OPTIMAL STAFFING CAN MITIGATE THE STAFFING CRISIS

DR.IR. ALEIDA BRAAKSMA
CENTER FOR HEALTHCARE OPERATIONS IMPROVEMENT AND RESEARCH

CHOIR

CHOIR

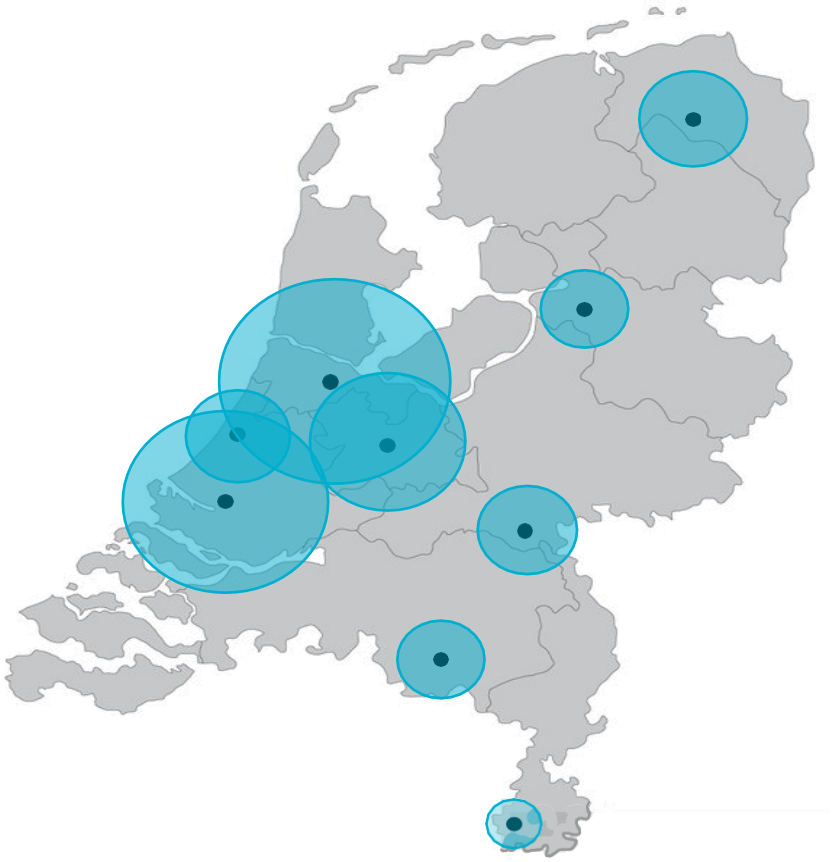
- Mission: help the healthcare sector to improve
  the efficiency, quality of care and service, and quality of labor
  through redesigning and optimizing processes
  based on rigourous mathematical research
- Researcher in residence model

Today, two examples on efficient staffing:

- A flexible nursing pool in neonatal care
- Aligning nursing ward staff to hourly bed census predictions

NEONATAL CARE

KIMBERLEY MORRIS, GRÉANNE LEEFTINK, ERWIN HANS, WILLEM DE VRIES



- Approx. 4100 patients admitted to neonatal ICUs (NICUs) yearly
- 9 NICUs in NL
- NICU capacity is mainly determined by available nursing staff
- Many NICUs regularly operate at full capacity
- 20% of critically ill babies transported (870 per year, 2-3 per day)
    - Negative impact on patient's health
    - Further away from family
    - Cannot be treated by own doctor

