5th Asia Pacific Conference on Industrial Engineering and Operations Management
Tokyo, Japan, September 10-12, 2024
Publisher: IEOM Society International, USA DOI: 10.46254/AP05.20240056
Published: *September 10*, 2024

Optimal Hospital Bed Allocation under Indonesia's National Health Insurance Scheme

Oki Almas Amalia, Irwan Endrayanto and Fajar Adi Kusumo
Department of Mathematics, Faculty of Mathematics and Natural Sciences
Universitas Gadjah Mada
Yogyakarta, Indonesia
okialmasamalia@mail.ugm.ac.id, endrayanto@ugm.ac.id,
f_adikusumo@ugm.ac.id

Oki Almas Amalia, Anne B. Zander and Richard J. Boucherie
Department of Applied Mathematics,
Faculty of Electrical Engineering, Mathematics and Computer Science
University of Twente
Enschede, the Netherlands
o.a.amalia@utwente.nl, a.b.zander@utwente.nl,
j.boucherie@utwente.nl

Abstract

In this paper, we develop a model for bed allocation problems under Indonesia's National Health Insurance Scheme (*Jaminan Kesehatan Nasional* - JKN) managed by the Social Security Organizing Body (*Badan Penyelenggara Jaminan Sosial* - BPJS). This scheme categorizes patients and beds into three insurance classes. However, patients often face bed shortages in their designated classes. To address these bed shortages and the consequences of patients residing in beds other than those of their designated classes, we propose a bed allocation model using an overflow queueing model with repacking: when a patient arrives and finds all beds in its treatment class occupied, according to the BPJS-JKN the patient will be put in the first higher class bed and transferred immediately to its original class as soon as a bed is available in that class. We obtain a product form expression for the stationary distribution of bed occupancy, allowing explicit evaluation of various performance measures, including the blocking probabilities. Furthermore, we maximize the expected profit from the inpatient care under the BPJS-JKN health insurance scheme. Using the model, we develop a capacity planning tool to maximize the total revenue. To illustrate our model, we apply our model to our partnering hospital in Yogyakarta, Indonesia.

Keywords
Bed allocation, overflow model, repacking, BPJS-JKN.

Biographies
Oki Almas Amalia is a second-year PhD student in a joint degree program at the Stochastic Operations Research, Department of Applied Mathematics, University of Twente, the Netherlands and the Department of Mathematics, Universitas Gadjah Mada, Indonesia. She earned her M.Sc. degree from a dual degree program at the same universities in 2019. Her research focus is on the application of operations research in healthcare logistics.

Irwan Endrayanto is an assistant professor in the Department of Mathematics, Faculty of Mathematics and Natural Sciences, Universitas Gadjah Mada, Indonesia. Since 2017, he has been appointed as the Head Division of Academic

Studies at the Center for Academic Innovation and Studies. His research interest is mainly in stochastic operations research and its applications, including applications of queueing theory, discrete and stochastic resource allocation, simulation. In the last 7 years, he has been actively involved in developing mathematical models for optimizing resource allocation and logistics design in healthcare operations.

Fajar Adi-Kusumo is an associate professor in the Department of Mathematics, at Universitas Gadjah Mada, Indonesia. He received his doctoral degree from Bandung Institute of Technology, Indonesia in 2008. His research interests include dynamical systems, biomathematics, and mathematical modelling for the climate. He is also interested in doing research in operations research.

Anne Zander is an assistant professor of Stochastic Operations Research in the Department of Applied Mathematics at the University of Twente, the Netherlands. Anne Zander holds a Diploma in Mathematics and an Engineering Doctorate from the Karlsruhe Institute of Technology, Germany. She works in sequential decision-making under uncertainty focusing on applications in healthcare logistics.

Richard J. Boucherie is a full professor of Stochastic Operations Research in the Department of Applied Mathematics of the University of Twente, co-founder and co-chair of the University of Twente Center for Healthcare Operations Improvement and Research (CHOIR) in the area of healthcare logistics, and co-founder of the spin-off company Rhythm, that carries out actual implementations of healthcare logistics solutions in healthcare organizations. Richard received M.Sc. degrees in Mathematics (Stochastic Operations Research) and Theoretical Physics (Statistical Physics) from the Universiteit Leiden, and received a Ph.D. degree in Econometrics from the Vrije Universiteit, Amsterdam. Richard focuses on both theoretical developments in stochastic processes and applied research in operations research. His main theoretical focus is on (networks of) queues with closed-form equilibrium distributions, stochastic Petri nets, and random walks. His main application-oriented focus is on queueing models for communications systems and healthcare.