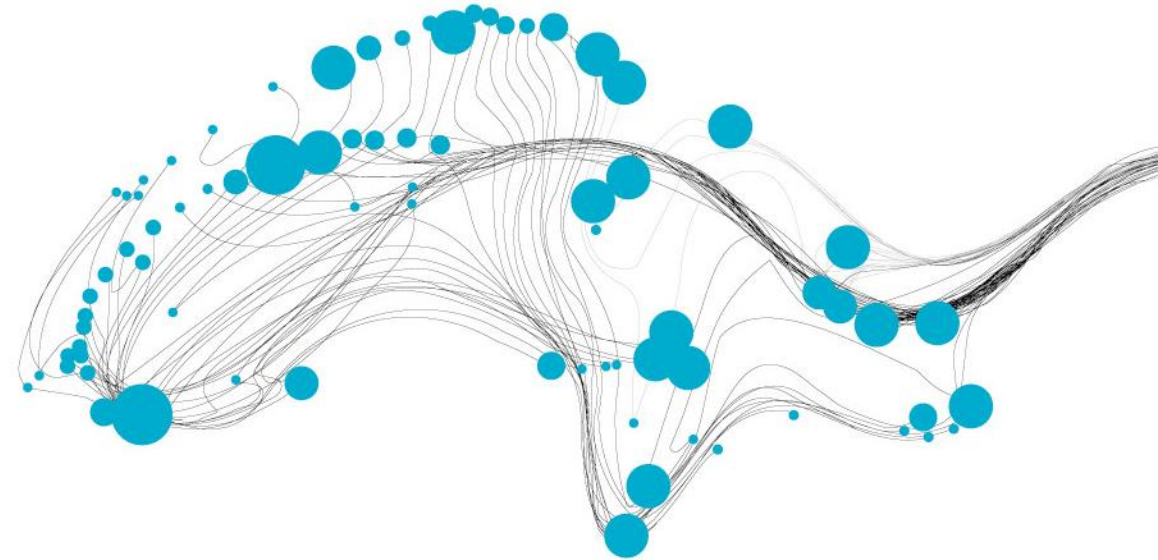


CAPACITY PLANNING IN VVT: FROM FORECASTS TO CAPACITY AND STAFFING DECISIONS

ANNE ZANDER (CHOIR, UNIVERSITY OF TWENTE)

JOINT WORK WITH:

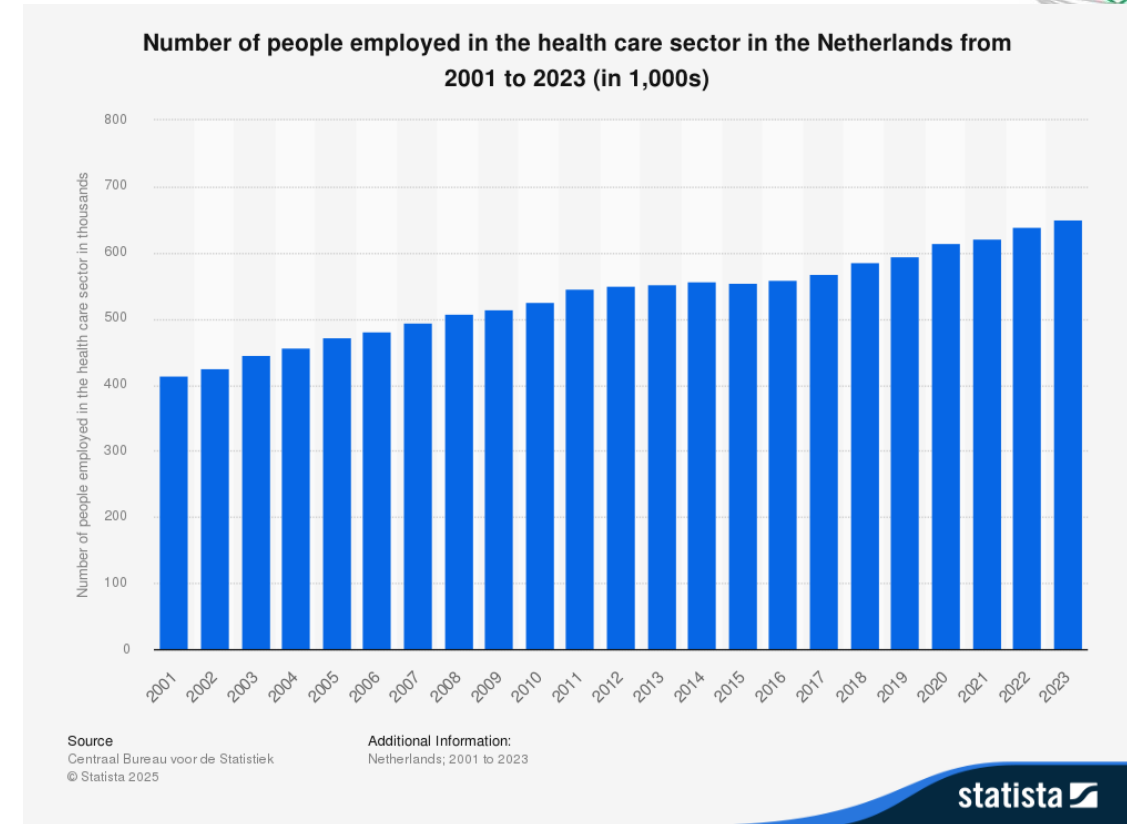
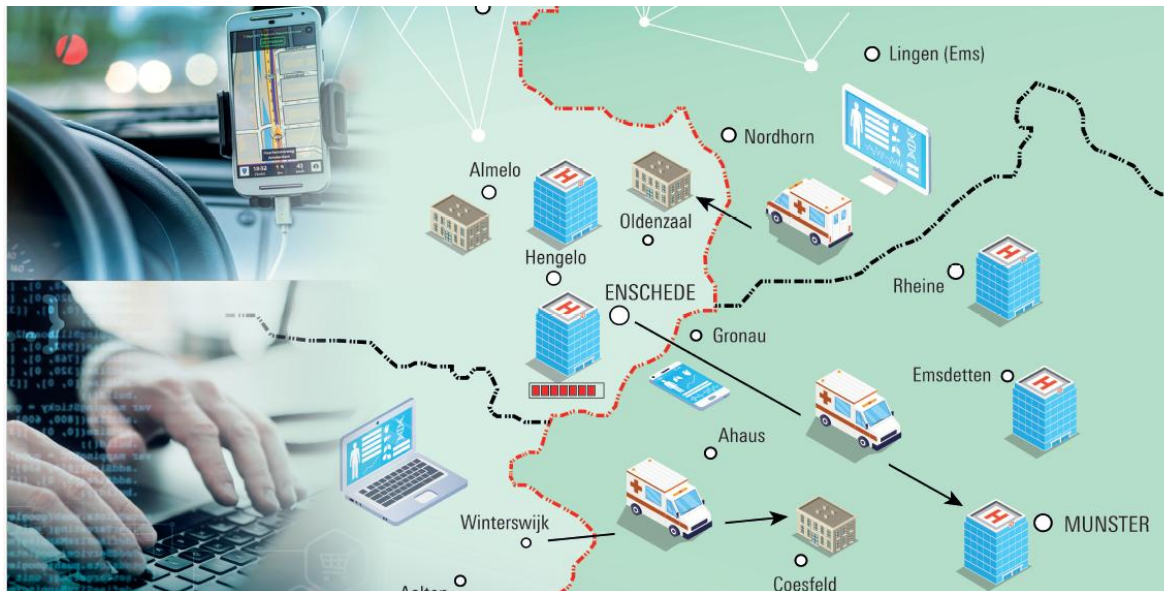
NINA BAUMGARTNER, ANOUK BEURSGENS, RICHARD BOUCHERIE, ALEIDA
BRAAKSMA, CHRIS PETRI



SYMPOSIUM - ZORGLOGISTIEK IN DE VVT-SECTOR, DECEMBER 11, 2025

MOTIVATION CARE-FLOW

- Increasing demand for healthcare
- Decrease in skilled workforce
- High costs
- Shortages of capacity (especially in border regions)



GOALS CARE-FLOW

Develop and evaluate algorithms and software products to support capacity planning and streamline patient flow, ensuring access to and the efficiency of healthcare in a cross-border region.