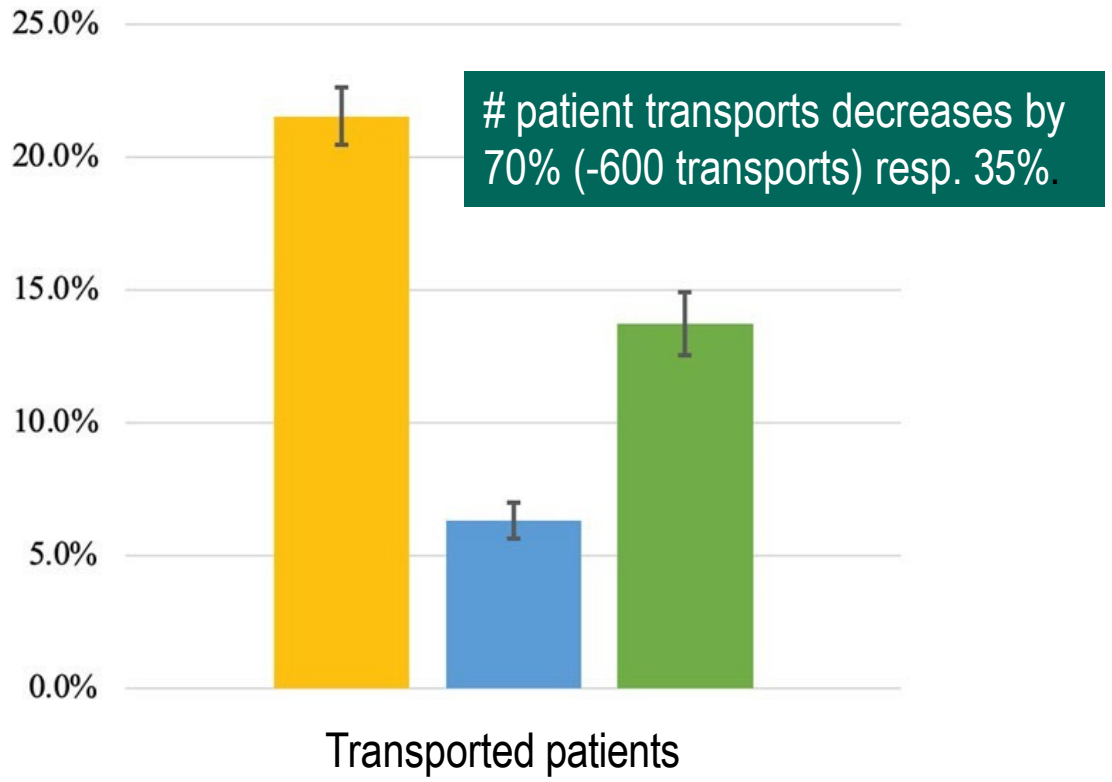
CHOIR

FLEXIBLE NURSING POOL

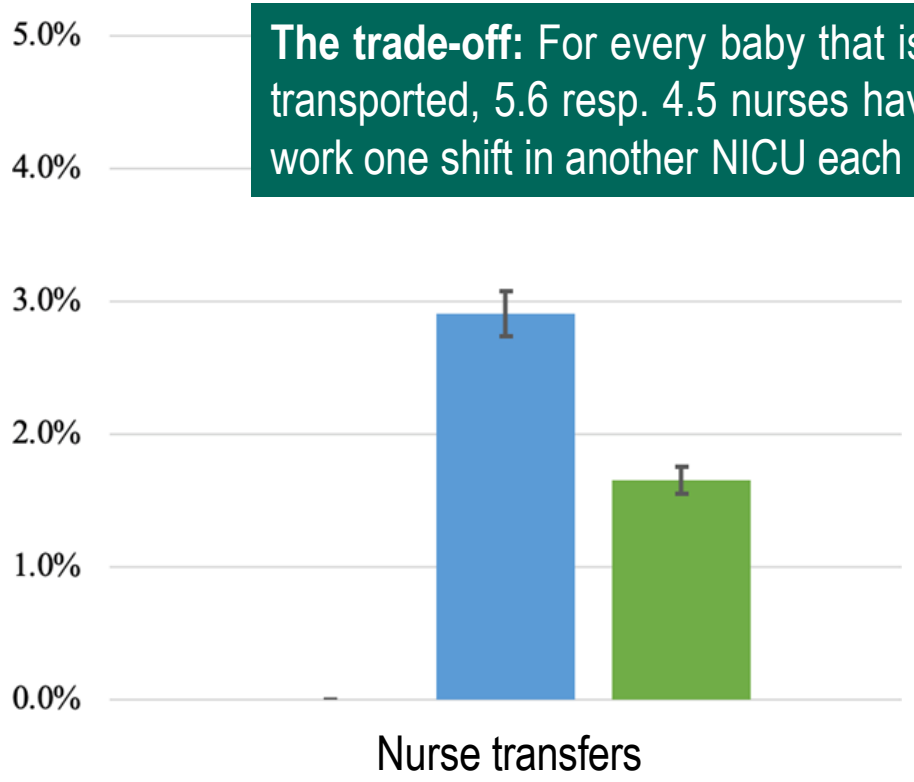
- Almost always at least one staffed NICU bed available in NL
- Capacity issue due to nurse shortage
- Proposal: flexible nurses
- Assumption: flex nurses and patients can only be relocated during shift changes
- Model: computer simulation with integrated optimization model
- Experiments:
  - # nurses in flex pool: 1, 2, or 5 nurses per NICU
  - Participating NICUs: only Randstand, all except “outliers”, or all
  - Cross-training policy:

A BIT OF FLEXIBILITY GOES A LONG WAY

- Experiments: baseline; 5 flex nurses, all locations, n-to-all; 2 flex nurses, all locations except “outliers”, reciprocal pairs



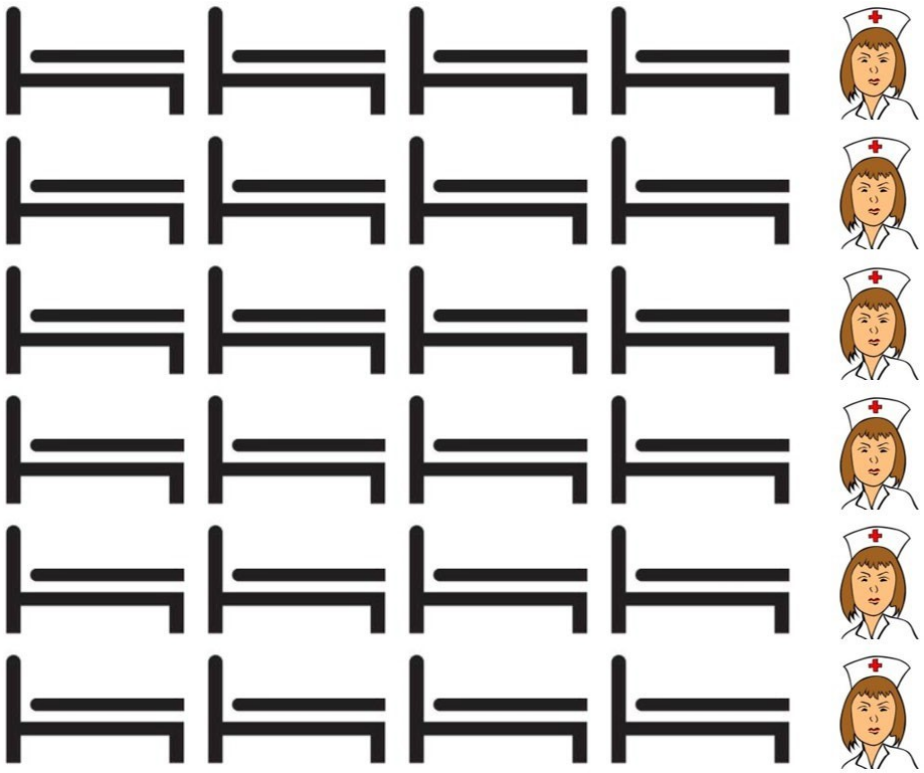
Transported patients

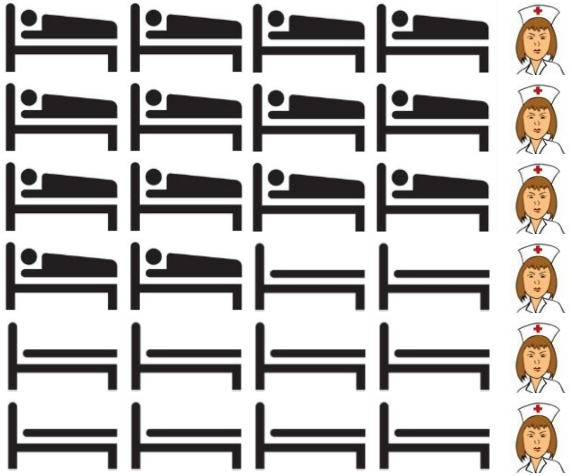


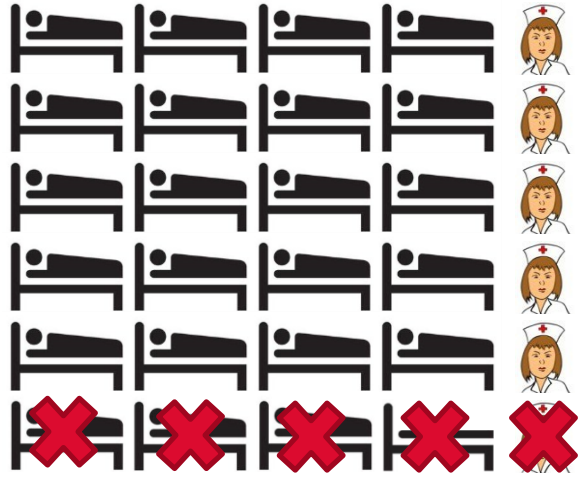
Nurse transfers

HOW TO EFFICIENTLY STAFF A NURSING WARD?

