Leiden University Medical Center

CHOIR

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Allocating emergency beds improves the emergency admission flow

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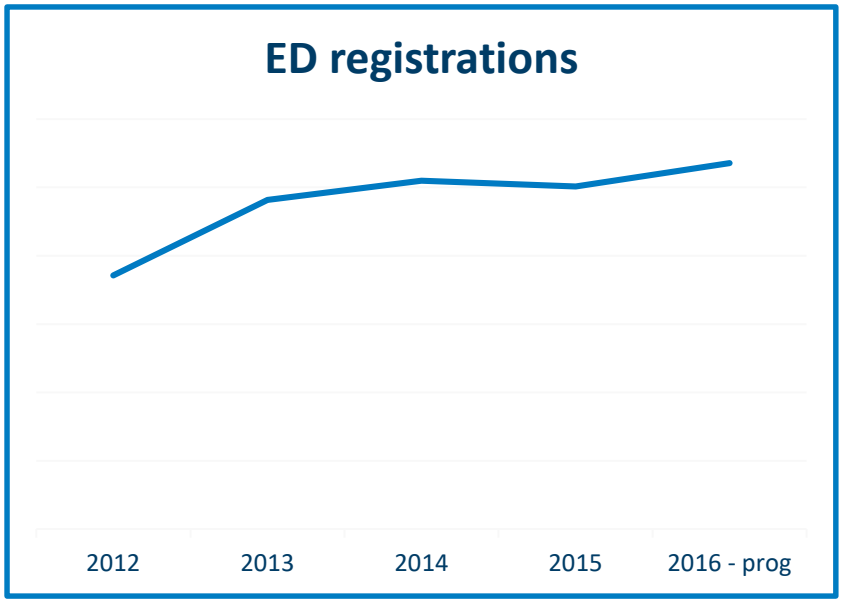
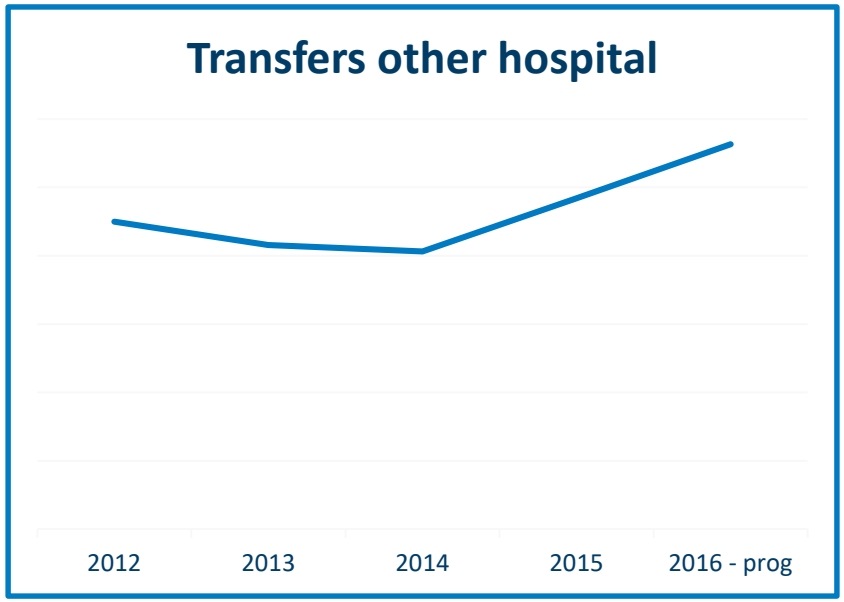
Thomas Schneider, A. J., Luuk Besselink, P., Zonderland, M. E., Boucherie, R. J., Van den Hout, W. B., Kievit, J., ... & Rabelink, T. J. (2018). Allocating Emergency Beds Improves the Emergency Admission Flow. *INFORMS Journal on Applied Analytics*, *48*(4), 384-394.

Problem description

- Regional shrinkage emergency capacity (e.g. concentration of emergency care)
- Increasing number of acute admissions
- Overcrowded ED
- Flow congestions in admission process
- Refusals and boarders

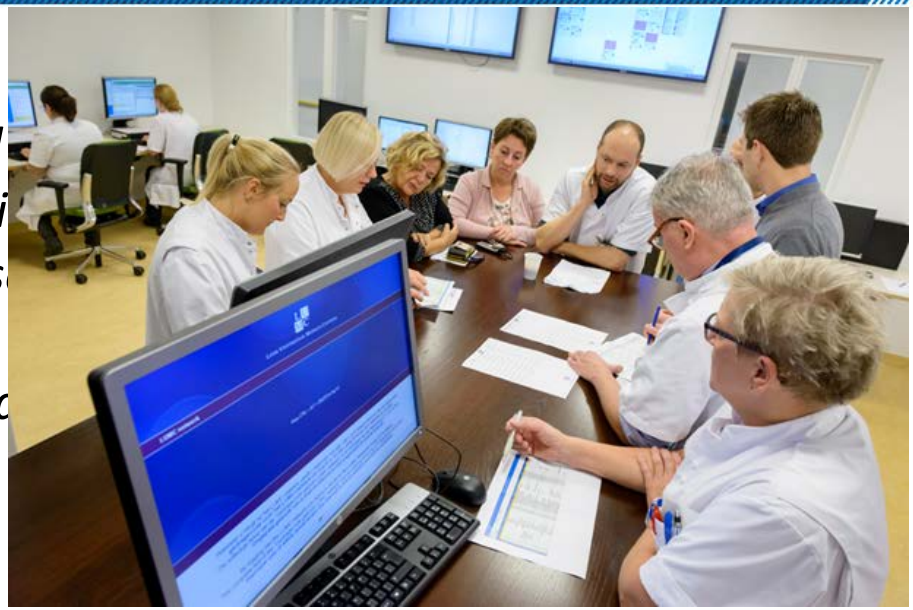




Intervention

Acute Medical Unit

A designated hospital
receive medical inpati
for expedited multidis
assessment, care and
typically between 24 d



WHY?