APPROACH

Predict the hospital patient outflow in need of follow-up care



Optimize follow-up care capacities (beds, staff) and patient allocation



Efficient use of capacity in follow-up care



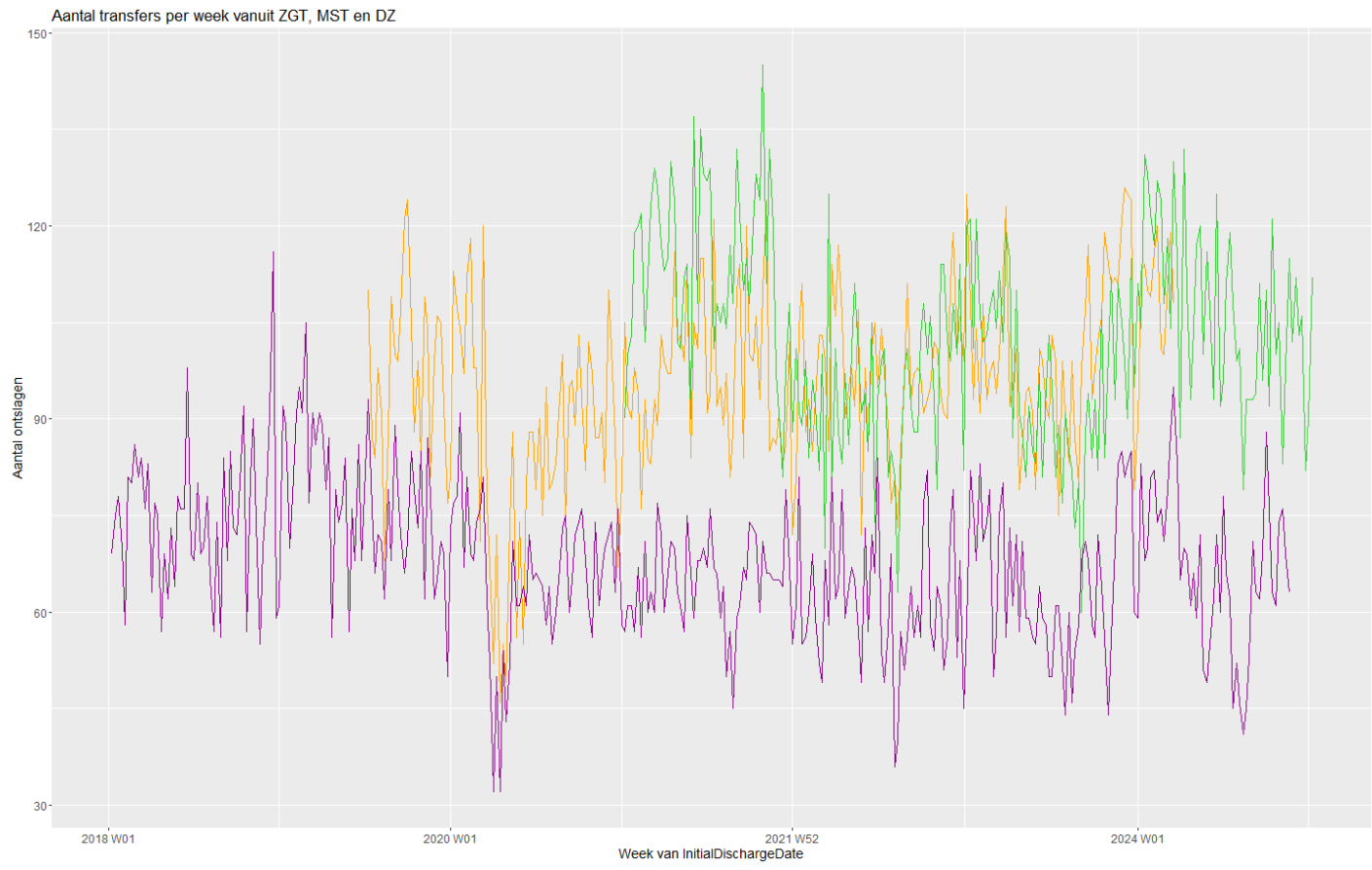
PREDICTION OF FOLLOW-UP CARE DEMAND

PIONEERS IN HEALTHCARE PROJECT

- Joint project with 3 hospitals in the Dutch region of Overijssel: MST (Enschede), ZGT (Almelo&Hengelo) and DZ (Deventer)
- Predict the hospital patient outflow in need of follow-up care for different time scales
- Data from 2018-2024 on (registered) transfers and individual patient characteristics (POINT and HIX)


TRANSFER DATA


Number of transfers



Week


OVERVIEW MODELS

 **Long-term model**
Predict daily number of requested transfers to each follow-up care type months ahead

-  - Retrospective transfer data (No knowledge about current situation)


 Time Series Analysis


 **Mid-term model**
Predict daily number of requested transfers to each follow-up care type for next days/weeks

