A mathematical programming framework to manage extended operating room hours

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Outline

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Operating rooms

Planning and scheduling decisions

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1 Motivation

Motivation

Complex management of healthcare organizations:

Ageing of the worldwide population

Increasing demand for health services

Development of new and expensive methods, equipment and instruments

+

Complex management of operating rooms:

Ministry guidelines

Hospital finances

Impact in health status of patients

→

Need for adequate, equitable and timely care provision

Planning and scheduling decisions

Strategic

Case mix and capacities to be installed in the hospital

Tactical

Available time is divided among the specialties or groups of surgeons

Operational

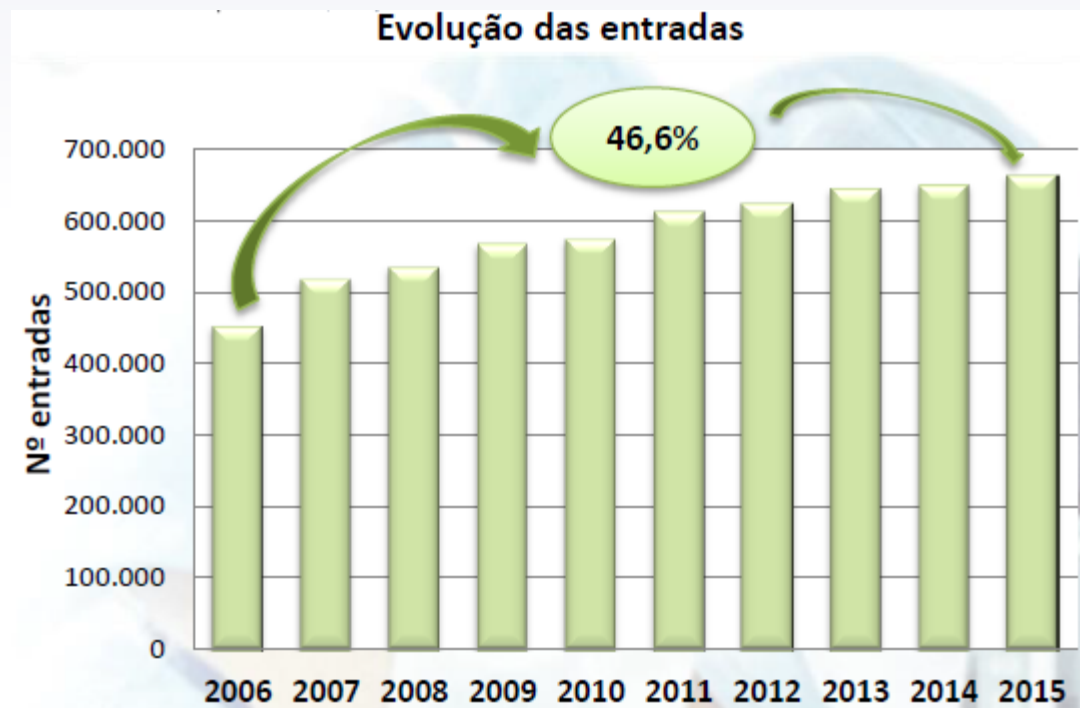Scheduling surgeries and patients considering staff availability

Elective surgeries

Clinical priority and corresponding maximum guaranteed response time

High waiting times

Difficult to comply with target due dates

Case study: Portugal

Evolução das entradas

- ▸ High waiting times
- ▸ Non compliance with recommended maximum waiting times
- ▸ Lack of human resources

Case study: Portugal

Indicadores	2006	...	2010	2011	2012	2013	2014	2015
Total de patologias								
% Inscritos que ultrapassam o TMRG	43,5%		13,0%	15,8%	15,1%	12,8%	12,0%	12,2%
% Inscritos prioritários que ultrapassam o TMRG	68,6%		29,1%	31,0%	31,1%	30,2%	26,9%	28,1%
% Operados que ultrapassavam os TMRG	25,8%		7,7%	9,1%	9,1%	8,0%	8,0%	8,5%
% Operados prioritários que ultrapassavam os TMRG	28,8%		12,1%	13,1%	13,2%	12,6%	13,1%	13,2%
Neoplasias malignas								
% Inscritos NM que ultrapassam o TMRG	55,1%		16,5%	23,7%	21,7%	25,1%	19,7%	19,7%
% Operados NM que ultrapassavam o TMRG	28,3%		14,1%	13,5%	14,8%	15,3%	16,0%	16,1%

Waiting lists reduction

- Decreasing demand
  - Transferring patients to other healthcare institutions
    - Surgical vouchers
- Increasing used capacity
  - Overtime
  - Extended opening hours of operating rooms