- Focus on throughput: daily ‘stand-session’ to discuss transfers
- From OM perspective an AMU can act as:
  1. buffer
  2. overflow

‘Abuse’ of capacity lies ahead. So without further coordination both settings will fail

Research questions

The AMU at Leiden University Medical Center started in 2011 with 8 beds and expanded in 2014 to 24 beds.

This expansion resulted in larger patient flows via the AMU and increased the number of stakeholders in the admission process resulting in more focused coordination.

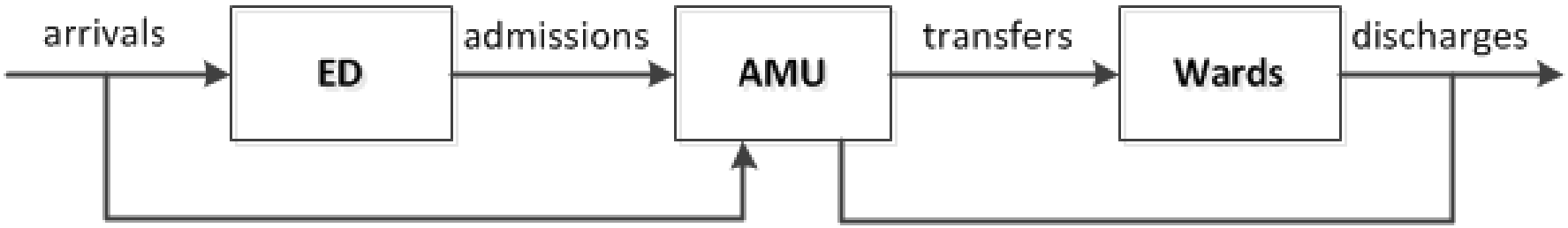
Strategic

- To what extent are we future proof in terms of unwanted refusals?

Tactical

- What capacity on medical wards should be allocated for acute admissions from the AMU?