ALEIDA BRAAKSMA, NIKKY KORTBEEK, RICHARD BOUCHERIE, FERRY SMEENK, CHRISTIAN BURGER, PIET BAKKER





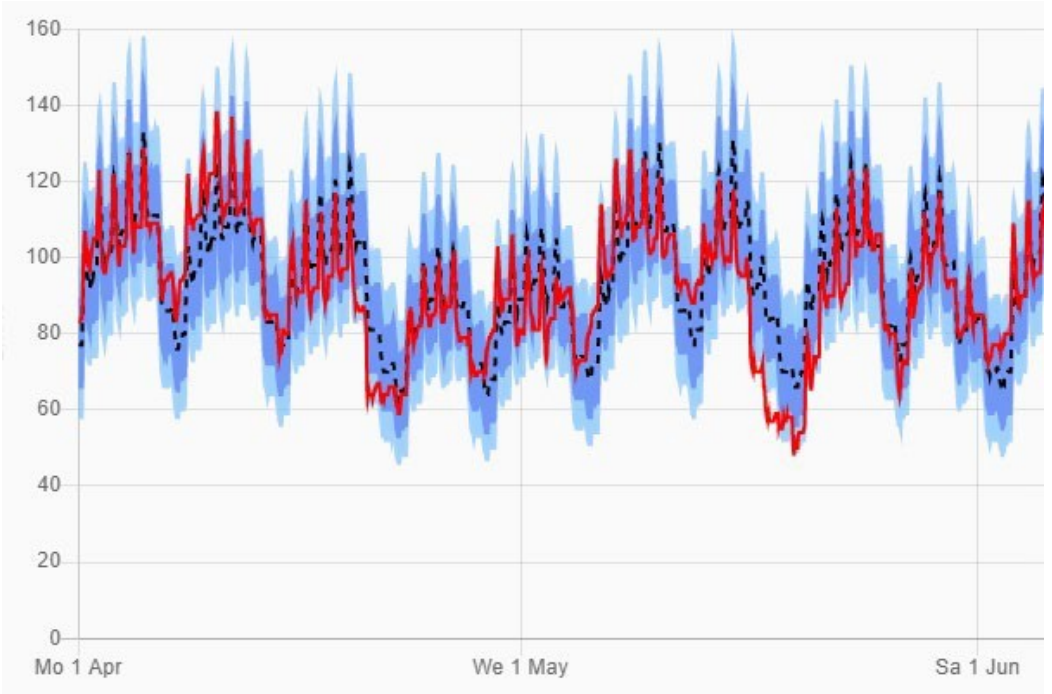


Variability in bed occupancy

- Predictable: reduce / predict and anticipate
- Unforeseen: flexibility

PREDICTING BED CENSUS

- Hourly bed census predictions
- Input:
  - Arrival pattern & expected length of stay elective patients
  - Arrival pattern & expected length of stay emergency pts
- Output:
  - Probability distribution on number of occupied beds per nursing ward per hour
- Data-driven



STAFFING BASED ON PREDICTIONS

$$\min \quad z_E = \omega_f f_{q,\tau} + \sum_k \omega_d d^k_{q,\tau}$$

$$\text{s.t.} \quad d^k_{q,\tau} \geq S^k$$

$$d^k_{q,\tau} \geq \left\lceil \beta^k \cdot M^k / r^k_{q,\tau} \right\rceil$$

$$c^k_{q,\tau}(\boldsymbol{d}_{q,t}, f_{q,\tau}, r^k_{q,\tau}) \geq \alpha^k$$

$$d^k_{q,\tau} \geq \gamma^k \cdot s^k_{q,\tau}(\boldsymbol{y})$$

$$s^k_{q,\tau}(\boldsymbol{y}) = d^k_{q,\tau} + g^{k,\pi^*}_{q,\tau}(\boldsymbol{d}_{q,\tau}, f_{q,\tau}, \boldsymbol{y})$$

- Goal: continuously guantee quality of care while staffing efficiently
- Nurse-to-patient coverage: $\dfrac{r^k_{q,\tau} \cdot s^k_{q,\tau}}{x^k}$

