EURO 2016 - New Advances in Health Care Applications

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The EURO-k conferences are intended to be forums for communication and cooperation among European operations researchers who are active in all the diverse special areas of Operations Research (OR) and to the free exchange of knowledge, experience, new ideas and promising results relating to the research and practice of OR. In the 40-year history of the EURO-k series, the conferences have been held in 18 different countries.

EURO 2016 is the premier European conference for Operations Research and Management Science organized by EURO – the European Association of Operational Research Societies and the Polish Operational and Systems Research Society at Poznan University of Technology. The conference was a success beyond all the expectations of the Program and Organizing Committees, chaired by Daniele Vigo and Joanna Józefowska, respectively. EURO 2016 hosted 1747 participants from 70 different countries. Overall, 1580 presentations were delivered at EURO during the days 3-6 July 2016, and the number of abstract submissions reached 2038 (for further details see https://www.euro-online.org/media_site/reports/EURO28_Report.pdf).

The Program Committee (PC) was chaired by Daniele Vigo (University of Bologna, Italy) who was flanked by an impressive list of PC members: Tolga Bektas (University of Southampton, United Kingdom), Erik Demeulemeester (KU Leuven, Belgium), Wout Dullaert (VU Amsterdam, Netherlands), Salvatore Greco (University of Catania, Italy), Ruth Kaufman (London School of Economics, United Kingdom), Ekaterina Kostina (University of Heidelberg, Germany), Ivana Ljubic (ESSEC Business School, France), Marco Lübbecke (RWTH Aachen University, Germany), Inês Marques (University of Lisbon, Portugal), Mustafa Pinar (Bilkent University, Turkey), Dolores Romero Morales (Copenhagen Business School, Denmark), David Pisinger (Technical University of Denmark, Denmark), Joanna Józefowska (Poznan University of Technology, Poland), Gerhard-Wilhelm Weber (Middle East Technical University, Turkey), Sally Brailsford (EURO Vice President I 2015, United Kingdom), Albert Wagelmans (EURO Vice President I 2016, the Netherlands). Together, these people created a high quality scientific program, with a very large number of presentations in operations research.

The submissions for EURO 2016 have been subdivided in 25 areas under the responsibility of the Program Committee (PC). Erik Demeulemeester and Inês Marques were the PC members responsible for the OR in Health, Life Sciences and Sports area, which collected 126 abstracts organized in 35 sessions. The authors were invited to submit their work to this special issue of the Operations Research for Health Care (ORHC) journal with the aim of collecting high-quality papers focused on new advances in health care applications.

Amongst the 24 papers submitted, 13 papers were accepted for publication in this special issue after a careful reviewing process (2 papers were afterwards published in a regular issue of the journal). The selected papers cover a wide range of health care applications: primary care, acute care, home care, emergency medical services, emergency department, hospitals assessment, and health economics. Table 1 shows an overview of the papers that are included in this special issue. These papers provide a good sample of the wide range of new applications of operations research to improve health care management over different national contexts (Egypt, India, Iran, Italy, the Netherlands, Norway, Portugal and Tunisia). Each contribution is briefly described hereafter.

Paper	Area	Decisions	Methods	Uncertainty	Case/Data
[1]	Home Care	Location-allocation	Stochastic programming	X	Iran
[2]	Emergency department	Resource allocation	Stochastic programming	X	Tunisia
[3]	Health economics	Resource allocation	Economic models Simulation	X	Egypt
[4]	Acute care	Scheduling	Integer programming		
[5]	Emergency Department	Clustering	Neural Networks		Italy
[6]	Acute care	Allocation and Scheduling	Integer programming		Norway
[7]	Emergency Medical Services	Allocation	Queueing theory, Integer Programming	X	The Netherlands
[8]	Hospitals	Assessment	Fuzzy logic based model		India
[9]	Health economics	Economic assessment	Cost-effectiveness analysis		
[10]	Emergency Department	Resource allocation	Forecasting	X	Portugal
[11]	Primary care	Allocation and Scheduling	Stochastic programming	X	not clear

Table 1: Overview of the papers published in the special issue

Khodaparasti et al. [1] propose a multi-period model for locating nursing home facilities that incorporates the dynamic evolution of budget and demand. When new financial resources become available, new facilities can be opened and additional demand can be gradually satisfied. The uncertainty in demand is tackled by applying a chance constrained approach. To address the elasticity of demand, the authors define a user-specific distance threshold reflecting the preferences of users to access the service. The model was implemented on a real case study for nursing home location planning problem in Shiraz city, Iran.

Daldoul et al. [2] reduce the average waiting time of patients in the Emergency Department (ED) by optimizing the allocation of human resources (physicians and nurses) and beds. To this aim a stochastic MILP model is solved by a sample average approximation approach considering the uncertainty in the number of patient arrivals and their service time. Using data from the ED of the La-Rapta hospital in Tunisia, the authors show that the total average waiting time can be reduced by more than 20%.

Abu-Sheasha et al. [3] propose an infection control program to estimate the cost of surgical site infection both from patient and hospital perspectives using simulation. They developed two economic models, which were fed by data collected from a cohort of 351 surgical patients in the Medical Research Institute hospital, in Egypt, through a 6-months period. This data could help choosing one of three hypothetical

infection control programs of different costs and efficacies. The results can be used to inform decisions about allocating scarce resources, implement an infection control programs, and predict expected cost-savings.