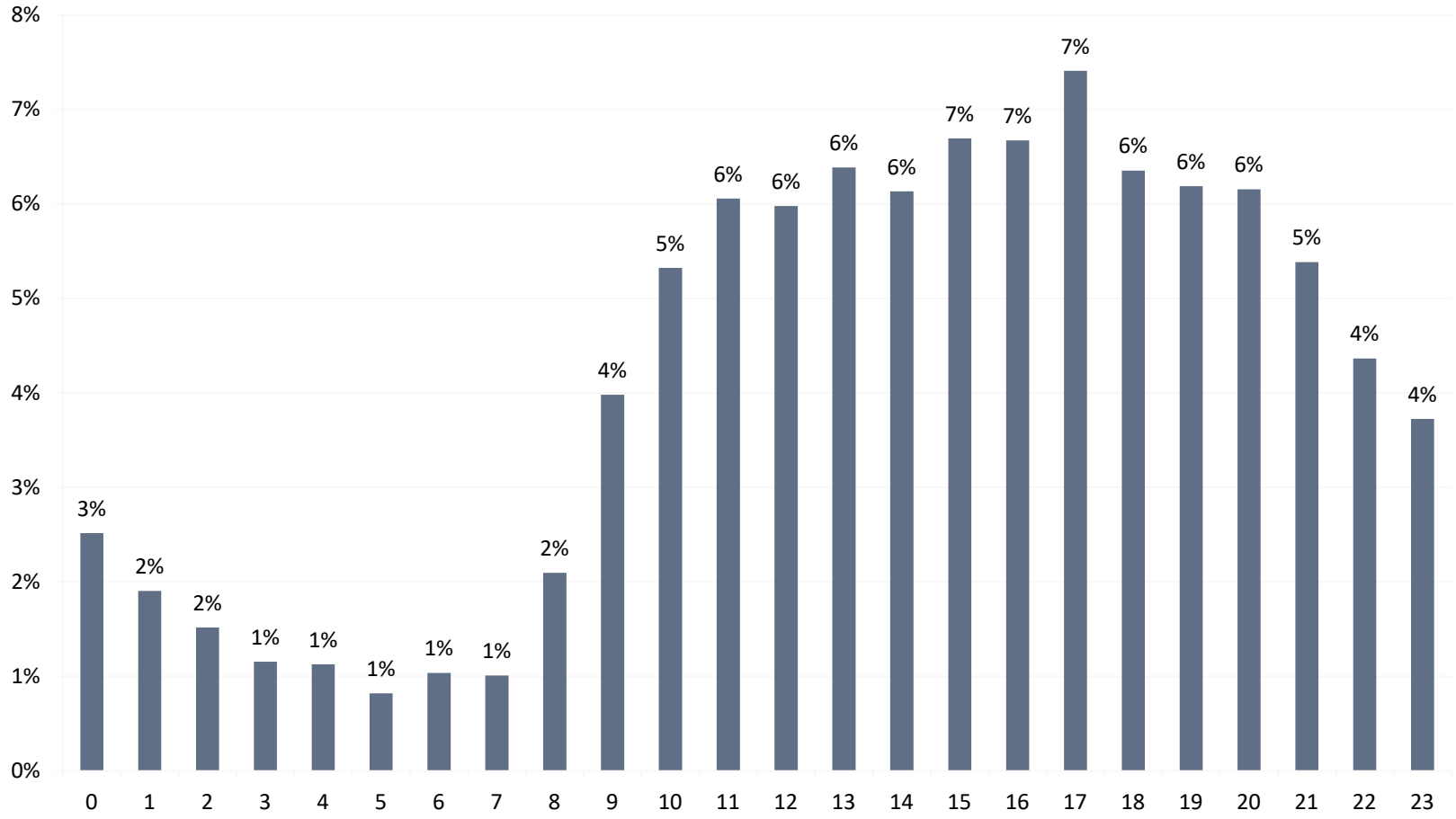
Acute admission process LUMC



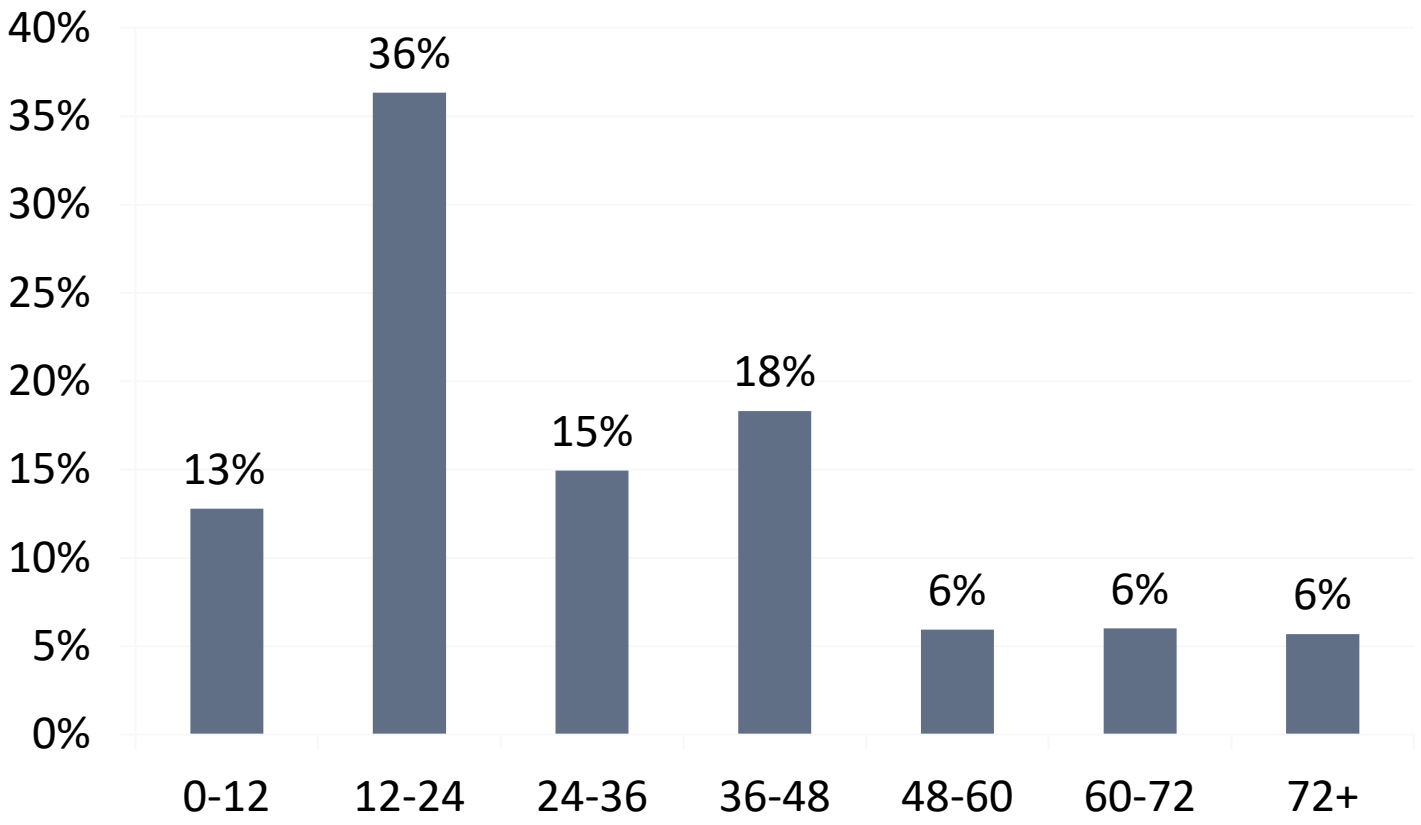
Data analysis

Data of all patients visiting the