-  - Retrospective transfer data
- Retrospective patient data
- Data of patients who are currently in the hospital

 Conditional LoS distribution

 **Short-term model**
For an individual patient, predict discharge date and follow-up care type

-  - Retrospective transfer data
- Retrospective patient data with detailed medical and logistic characteristics
- Data of patients who are currently in the hospital

 Machine Learning
Conditional LoS distribution



OPTIMIZATION OF FOLLOW- UP CARE CAPACITY

OVERVIEW OF TO BE DEVELOPED MODELS

- Based on patient inflow and the length of stay in follow-up care, predict future bed occupancy, then optimize capacity accordingly

Strategic
(long-term)

- Number of (flexible) beds per patient type
- Staff composition (number and skills)

Tactical
(mid-term)

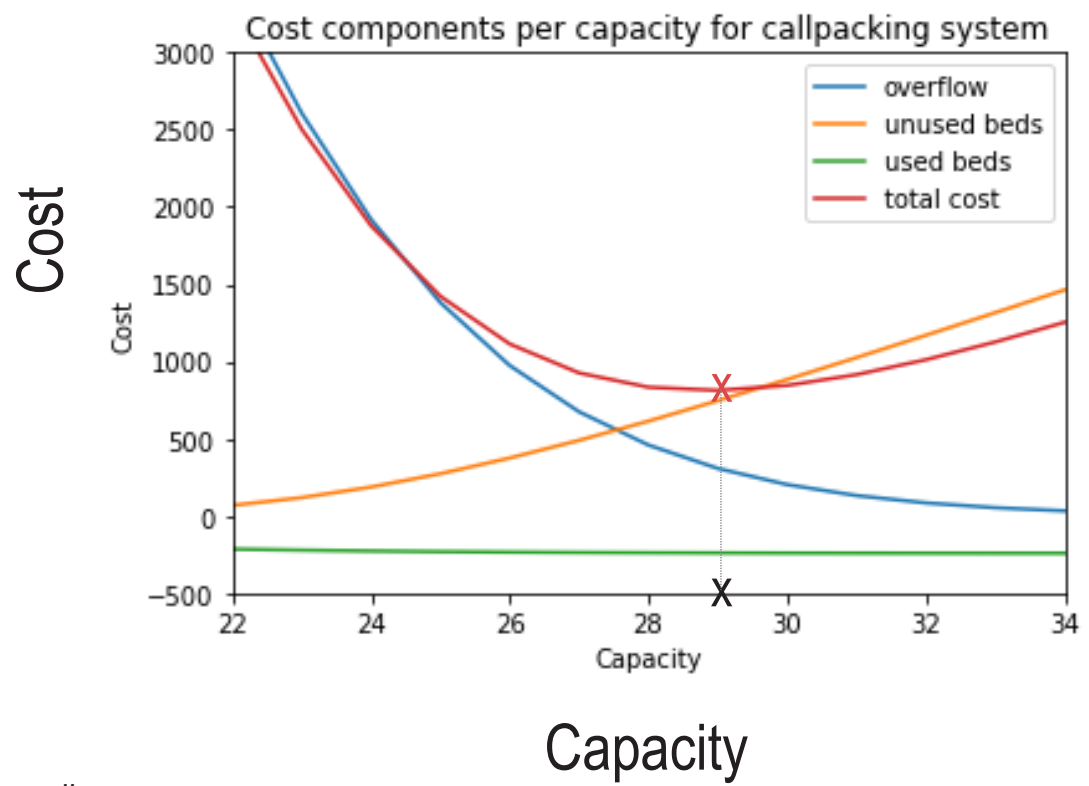
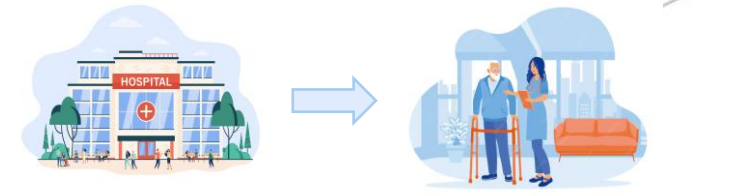
- Rostering of staff