Case study: Vouchers
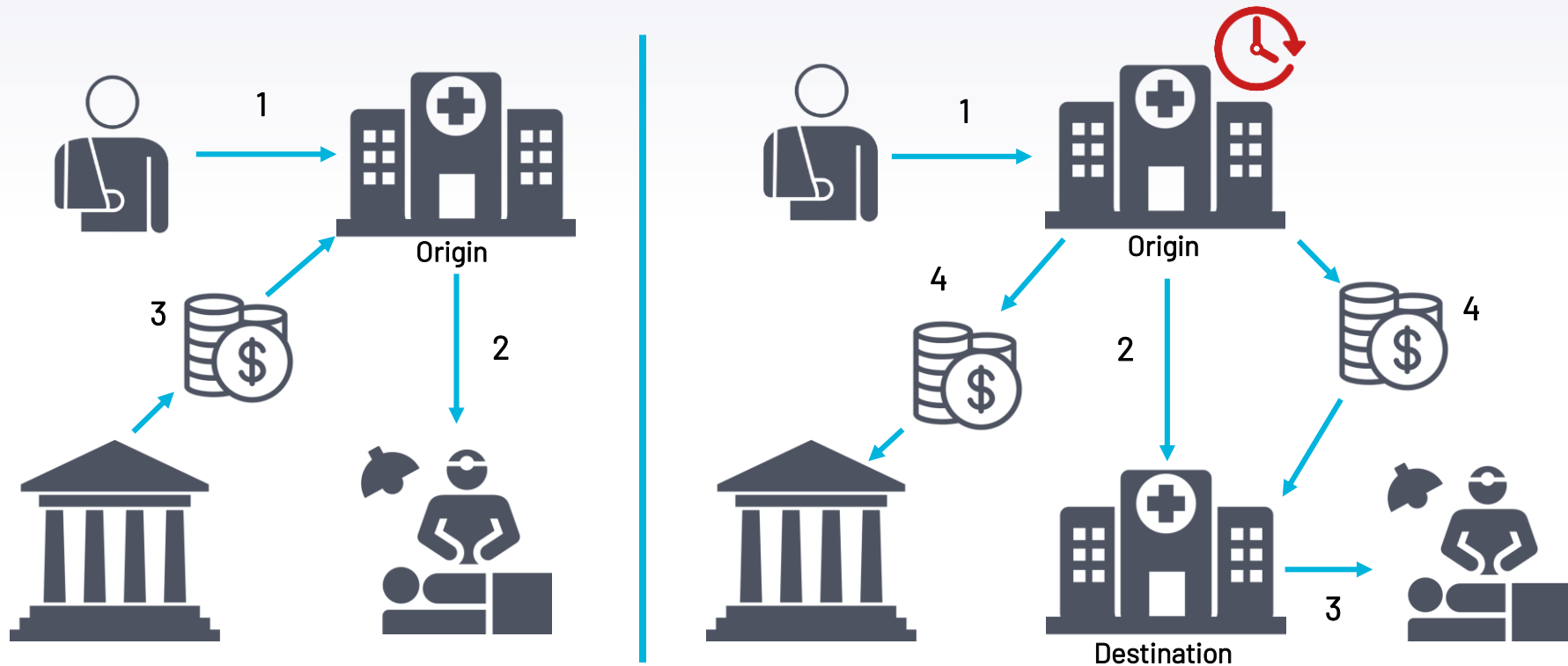
Case study: Vouchers

Vales de cirurgia emitidos

ARS	Episódios com nota de transferência/ vale de cirurgia emitido (n.º)	Operados em hospitais de destino (n.º)	Valor médio por operado em hospitais de destino (€)	Valor total (milhares €) [1]
Norte	21.049	4.771	2.353	11.227
Centro	17.466	4.427	1.668	7.384
LVT	35.125	7.339	1.741	12.777
Alentejo	3.778	629	1.578	993
Algarve	6.846	3.118	1.140	3.554
País	84.264	20.284	1.799	36.499

Waiting lists reduction

- Decreasing demand
  - Transferring patients to other healthcare institutions
    - Surgical vouchers
- Increasing used capacity
  - Overtime
  - Extended opening hours of operating rooms

Loss of patients to another institutions
High costs to the hospitals
Low flexibility in managing waiting lists
No systematic methods

2 Problem definition

# EXTENDED OPENING HOURS OF OPERATING ROOMS

Grants managers a lot of flexibility on the OR utilization and, to the best of our knowledge, has not received adequate attention from the research community.