AMU between 2012 and February 2014

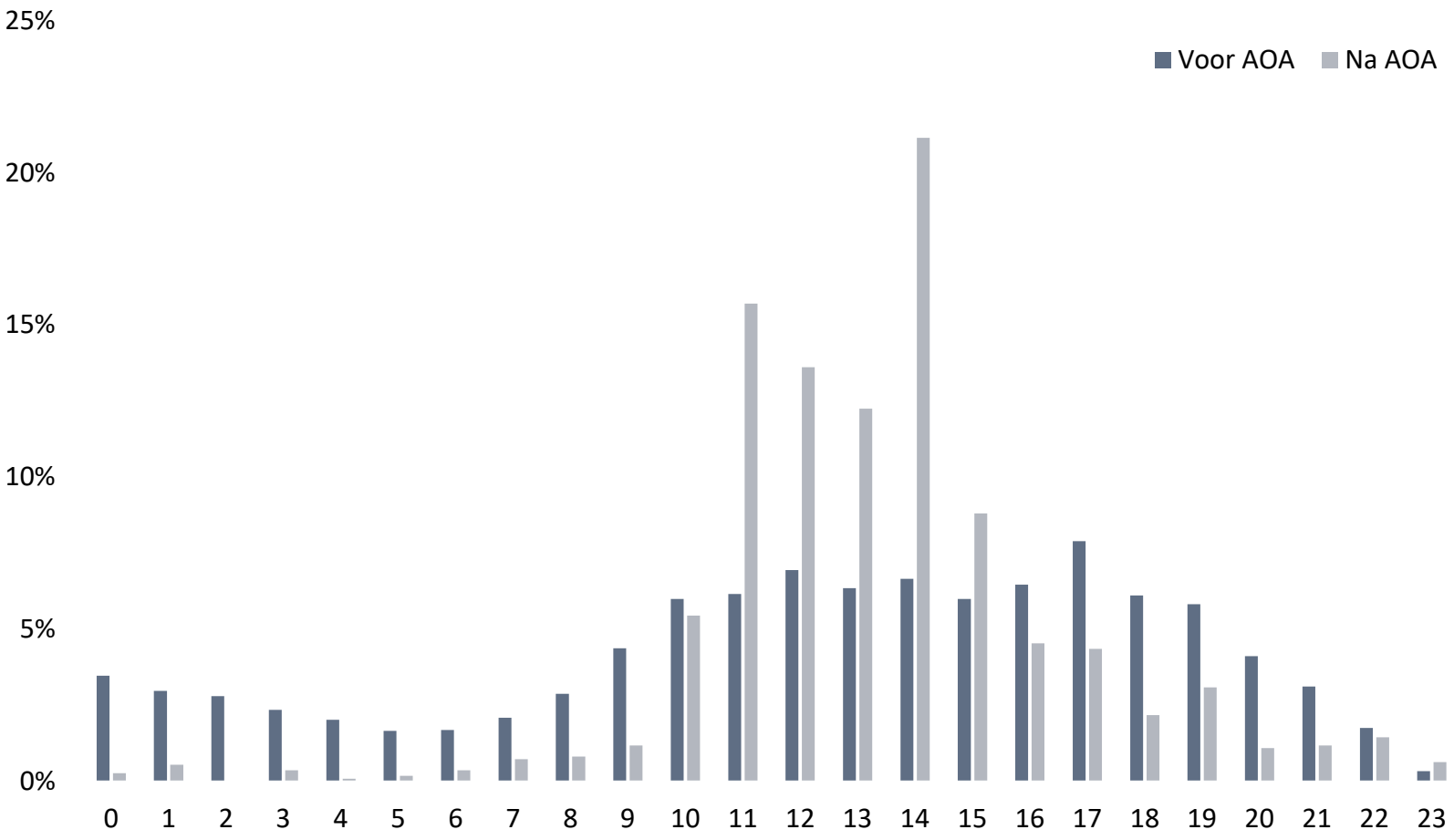
Arrival rates ED



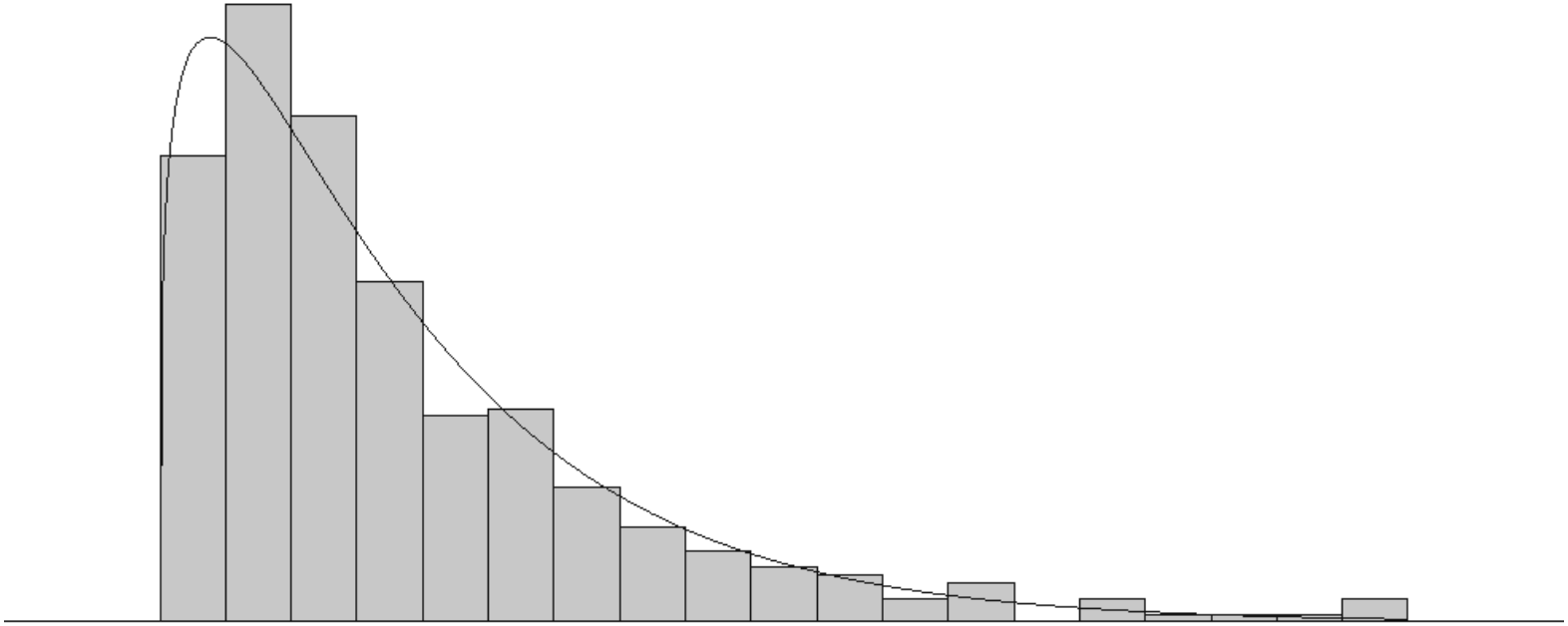
Length of Stay AMU (hr)



