The natural history of pancreatic cancer and the effectiveness of screening – A model-based analysis

MSR200

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Introduction

- **Rapid progression and vague symptoms** of pancreatic cancer contribute to its predominantly late diagnosis and high mortality rate
- In Germany, it is projected to become the **second leading cause of cancer-related deaths** and the **fifth most common cancer** by 2030 (Quante et al. 2016)
- **Early detection** enables surgical and other treatment options which can **improve survival rates** and **patient outcomes**
- The **societal impact** of a **blood-based pancreatic cancer test**, which is being developed by the PANCAID project, will be evaluated

What is the impact of a pancreatic cancer screening policy on patient survival for screened vs. not screened patients?

Methods

- **Microsimulation** of screening effectiveness compared to no screening
- Generating **life histories** of male and female individuals at risk (i.e. time of birth and death)
- Simulating **pancreatic cancer histories** of individuals given a lifetime risk
- Applying a hypothetical **screening policy** with assumptions (e.g. start/ stop age, frequency) and data specifications (e.g. sensitivity, specificity)
- Survival data was sourced from the literature (Huang et al. 2018)
- Analysis of **differences in survival**: successfully screened *vs* if no screening would have taken place

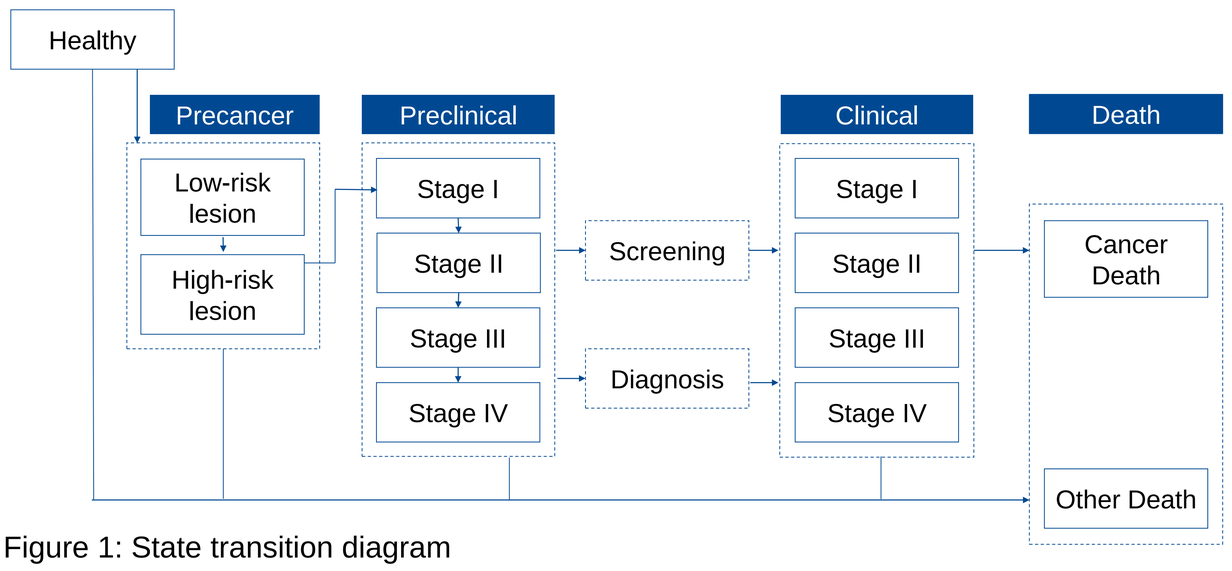

Figure 1: State transition diagram

Population: 100,000 individuals

Duration: Lifetime

Test sensitivity parameters: from **65%** (Stage I) to **95%** (Stage IV)