Different time slots in ORs

MSS

Specialties are allocated to a timeslot

Fixed and difficult to change

Provide stability

No systematic method

Overtime

Short extension of time

To deal with unforeseen time extension

Different from overutilization

Mandatory/Dissatisfaction

Additional costs

Low flexibility

EOHOR

Take advantage of non-used time slots

No time limit

Fee-for-service reward

Higher productivity

Additional vs Prevent costs

Non-mandatory/Satisfaction

High flexibility

Prevent patient tranfer

Allows planning

Timings

MSS
Plan

EOHOR

EOHOR

EOHOR
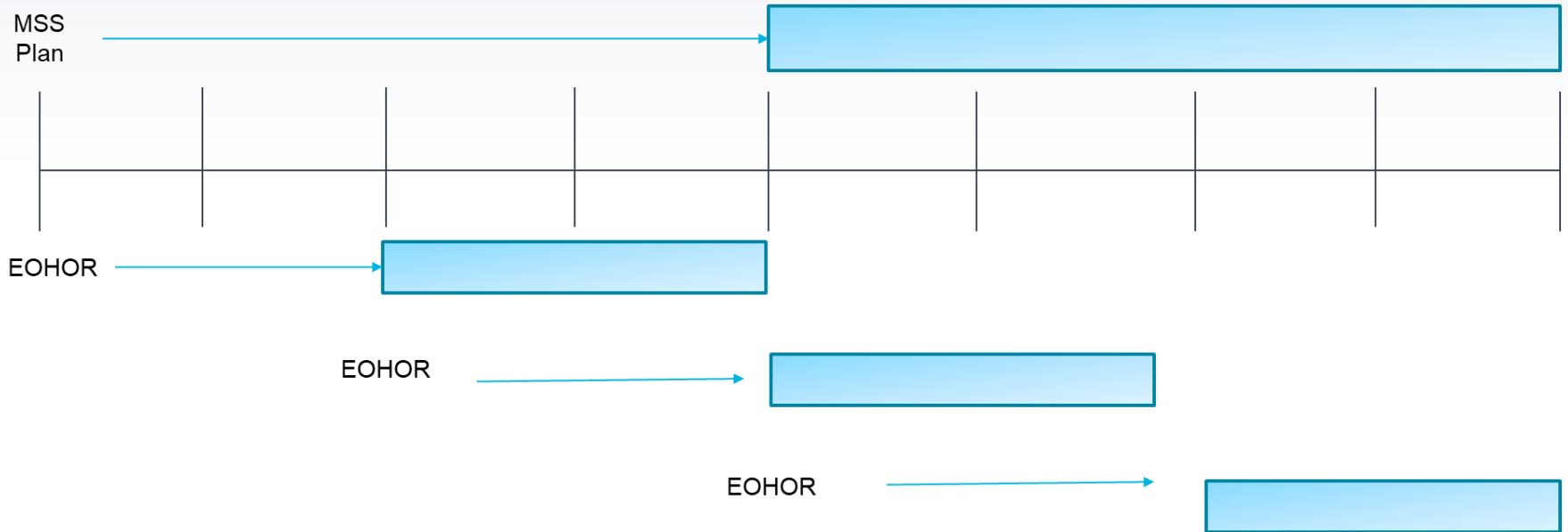
Contribution

What are the objectives?

Better allocate existing capacity

Link MSS and EOROH planning and scheduling decisions

Comply with high levels of demand and lack of HR

Satisfying waiting time targets

Avoiding issuing of surgical vouchers

How will we achieve them?

Efficient tactical and operational decisions

3-step framework for planning and scheduling method to jointly manage MSS and EOROH

Expected contribution

Combination of two types of scheduling

Formalize the idea of EOROH

Different utility values for different time slots

Comprehensive approach to cluster patients based on their characteristics

Why is this important?

Short-term systematic method to assist planning and scheduling decisions in operating rooms, by using efficiently all the available time slots, which allows to increase throughput and comply with waiting time targets

3 Proposed methods

Three-step framework

Dynamic rearrange of staff assignment to MSS

Cancel time slots according to potential to be used in EOHOR

Mathematical model

Schedule patients to MSS

Heuristic rule

Schedule patients for EOHOR

Integer linear programming model

Clustering patients

Availability of specialties, anesthetists and time slots

Number of patients from each cluster to be scheduled (flexibility)

Clustering

Identify subgroups of patients with similar characteristics based on:

- ▸ Waiting time
- ▸ Probability to accept the voucher
- ▸ Cost of the voucher

Choose wisely the patients to be scheduled in EOHOR

Reduce complexity of the problem

Timeline

Discussion about main topic

Framework formulation

Framework implementation

Work publishing process

MSS

Overtime

EOHOR

Dynamic MSS rearrangement

MSS scheduling

EOHOR scheduling

Clustering approach development

Results analysis

4 Expected results
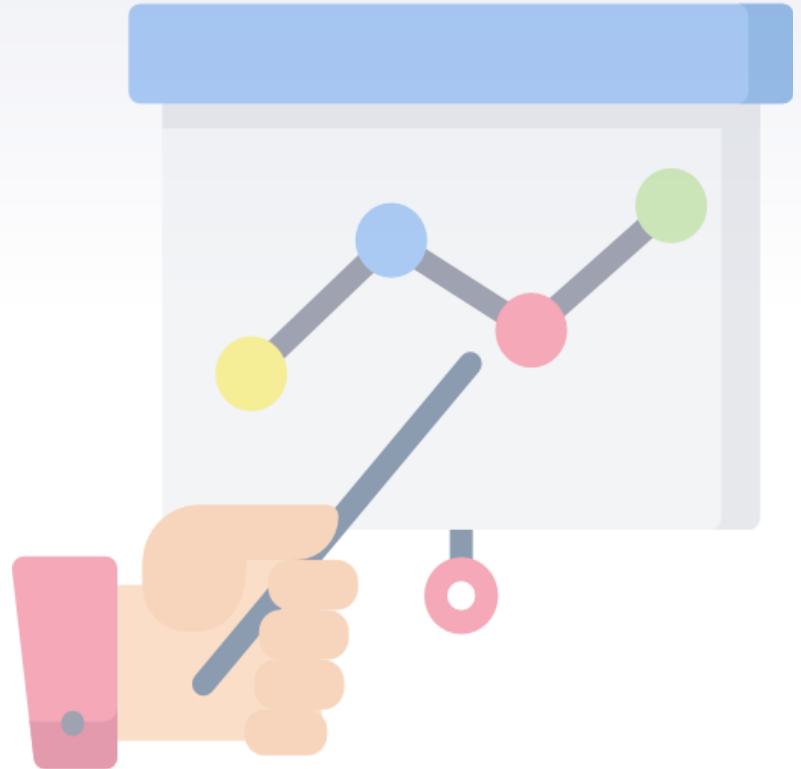
Expected results

Dynamic rearrange of staff assignment to MSS

- ‣ Cancel slots that cannot be used as EOHOR
- ‣ Increase potential capacity

Schedule patients for MSS

- ‣ Increase the number of scheduled patients
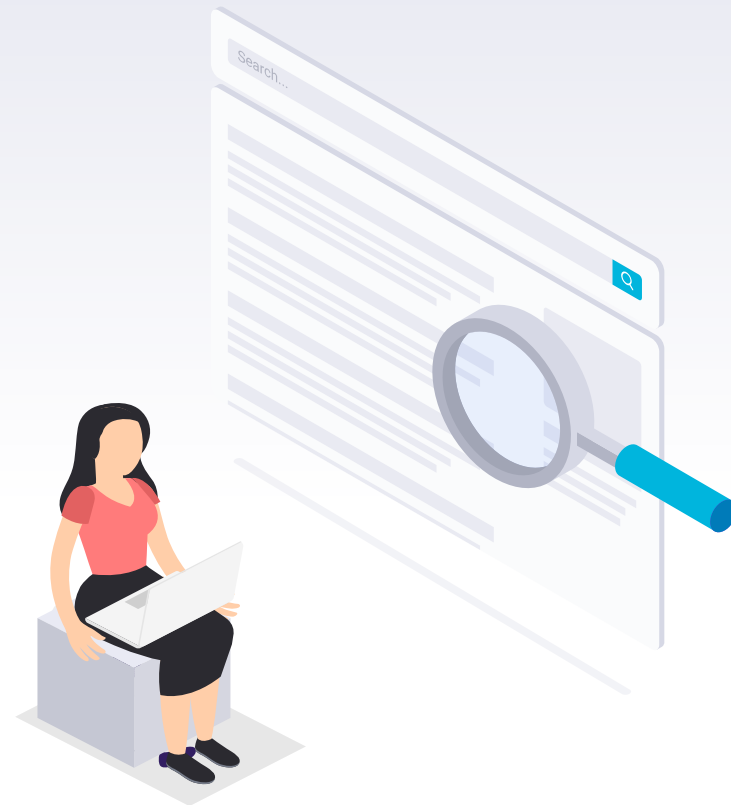
Schedule patients for EOHOR

- ‣ Increase throughput and reduce WLs
- ‣ Choose patient groups efficiently
- ‣ Comply with waiting time targets

THANK YOU!

Any questions?

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