Arrival rates at wards



Length of Stay at wards



Example of medical specialty Surgery

Conclusions data analysis

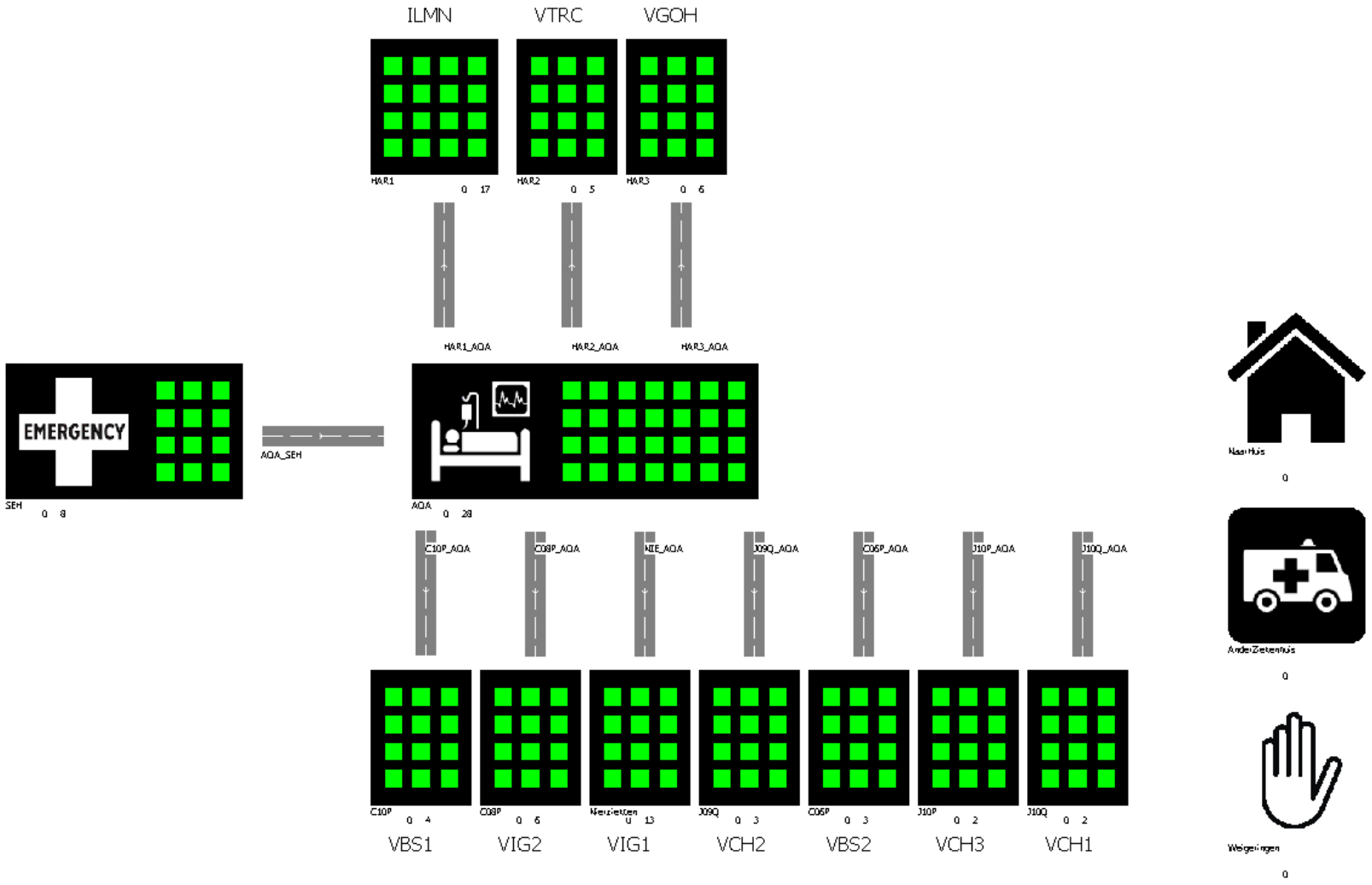
- Interarrival times — Non homogeneous Poisson process (assumption)
- LoS — Testing for statistical difference, 2 specialties same LoS at all wards, 1 ward same LoS for all specialties
- Specialty distribution — Frequency table
- Flow distribution — Frequency table