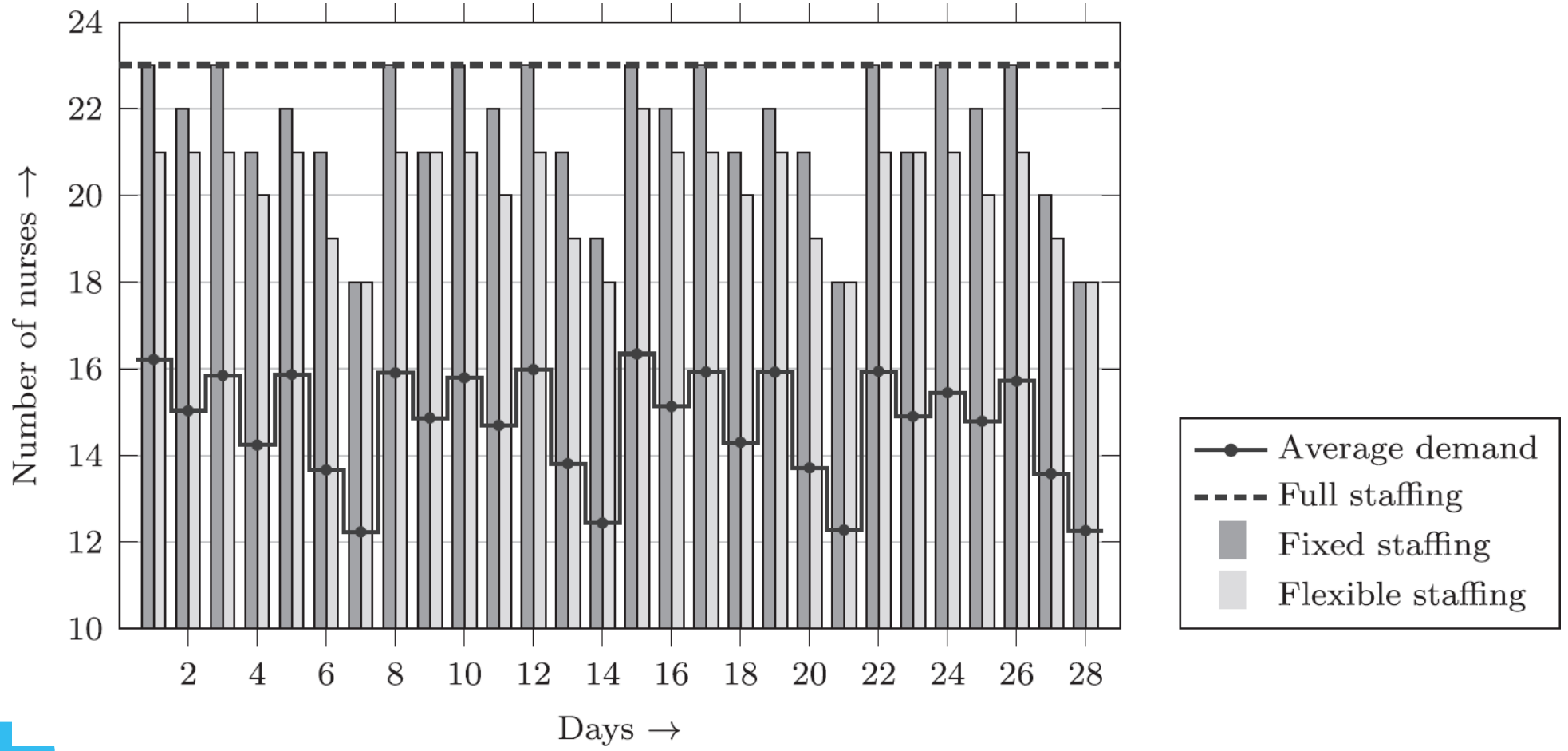
1⁺
0.7 - 1
0 - 0.7

Model requirements:

- Minimum number of nurses
- Minimum coverage
- Minimum % of time coverage 1⁺
- Flexibility ratio
- Fair flex nurse assignment

CHOIR

ILLUSTRATION OF RESULTS



FROM RESEARCH TO PRACTICE

vement potential:

eased reliability, consistent quality

nslates CHOIR research to practice

<: productivity +11%, admissions per FTE +25%

rgeries during COVID-19 pandemic

geries; bed and staff capacity aligned w

rhythm