Operational
(short-term)

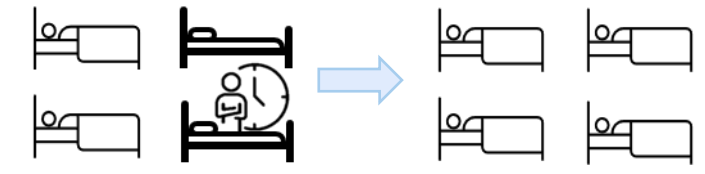
- Adjustment of roosters
- Accept/reject patient requests

OPTIMIZE NUMBER OF BEDS IN FOLLOW-UP CARE

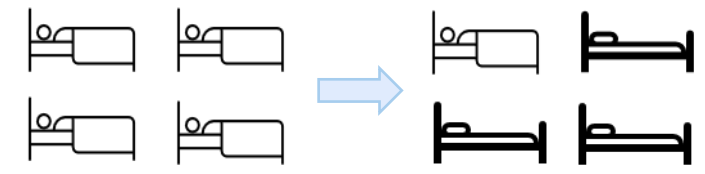
$$\min_c C_{bb} E \# bb + C_{uub} E \# uub + C_{ub} (c - E \# ub)$$



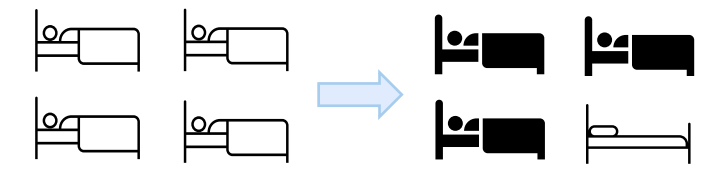
blocked beds



unused beds



$C_b < 0$
used beds



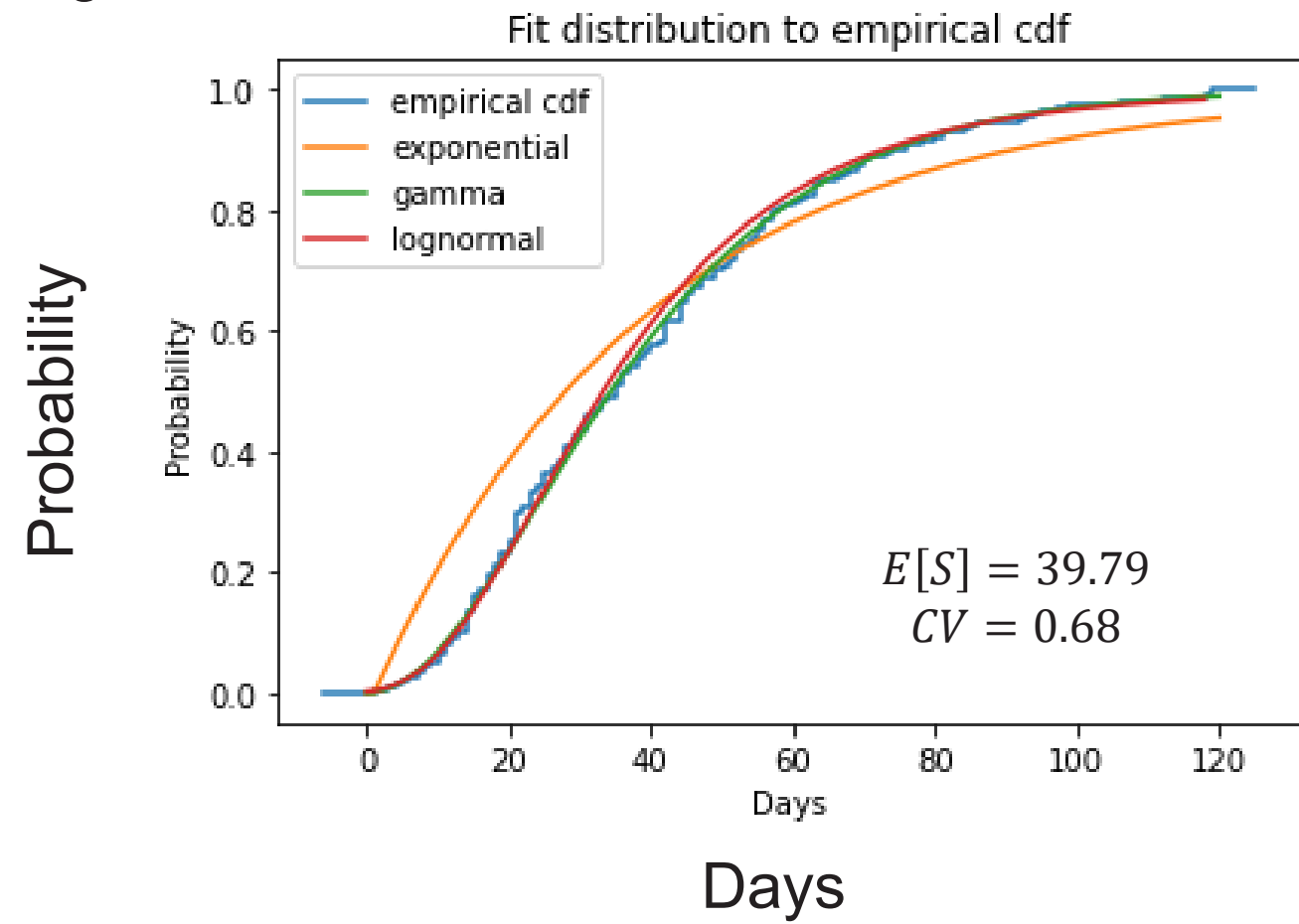
INFLOW AND LENGTH OF STAY DATA

GRZ data of one aftercare organization




Arrival rate $\lambda = 0.58 \text{ day}^{-1}$



Cost parameters

$$C_{bb} = 400$$
$$C_{uub} = 150$$
$$C_{ub} = -10$$



FOLLOW-UP CARE vs SYSTEM PERSPECTIVE

| | Hospital & follow-up care | | Follow-up care only |
|-----------------------------|---------------------------|---|---------------------|
| Optimal capacity | 27 |  | 19 |
| Costs for the system | 812.32 |  | 6445.79 |
| Costs for follow-up care | 505.28 |  | -183.48 |
| Mean number of blocked beds | 0.81 | | 17.71 |

-  Cooperation between the hospital and the follow-up care organization would be beneficial
-  It would be reasonable to compensate the follow-up care organization for increasing their capacity



SUMMARY & FURTHER RESEARCH

SUMMARY

- Prediction of the outflow of hospital patients in need of follow-up care on three different timescales
- Optimization of bed capacity in follow-up care from a system perspective

FURTHER RESEARCH

- Regional, cross-border setting: Several hospitals, follow-up care organizations, and patient types
- Include external demand (not from the hospital) for follow-up care
- Bed occupancy prediction in follow-up care
- Other strategic, tactical, and operational (capacity) planning problems in follow-up care