Characteristics process & modelling approach

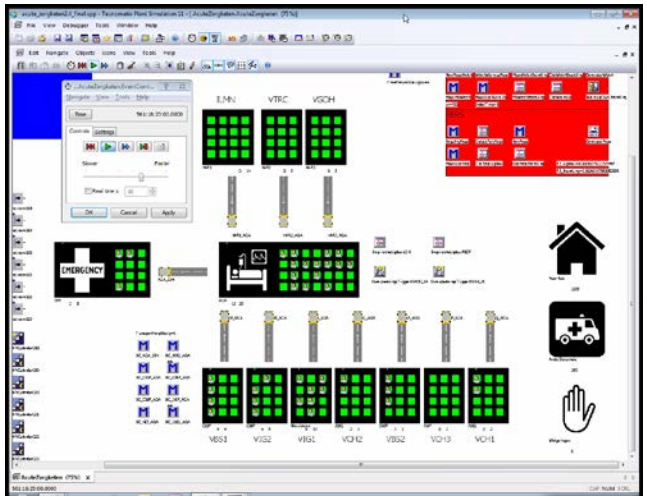
- Non homogeneous interarrival times
- Different type of departments (ED, AMU and wards)
- 12 medical specialties
- LoS at ED, AMU and wards based on specialty
- Distribution of specialties
- Distribution of patient flow from AMU to medical wards
- Transfers from AMU to wards only between 9 AM and 9 PM
- Blockage when ED is occupied
- Boarding not allowed

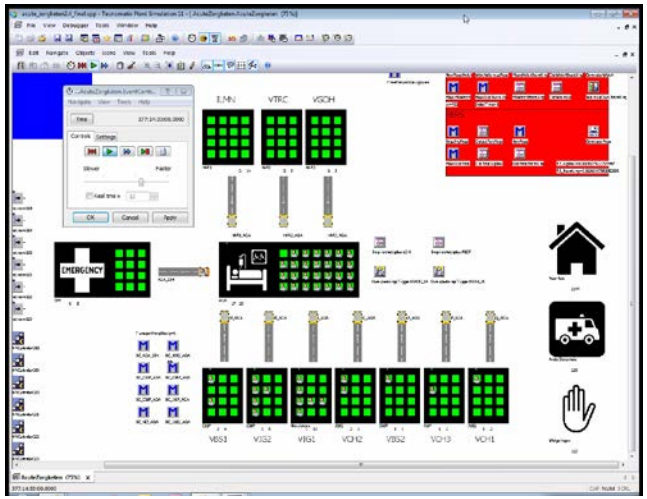
We choose a simulation approach.