Heshmat and Eltawil [4] present a strategy to address the optimal drug doses management for chemotherapy treatments under resource and time constraints. The authors present two mixed integer programming models solved sequentially to find optimal drug schedules, which result in a decreasing number of cancerous cells with time, and the optimum starting day for new patients.

Resta et al. [5] propose a framework based on a neural network to support a bed manager and smooth elective and emergent patient flows. They cluster admissions of emergency patients to hospital wards by considering patient profiles. A large quantity of data was collected to obtain information related to the arrivals of emergent patients and capture seasonality of patients flow in a medium-sized emergency department located in Genova, Italy. Results show that triggering an appropriate tool in advance can support a bed manager to better allocate patients to beds.

Gulhav et al. [6] consider a tactical block scheduling problem where patient groups are reserved time blocks for scanning at a heterogeneous set of Magnetic Resonance Imaging (MRI) labs. An integer programming model is proposed combining penalties for allocating time blocks to patient groups at unfavorable time slots and labs and rewards for advantageous positioning of open time slots. The aim is to facilitate the coordination of the MRI resources between the hospital departments to achieve a fair distribution of time slots to the patient groups and open time blocks. Real-sized instances for a major Norwegian hospital are solved in short time. The authors show that the model can be used to produce Pareto optimal solutions, and how these solutions can provide the decision makers with managerial insights.

van Buuren et al. [7] propose an adjusted queueing approach to the Erlang B queueing models for the facility location and allocation of Emergency Medical Service (EMS) vehicles. This model addresses, explains, and solves the overstaffing problem that occurs when applying traditional Minimal Reliability Maximal Availability (MR-MA) allocation models in mixed regions, i.e. regions that have both urban and rural areas. The authors show that the application of the adjusted queueing model leads to solutions with better ambulance care than the existing situations for four mixed regions in the Netherlands, at a lower staffing cost.

Narayanamurthy and Gurumurthy [8] discuss about the importance of leanness assessment in healthcare institutions by documenting different leanness assessment techniques in the literature and its absence in healthcare institutions. The authors develop a framework for assessment of lean thinking and the associated Fuzzy-Logic Input Based Healthcare Institution Lean Implementation Assessment (FLB-HLIA). The procedure for measuring leanness using FLB-HLIA has been applied to an Indian case hospital.

An optimal control strategy and a cost effectiveness analysis for the Zika virus disease is presented by Momoh and Fügenschuh [9]. The authors propose a mathematical model for the transmission of the Zika virus with four preventive measures as control: the use of treated bednets, the use of condoms, a medical treatment of infected persons, and the use of indoor residual spray (IRS). Various combinations of the possible control strategies are implemented, and the authors conclude that a strategy that combines treated bednets, treatment of symptomatic infected humans and indoor residual spray is the most cost-effective for controlling the Zika virus.

Monteiro et al. [10] address the management of hospital resources affected by unpredictability of arrivals to an ED. The authors define forecasting models based on time series and test them on real data collected from January 2012 to December 2013 at the Braga Hospital, in Portugal. These models were then evaluated on data to determine accuracy of the estimates obtained by prediction of number of arrivals. Results show predictions of good quality level for a week or a month, and that accurate forecasting of

ED arrivals decreases the cancellations of planned admissions and optimizes the beds allocation to the demand.

A concept for the optimal configuration and capacity allocation for appointment systems in primary care is presented by Schacht [11]. It is designed to provide decision-support for primary care clinics to cope with seasonal variations in patient demand to assure access to health care services. The tactical decision is the efficient allocation of capacity for walk-ins and pre-scheduled patients, where it must be assured that urgent patients have sufficient access to health care services. The main contribution of this paper is a concept determining efficient appointment systems to cope with stochastic and seasonal patient load by reconfiguring the appointment system throughout the year which shows to be beneficial even with a high share of urgent patients.

We would like to thank all the authors for submitting such high-quality papers to this special issue, and we commend them for their work. We also take this opportunity to express our gratitude to all the reviewers who provided constructive comments and suggestions in a timely manner, and contributed to improve the quality of the papers. Finally, we thank the Editor-in-Chief of ORHC, Stefan Nickel, for the opportunity of publishing the special issue for EURO 2016 in ORHC journal.

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- [7] Martin van Buuren, Rob van der Mei, Sandjai Bhulai. Demand-point constrained EMS vehicle allocation problems for regions with both urban and rural areas
- [8] Gopalakrishnan Narayanamurthy, Anand Gurumurthy. Is the hospital lean? A mathematical model for assessing the implementation of lean thinking in healthcare institutions
- [9] Abdulfatai A. Momoh, Armin Fügenschuh. Optimal control of intervention strategies and cost effectiveness analysis for a Zika virus model
- [10] Miguel Carvalho-Silva, Maria Teresa T. Monteiro, Filipe de Sá-Soares, Sónia Dória-Nóbrega. Assessment of forecasting models for patients arrival at Emergency Department

[11] Matthias Schacht. Improving same-day access in primary care: Optimal reconfiguration of appointment system setups