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Improvement & Research (CHOIR)*



University of Twente
The Netherlands



Presentation overview

- Background “OR/OM in Healthcare” in NL
- Research within CHOIR
- CHOIR approach of research collaboration with healthcare organizations
- Research within CHOIR: end-to-end optimization of patient flows

The Netherlands



Population 16 million
Capital: Amsterdam
Healthcare: 12% of GDP



“OR/OM in healthcare is in its infancy”

Michael W. Carter (ORMS Today, 2002):

“surprisingly few people from the OR/MS community actually work in healthcare”



In Netherlands almost no “OR/OM in HC research” until 2003

Causes:

- Financial system (budgets) did not reward efficiency
- Healthcare managers typically have medical/nursing background (no attention for OM-principles in their education)
- Poor state of ICT (information systems)



Het kan écht: betere zorg voor minder geld

Sneller Beter - De logistiek in de zorg



Logistical improvements go hand-in-hand with quality improvements: patients that have to visit the hospital less often, have shorter waiting times, and may count on more attention from nurses and physicians.

Logistical quality improvements will yield some 3 to 3.5 billion EUR: almost a quarter of the entire hospital budget...

In other words:

improved care for less money!



Cultural change in Dutch healthcare

As a result of:

- TPG report (2004)
- Ever-increasing costs
- Ageing population
- Increased media attention
 - Waiting lists, bad practices
 - Benchmarking (“naming and shaming”)



Cultural change in Dutch healthcare

The focus is on:

- More advanced ICT (e.g. HIS, EPR)
- Reorganization of processes (e.g. clinical / care pathways)
- Introduction of regulated market mechanisms
- Operations management education of healthcare managers
- Hiring of experts from industry as managers in hospitals
- Introduction of successful logistical concepts from other industries (Lean mgmt, Six Sigma, TOC, JIT, etc.)
- Optimization of core resources using OR/OM à since 2003



CHOIR

Center for Healthcare Operations Improvement & Research

Multi-disciplinary healthcare research center:

- Operations Management, Logistics
- Purchasing management
- Stochastic operations research
- Discrete Mathematics & Mathematical Programming
- Organization studies
- Quality & Safety Management
- Information & Technology Management



CHOIR: research approach

- Research funding from hospitals, government
- PhD, MSc, BSc students
 - Graduation projects at hospitals
 - Healthcare mgmt. courses in study program
- Ensure implementation of outcomes:
 - Multi-disciplinary approach (researchers and supervisors)
 - Publication in both OR- and HC-management-journal
 - Goal: ensure implementation
- Intensive collaboration with hc organizations à



CHOIR: partners from healthcare sector

- *Academic hospitals:* Amsterdam, Utrecht, Leiden, Maastricht
- *Specialized hospital:* Netherlands Cancer Institute
- *Other hospitals:* Enschede, Zwolle, Hengelo/Almelo, Deventer, Sittard, Gorinchem, Den Haag, Gouda, Winterswijk
- *Rehabilitation centers:* Enschede, Leiden
- *Consultancy & software:* ORTEC bv, B-Sim
- *Government:* Netherlands Board for Healthcare Facilities



Research development

- Initial focus on single departments
 - Operating rooms (planning, scheduling, etc.)
 - Radiology (CT, MRI)
- 2007: founded NL working group “OR in HC”
- 2008-2012 project “LogiDOC”
 - 12 hospitals, 6 PhD students (2 vacancies)
 - Focus on care pathway optimization within hospitals
 - PhD students are at hospitals 2-3 days per week
- Future: optimization of the “transmural” care pathway
(along all involved organizations)



CHOIR - Centre for Healthcare Operations Improvement & Research

CHOIR - home > Home > ORchestra Bibliography



ORchestra Bibliography - Healthcare Operations Research Literature

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Printable version

A detailed bibliography of operations research in healthcare literature. Categorized by medical and model categories. ORchestra Bibliography is kept up-to-date by CHOIR from the University of Twente.

The literature database is coming on March 6th, 2009.