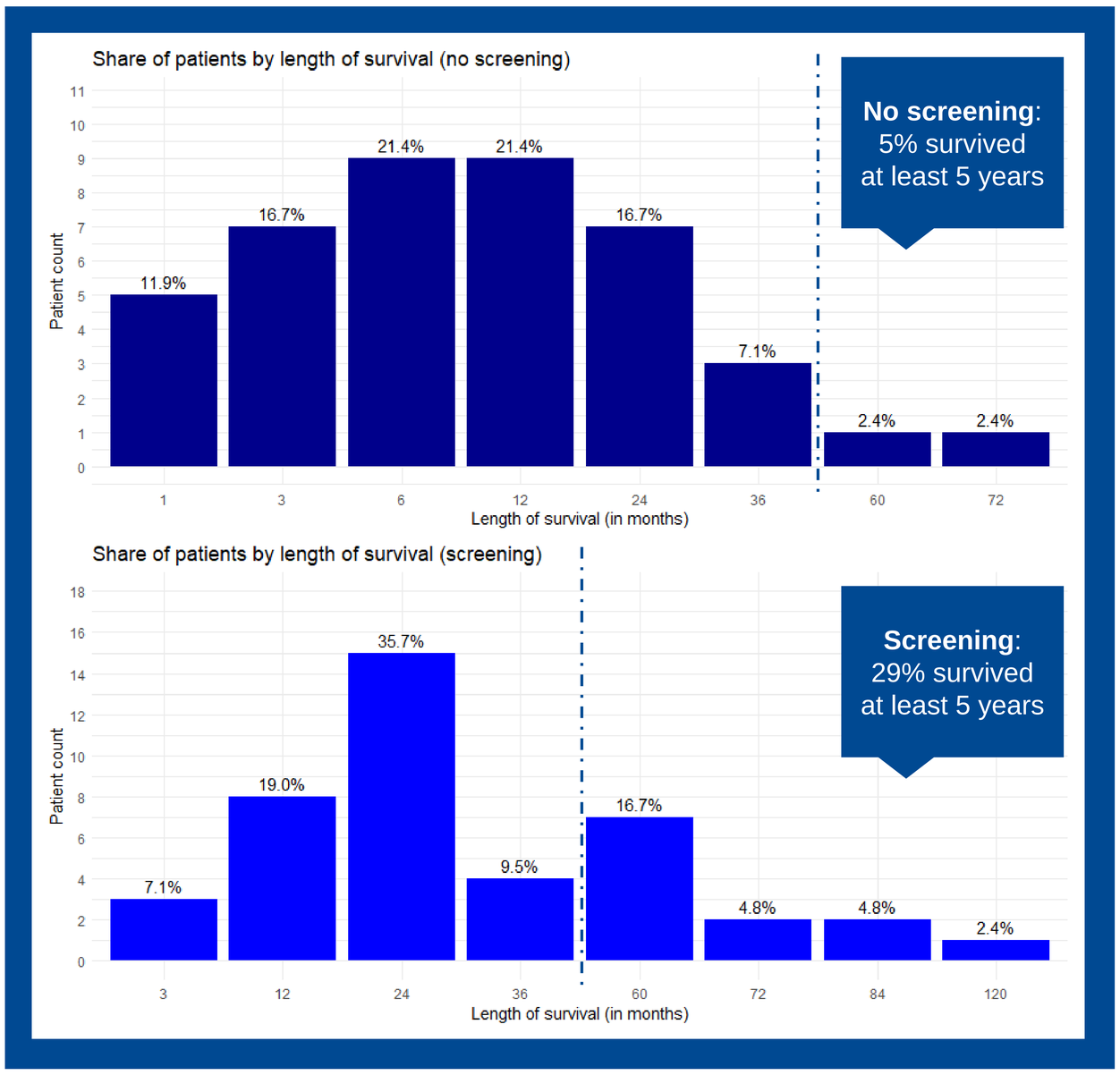

Figure 2: Share of survival lengths after pancreatic cancer diagnosis in presence and absence of screening

Results

- Annual screening of a hypothetical population with 100,000 individuals at 1.9% pancreatic cancer lifetime risk starting at age 55 for 4 rounds resulted in an average life-year gain of **1.6 years per true-positively screened individual**
- 44 individuals had a true-positive result and out of these patients, 36 received an early diagnosis at stage 1 or 2
- The share of patients surviving at least 5 years after a pancreatic cancer diagnosis was **29% vs. 5% when true-positively screened versus not screened**
- A specificity of 90% or 95% would lead to 30,000 or 17,500 false-positive results
- Sensitivity analysis: starting screening later than 55 increases the average life-year gain up until age 67 as start age, from which this gain decreases

Conclusion

- Screening may result in **a life-year gain** in true-positive patients compared to the no-screening alternative
- Pancreatic cancer screening in the normal population at about 2% lifetime risk would likely result in an unacceptable number of false-positive and few true-positive patients

  → Early detection strategies for pancreatic cancer should target high-risk individuals instead of the general population
- Further modifications of the model will investigate which threshold risk, test parameters, and optimal screening protocols, could enable early detection under certain circumstances
- Evaluating the cost-effectiveness of blood-based testing for pancreatic cancer will be the ultimate purpose of the model

References

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PANcreatic CAncer Initial Detection via liquid biopsy

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