Simulation model

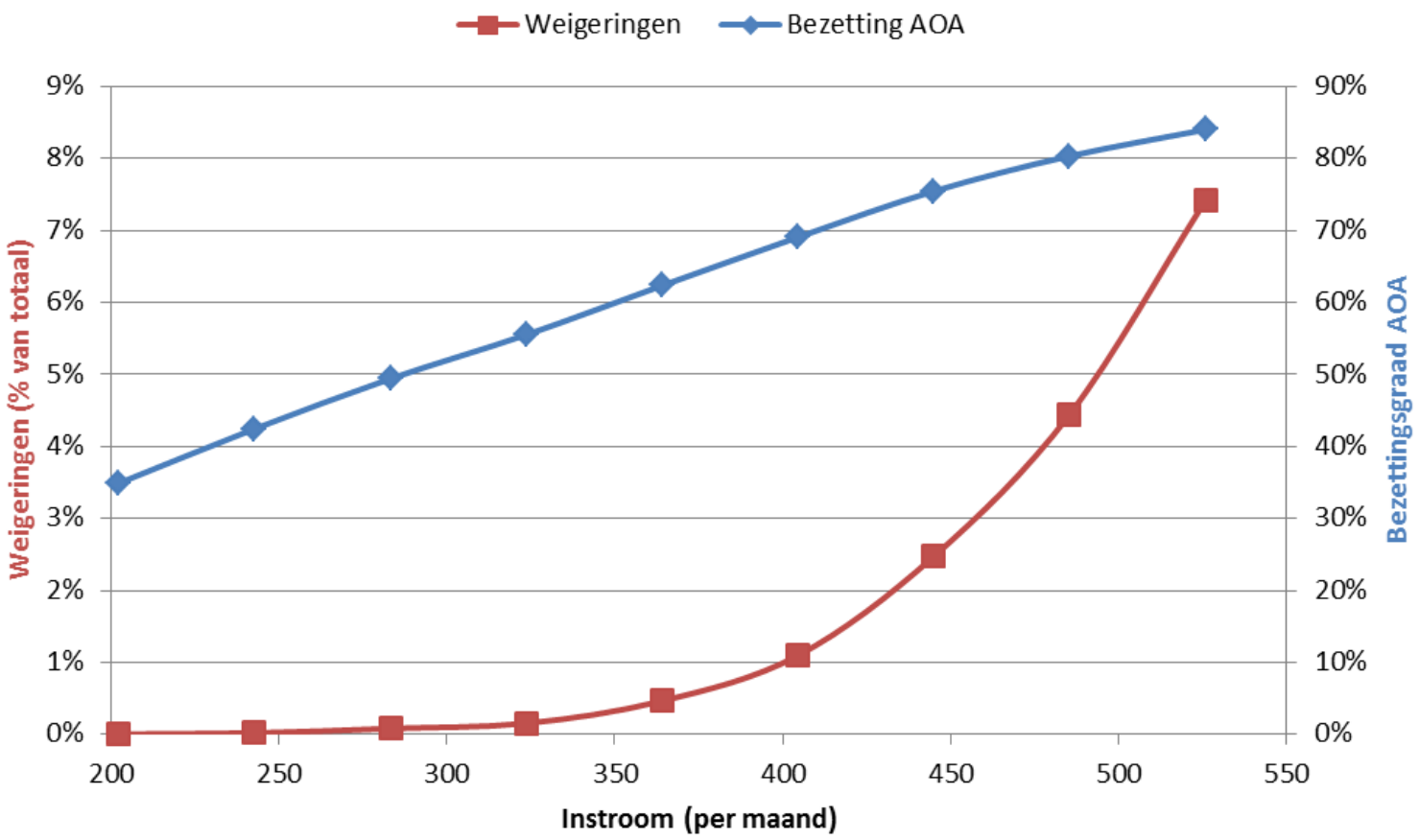


Simulatiemodel





Strategic question



Tactical question

What capacity on medical wards should be dedicated for acute admissions from the AMU?

Two scenario's: (1) for individual wards and (2) for combined care units

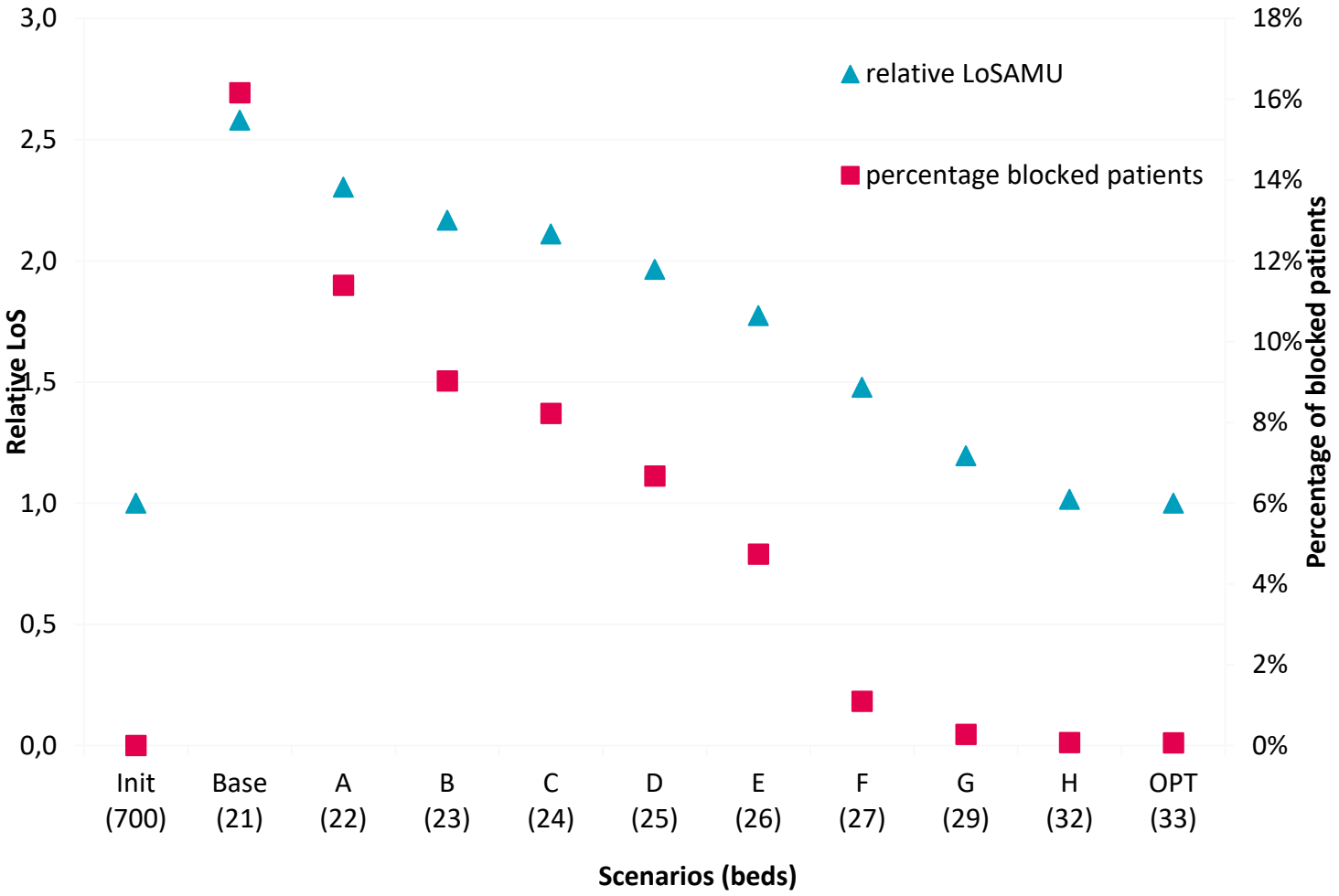
Table 1. Heuristic 1 Locates a Feasible Allocation of Emergency Beds in Inpatient Wards Using the Process Outlined