à <http://www.choir.utwente.nl/en/ORchestra/>

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Integral planning of operating room and wards



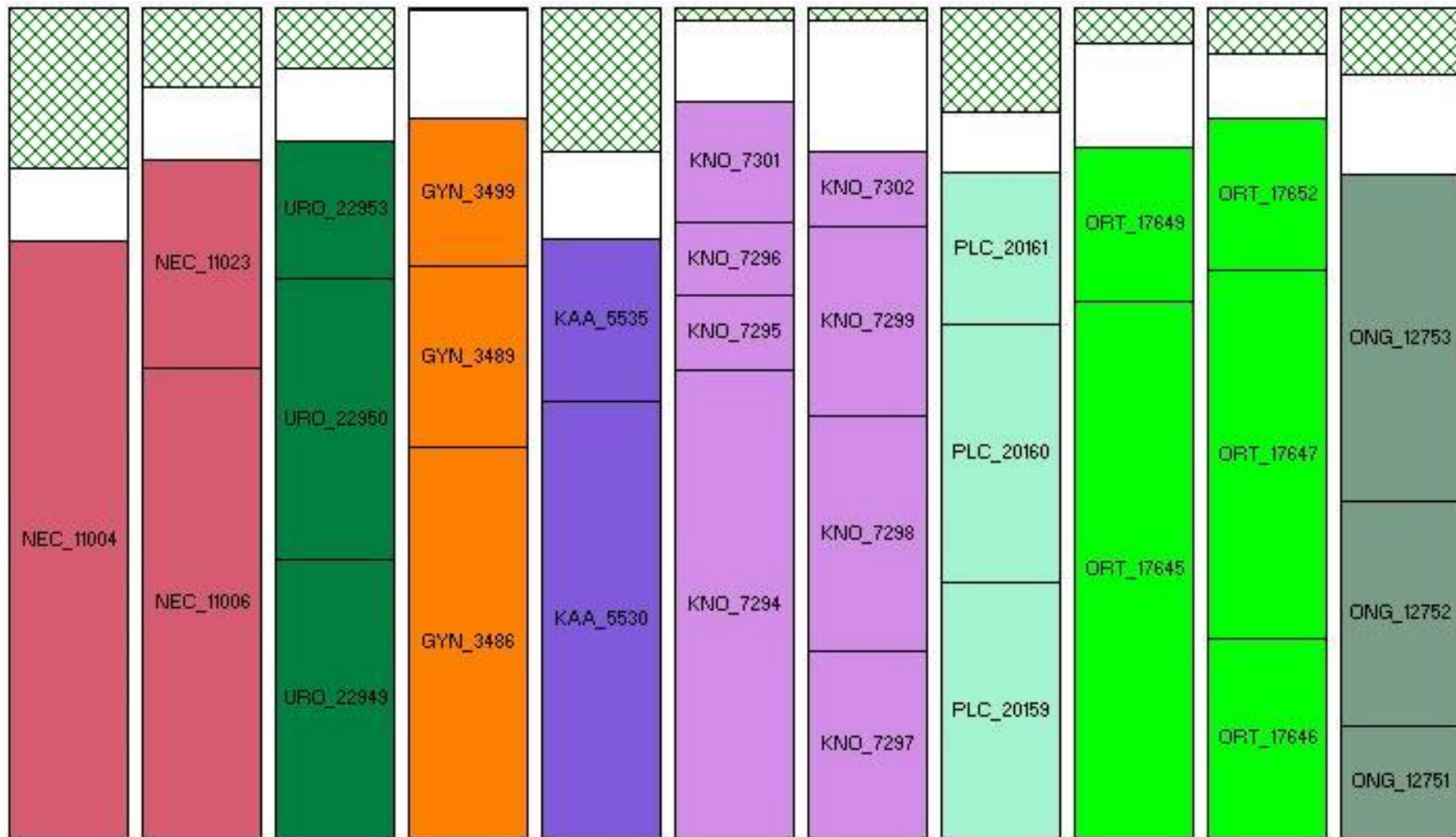
Introduction OR planning: **positioning** framework for hospital planning & control

