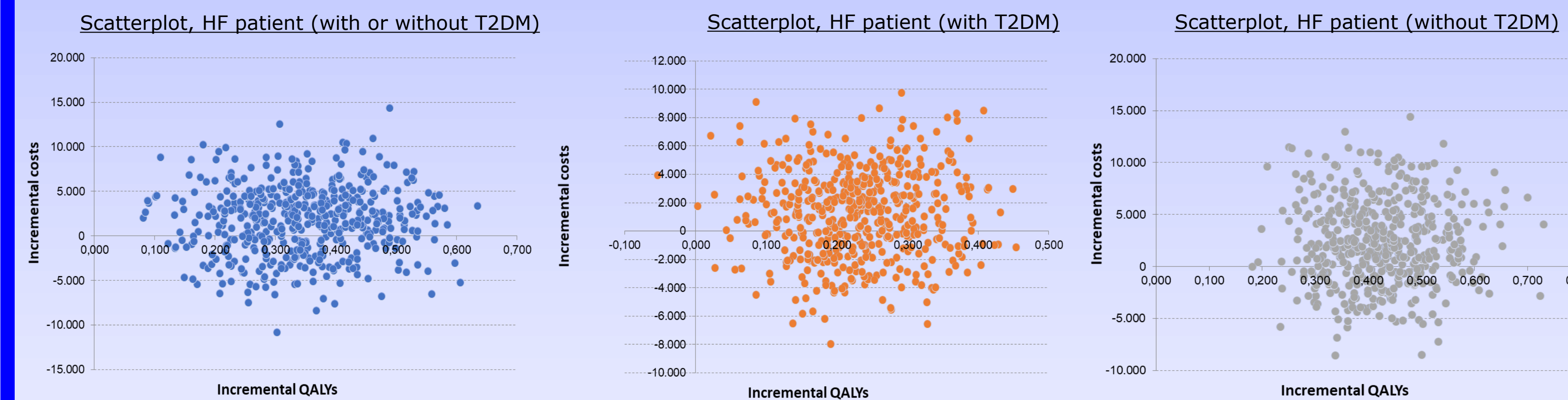


Source: own calculations

Sensitivity Analysis

Probabilistic sensitivity analyses (PSA) were carried out to examine the robustness of the model. The Monte-Carlo PSA results of 500 second-order simulations plotting incremental costs versus incremental effects (Figure 4). The acceptability-curve revealed that in case of a willingness-to-pay of about 23,000 € the NT-proBNP screening was a cost-effective strategy versus no screening, in 94%, 63% and 97% for HF patients, HF patients with T2DM and HF patients without T2DM, respectively.

Figure 4: Scatterplot, screening with NT proBNP vs. no screening



Source: own calculations

The one-way SA (OWSA) also shows constant cost-effective results. The ICUR of the comparison screening with NT-proBNP vs. no screening of an average patient with HF is significantly influenced by the following variations: the QALY values of the NYHA classes, the mortality rate of detected HF and the NYHA I cost. The ICUR values range from 1,432.32 € to 6,831.95 €, i.e. screening with NT-proBNP is always a highly cost-effective strategy in the entire group of HF patients.

Analogous results was determined for the subgroups.

Conclusion

Overall, the analysis concludes that screening with NT-proBNP is a highly cost-effective or even cost-saving diagnostic option for patients with HF. Sensitivity analysis confirmed the robustness of these findings.

References

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- Störk, Stefan, et al. "Epidemiology of heart failure in Germany: a retrospective database study." Clinical Research in Cardiology 106.11 (2017): 913-922.
- van Giessen A, Boonman-de Winter LJ, Rutten FH, Cramer MJ, Landman MJ, Liem AH, Hoes AW, Koffijberg H. Cost-effectiveness of screening strategies to detect heart failure in patients with type 2 diabetes. Cardiovasc Diabetol. 2016 Mar 22;15:48. doi: 10.1186/s12933-016-0363-z. PMID: 27001409; PMCID: PMC4802923.
- Additional literature with the author