Step	Phase	Explanation
1	Initialization phase	Set allocated emergency bed capacity at 100 for each ward (approximating unlimited capacity)
2	Base phase	Set capacity to average occupied beds per ward from Step 1
3	Optimization phase	Increase capacity of ward with highest utilization rate
4	Iteration phase	Repeat Step 3 until outcomes of the initialization phase are approached sufficiently (i.e., arbitrary maximum deviation of 3% from the relative LOS at AMU)

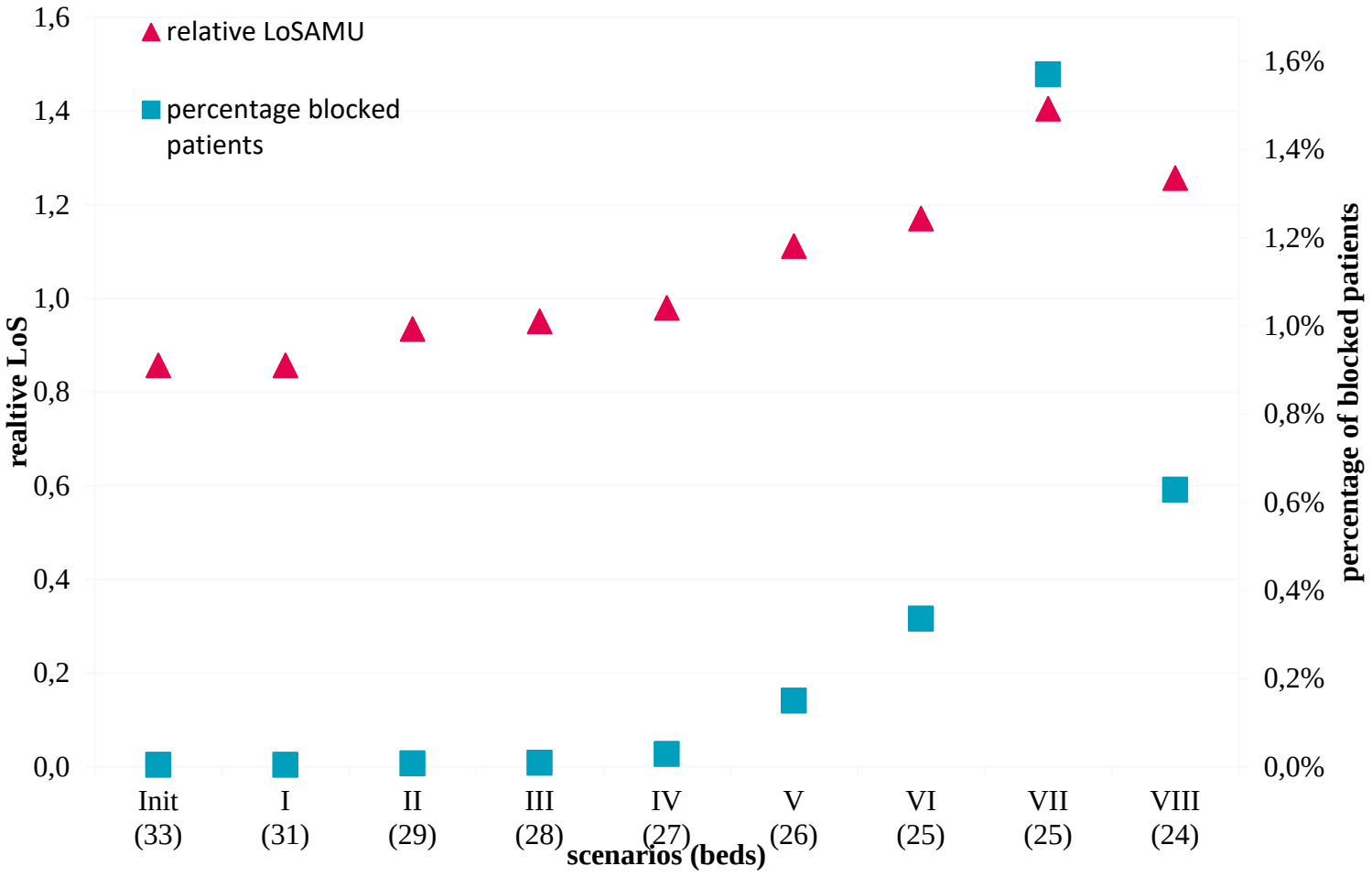
Table 2. Heuristic 2 Locates a Feasible Allocation of Emergency Beds in Care Units (i.e., Pooled Inpatient Wards) Using the Process Outlined

Step	Phase	Explanation
1	Initialization phase	Set allocated emergency bed capacity of care units equal to capacity of pooled wards (Table 3)
2	Optimization phase	Decrease capacity (i.e., number emergency beds) of care unit with lowest utilization rate
3	Iteration phase	Repeat Step 2 until outcomes of separate wards are approached sufficiently (arbitrary percentage of patients refused < 0.01)

Output heuristic 1



Output heuristic 2



Implementation & conclusions

Model used for tactical capacity management using data last 12 month (rolling horizon)

Did it solve all problems?

Future developments?

- Specialization for acute routine care
- Regional coordination of acute care

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Thank you!

ORchestra Bibliography

We kindly invite you to have a look at our online categorized bibliography for OR/MS in Health Care:

https://www.utwente.nl/choir/en/research/orchestra/