	<i>Medical planning</i>	<i>Resource capacity planning</i>	<i>Material coordination</i>	<i>Financial planning</i>
Strategic	Research planning, introduction of new treatment methods	Case mix planning, layout planning, capacity dimensioning	Supply chain and warehouse design	Agreements with insurance companies, capital investments
Tactical	Definition of medical protocols	Allocation of time and resources to specialties, rostering	Supplier selection, tendering, forming purchasing consortia	Budget and cost allocation
Operational offline	Diagnosis and planning of an individual treatment	Patient scheduling workforce planning	Purchasing, determining order sizes	DRG billing, cash flow analysis
Operational online	Triage, diagnosing complications	Monitoring, emergency coordination	Rush ordering, inventory replenishing	Expenditure monitoring, handling billing complications

B hierarchical decomposition à

B managerial areas à

Elective scheduling example (11 ORs)



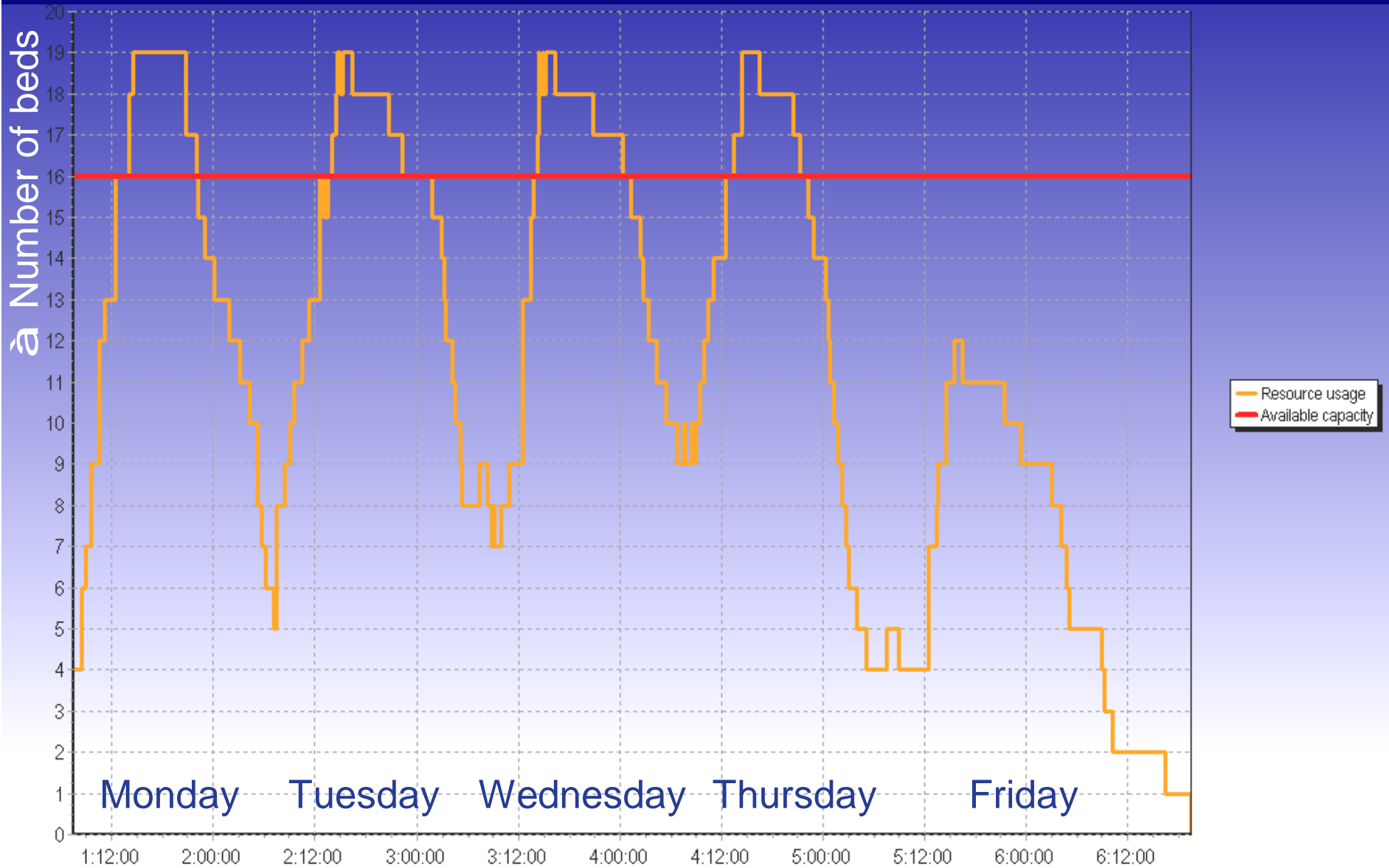


Elective surgery scheduling

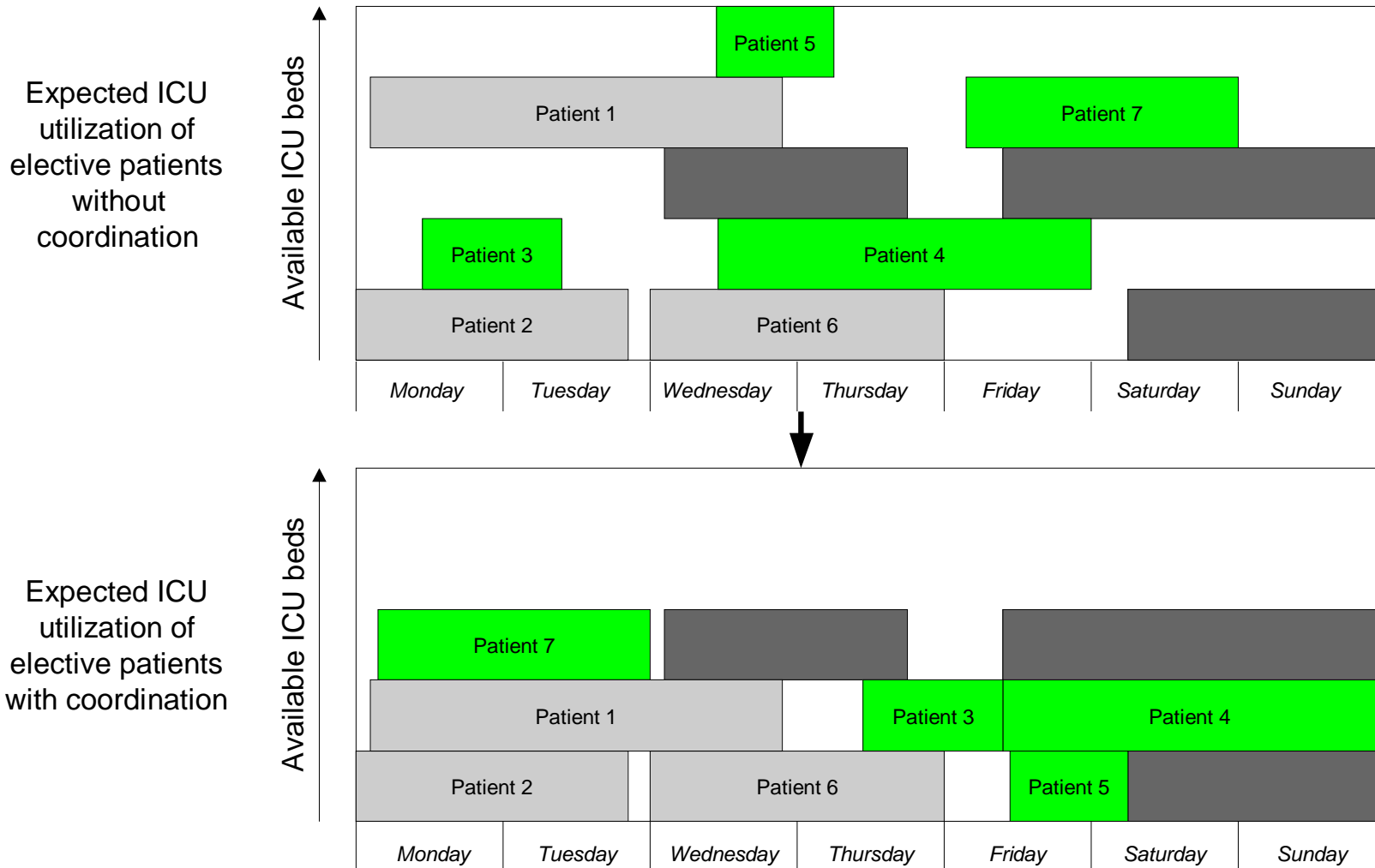
Complex scheduling problem:

- Sequencing
- Dealing with surgery variability (duration, no-show, cancellations, emergencies)
- Availability of staff, equipment, instruments,...
- Minimize: overtime, waiting time, costs...
- Maximize: utilization, access time, ...

Resulting capacity usage for shortstay ward



ICU bed requirements after surgery





Integral planning of operating room and wards

- Weekly optimization using mathematical techniques
 - Leads to “nervous schedules”
 - May interfere with autonomy of medical specialists
 - Hard to implement

- OR-scheduling is time-consuming, and repetitive

However: **many elective surgery types are recurring!**



Master surgical scheduling: idea

Idea: design a cyclic schedule of surgery types that:

- covers all frequent elective surgery types
- levels the workload of the specialties
- levels the workload of subsequent departments (ICU, wards)
- is robust against uncertainty
- improves OR-utilization
- maintains autonomy of clinicians

Assign patients to the “slots” in the schedule



Master surgical scheduling papers

- J.M. van Oostrum, M. Van Houdenhoven, J.L. Hurink, E.W. Hans, G. Wullink, G. Kazemier, **A Master Surgical Scheduling approach for cyclic scheduling in operating room departments**, in: **OR Spectrum**, 30(2), pp. 355-374, 2008.
Mathematical description
- J.M. van Oostrum, E. Bredenhoff, E.W. Hans, **Managerial implications and suitability of a Master Surgical Scheduling approach**, to appear in: **Annals of OR**.
Mathematical analysis of suitability, organizat. conditions
- M. Van Houdenhoven, J.M. van Oostrum, G. Wullink, E.W. Hans, J.L. Hurink, J. Bakker, G. Kazemier, **Fewer intensive care unit refusals and a higher capacity utilization by using a cyclic surgical case schedule**, in: **Journal of Critical Care** 23, 222-226, 2008.
For healthcare managers

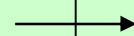


Master surgical scheduling: approach

PHASE 1:

Generation of
“OR-day schedules”

Goal: capacity utilisation



ILP, solved by column generation
and then rounding

Constraints:

- All surgeries must be planned
- OR-capacity (probabilistic)

PHASE 2:

Assignment of
“OR-day schedules”

Goal: bed usage leveling



ILP, solved using CPLEX in
AIMMS modeling language



Master surgical scheduling conclusions

Advantages:

- Easy to implement (first hospital: RIVAS Gorinchem)
- Allows personnel coordination in early stage
- Less overtime, higher utilization
- Less surgery cancellations → shorter lead-times
- Improved coordination between departments

Disadvantage:

- Does not cover all surgeries



Peter Vanberkel (LogiDOC project) Focused Factories in Healthcare

- Designing for Economies of Scale vs.
Economies of Focus
 - A paper highlighting the tradeoffs between gains of efficiency due to “focus” and losses of economies of scale
- Reallocating Resources to Focused Factories: A Case Study in Chemotherapy
(<http://fp.tm.tue.nl/beta/>)



Peter Vanberkel (LogiDOC project) Multi-department modeling

- Projecting the Ward Census from a cyclical Operating Theatre Program
 - Used to develop the new Operating Theatre Program at NKI-AVL
- Planning Upstream Capacity to accommodate a major Operating Room Expansion
- Literature
 - A Survey of Health Care Models that Encompass Multiple Departments (<http://fp.tm.tue.nl/beta/>)
 - ORchestra Bibliography (<http://www.choir.utwente.nl/en/ORchestra/>)

Questions...?



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